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Cloud Computing in Lebanese Enterprises: Applying the Technology, Organization, and Environment (TOE) Framework

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Abstract

In the last few years, cloud computing (CC) has grown from being a promising business concept to one of the fastest growing segments of the IT industry. Many businesses including small, medium (SMEs) and large enterprises are migrating to this technology. The objective of this paper was to describe the opinions of enterprises about the benefits and challenges of cloud computing services in the private and public companies in South Lebanon. During 2019, a cross-sectional study which enrolled 29 enterprises used CC was conducted. The survey included questions on socio-demographic characteristics of representative of companies, and companies' factors in reference to the technology, organization, and environment (TOE) framework. Most (58.6%) of companies were private and micro and SMEs sized (86.8%). The cost saving (75.0%), scalability and flexibility (75.9%), security (44.8%), and improved service delivery were the main benefits that cloud offer to the business. The security aspect, the cost, and the limited provision of infra-structure remain a challenge for the adoption of CC. In conclusion, the research reveals the potential for the development of CC and obstacles for successful implementation of this new technology.

Keywords

Cloud Computing, SMEs, TOE Framework, Benefits of Cloud Computing

1. Introduction

Cloud computing (CC) is a growing data center technology in line with increasing traffic on the internet in the era of the Internet of Things [1]. It is typically a

recently conceived web base registering strategy and is the most favorite choice intended for the leasing of computing with the capacity in various domains [2]. Companies, both large and medium-sized as well as small-sized companies can leverage big data to gain a strategic competitive advantage [1] [3] [4].

CC has been captivating since 2007 the interest of the Information and Communications Technology (ICT) community ensuing in a massive amount of industry developments [5]. Through 2018, Cloud adoption is accelerating faster than previously anticipated [6].

CC services are delivered through a network, usually the Internet [7]. CC architecture consists of many loosely coupled cloud components: Front End and Back End. The services provided by vendors can be classified in three models, Platform as a Service (PaaS), Software as a Service (SaaS) and Infrastructure as a Service (IaaS) that actually depict how services are being provided to the customers. Cloud can have any of the four types of access: Public, Private, Hybrid, and Community (**Figure 1**) [1] [8]-[15]. As essential characteristics of CC are: 1) on demand self-service, 2) broad network access, 3) resource pooling with other tenants, 4) rapid elasticity, and 5) measured services [9] [16] [17] [18] [19].

The new economic model removes the need for the organization to invest a substantial sum of money for purchase of limited Information Technology (IT) resources that are internally managed, but rather the organization can outsource its IT resource requirements to a CC service provider and pay per use [8]. Spending on CC infrastructure and platforms grew at a 30% compound annual growth rate from 2013 through 2018 compared with 5 percent growth for overall enterprise IT, giving rise to the Cloud Access Security Broker market in the process [6].

CC is a topic that received a great deal of attention by individuals and organizations from different disciplines in the last decade. Besides, a various set of applications like social networking sites, scientific workflow systems, multiplayer

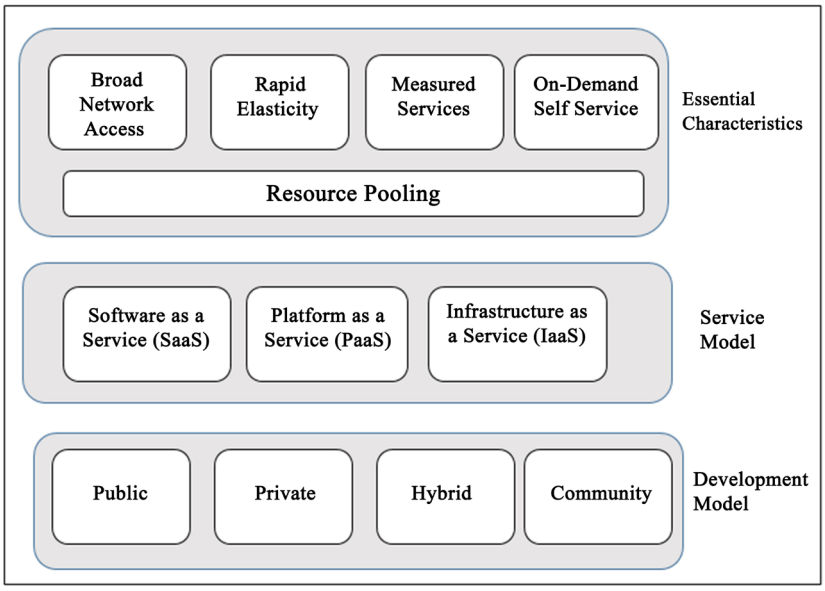

Figure 1. Visual model of cloud computing.

gaming portals, and enterprise applications have been deployed [20]. CC has been used by millions of people in various manifestations, including free email services (e.g., Yahoo Mail and Gmail) and free office productivity applications (e.g., Google Apps). Businesses of all sizes, industries, and geographies are turning to cloud services [6]. It has been appreciated as a significant step after Grid computing [5]. Instead of running the applications on a Personal computers or a Local Area Network, they run on a shared multi-tenant. More Businesses are running all kinds of applications in the cloud nowadays, like Customer Relationship Management Software (CRM), accounting, human resources (HR), custom-built applications [21], and health care systems [16]. It enables the users and consumers to integrate and combine many different services together that increase the creativity and productivity [22]. From business perspective, CC is in essence an economic model for a different way to acquire and manage IT resources [23] and enables companies to adopt ready-to-use application services through a "pay-as-you go" model that saves cost, resources and time [24]. CC has positive impact on the business organizations as it increases their revenue [22] and helps them to achieve the business goals [4] [17] [23] [25].

This technology overcomes the weaknesses of conventional servers for speed, scalability, and efficiency [1]. Cloud-based applications cost less, since the companies don't need to pay for all the hardware and software, facilities, or extensive configuration and maintenance of a full technology stack, to run them. Cloud provides the organizations with its unique features through more scalable, more reliable and more secure service [21], and also able to support the availability of data and services [1] [26]. It demonstrates compliance, speeding up decision making, expanding markets, agility, flexibility, economic advantage [26] and accelerating communication within organizations' divisions [1].

In spite of all the potential advantages offered by CC, enterprises are raising many questions which are creating lot of obstacles in the adoption of CC [27]. There are still SMEs who are not sure of the benefits of cloud services [1]. The security aspect and the provision of limited internet connection infrastructure are still a challenge for the adoption of CC in SMEs [17]. Providers, developers, and end users must consider these challenges and risks to take good advantage and to reach strategic goals of CC [28] [29] [30].

Whilst CC is no longer an emerging technology in developed countries, it is still a relatively new paradigm in other countries, particularly in developing countries [31]. Existing studies have examined CC adoption in Arabic countries [31] [32] [33] [34] and to a lesser extent in Lebanon. The Lebanese Ministry of Telecommunications launched the Vision of Digital Communications for 2020 [35] in July 2015. Practically, some CC Service Providers and especially Microsoft in Lebanon provide public and private cloud solutions, to meet the needs of its clients, irrespective of how the Lebanese Ministries embrace the cloud computing [35]. SMEs in Lebanon constitute ~93% - 95% of the population of enterprises in the country [36] where the unique characteristic of the economy

there may affect the deployment of CC [37]. So it is important to ensure the survival of these companies and encourage them to grow.

Extant research has demonstrated that the technology, organization, and environment (TOE) framework has broad applicability and possesses explanatory power across a number of technological, industrial, and national contexts. The TOE framework has been used to explain the adoption of CC [38]. In this study, the three elements of technology, organization, and environment may influence the way a firm identifies the need for, searches for, and adopts CC and the technological innovation decision making. After reviewing the literature on CC adoption and related research, the objective of this paper is to: 1) explore and describe the opinions of enterprises in South Lebanon about the benefits of CC services in their business operations in reference to the TOE framework; 2) to explore the reasons why enterprises are trying to adopt or avoid CC technologies and services in the private and public sector in South Lebanon.

2. Research Methodology

The goal of the research is to examine factors impacting cloud computing adoption in companies of the public and private sector in Lebanon by implementing the TOE framework.

2.1. Study Design and Target Population

From June until July 2019, a cross-sectional study was conducted in a number of enterprises engaged in ICT industry in South Lebanon to collect initial information regarding the experience of its employees on CC adoption in their organizations. The inclusion criterion for this study focused on organizations that have implemented CC solutions for at least 1 month. The banking sector was excluded from this study due to their confidentiality policies. A purpose sample was selected for the study. Managers and employees who were performing the role of frontline managers and were willing to participate were recruited. The research method is conducted by interviewing the representative (users of CC or the top management) of enterprises. All participants filled out the same questionnaire sent by mail. The self-administered questionnaire returned means the consent of the respondents to participate in this study. Ethical approval for this study was granted by the ethics committee of the Lebanese University.

2.2. Data Collection Tool

The primary instrument that was used to collect data was a pretested self-administered questionnaire. The variables were chosen by review of previous studies. The questionnaire covered 4 types of data:

- Sociodemographic information concerning the respondents such as age, sex, and professional qualifications of the managers, including educational level, job title, years of work experience.
- Organizational factors include the firm size of the institution, number of em-

ployees, type and sector of organization, owners of the organization, stack of the business, and top management support. The firm size is measured with the number of employees and companies are classified into four categories: micro, small, medium, and large. Micro-businesses have 10 employees or less, small businesses have 11 to 50 employees, medium sized businesses have 51 to 200 employees, and large businesses have 200 employees or more [37]. For instance, in Lebanon, a medium enterprise should simultaneously have between 50 and 100 employees [36].

- Technological data on CC: the characteristics of the CC server, availability, CC advantages and disadvantages, and the reasons for adopting and avoiding cloud based services. The date of implementation of CC and CC services providers were also collected.
- The environmental context includes, the technology support infrastructure (including the presence or absence of technology service providers), and the regulatory environment (type of Contract and pricing process).

2.3. Data Analysis

Statistical analysis involved the use of IBM SPSS Statistics version 23.0 (IBM, Armonk, NY). Participant demographic characteristics and the characteristics of the enterprises according three elements of technology, organization, and environment were analyzed using descriptive statistics based on TOE framework. The transcriptions and notes concerning the advantages and the disadvantages of the CC were subjected to a qualitative content analysis. Data verified for content by the researchers. Coding of the full data set was then completed and a summary of topics of each interview was made. Constant discussion between the research team in developing the coding and analyzing the data was conducted. Codes were studied and collated in sub-categories, and then wider categories. Then, each of the response categories organized into one or more associated themes that give a deeper meaning to the data [39].

3. Results

3.1. Characteristics of the Respondents

Thirty-one organization approached to this study, 29 (93.54%) accepted to participate. The sample included 4 (13.8%) females. The mean age was 40.86 years (SD = 10.93; median = 38 years; min = 22 years; max = 65 years). By focusing on the years of work experience, the respondents had a working experience ranging from 1 to 40 years (mean = 15.86, SD = 10.67, median = 15). 13.8% were at the rank of owner or manager and 62.1% were either at the rank of engineer or IT officer; only seven (24.1%) were employees.

3.2. Characteristics of the Enterprises According to TOE Framework

Table 1 presented a summary of the final analysis demonstrating the sub-categories, categories and themes of the CC according to TOE framework.

Table 1. Themes, categories and sub-categories of the cloud computing identified according to TOE framework.

Theme	Categories	Subcategories
Cloud computing	Organization	Organization's characteristics (size/type)
		Structure
		Workload
		Management support
	Environment	Technology support infrastructure
		Contract
		Availability
	Technology	Characteristics
		Advantages and disadvantages

Most (58.6%) of the companies were private institutions. The ownership of companies was distributed as following: 40.1% among them owned by one person or by family, 36.1% owned by the state and 25.7% were Limited liability companies (SARL). One half (55.2%) were company belonged education and 21.6% were telecommunication companies. CC was also used in healthcare in 7.2% of case, conceived for hospital management, clinical information systems, and the use electronic hospital information and management systems CC could be the method of choice to reduce the escalating costs of data storing and sharing. The managers of one of this organizations plan to government initiated a paradigm shift to use electronic hospital information and management systems. The numbers of employees in the organizations ranged from 3 to 10,000 employees (Mean = 1425.9; SD = 3085.1; median = 45 employees). Most (65.6%) of the organizations had micro and small sized organization (Table 2). No one declared the workload of their business. Concerning management support, the participants declared that top manager has significant impact for adopting new technology in organizations. "*Top manager have sufficient information for cloud services*" and "*Top manager is responsible for developing the company, so they established reasonable and strategic goals for using CC*".

The CC Service Provider was presented in Figure 2. Fourteen (38.9%) of the companies used cloud computing services from Google Cloud Platform, 11 (30.6%) by Microsoft Azure, and 5 (13.9%) were supplied by Amazon Web Services.

The type of contract between the companies and CC service providers was Terms and Conditions (TaC)/Terms of Service (ToS) in 58.6% of cases. 55.2% of the institutions had a dynamic price according to the size of data storage and the use of the applications (Table 2). The mean duration of the use of CC technology was 4.41 years (SD = 4.8; range: 1 - 20 years; median = 2 years). The majority of the companies (69.0%) used the CC for less than 5 years. The number of applications implemented by the companies using the cloud computing vary from 1 (48.3%) to 11 (3.4%) applications (mean = 2.6; SD = 2.8; median = 2).

Table 2. Characteristics of the organizations, technological, organizational and environmental (TOE) data, and satisfaction of users from cloud computing (n = 29).

Variables	Frequency (n)	Percentage %
Sector		
Private	17	58.62
Public	12	41.37
Ownership of companies		
One person	9	31
Family business	3	10.3
Limited liability company (SARL)	7	24.1
State	11	37.9
Type of the company		
Education	16	45.71
Telecommunication	7	20
Computer hardware & software application	2	5.71
Information and communication technology services	1	2.85
Health	2	5.71
Insurance	1	2.85
software solutions companies	1	2.85
Computer products	1	2.85
Financial services	2	5.71
Solutions	1	2.85
Software as a service	1	2.85
Size		
Micro-businesses (10 employees or less)	5	17.2
Small businesses (11 to 50 employees)	14	48.3
Medium businesses (51 to 200 employees)	6	20.7
Large businesses (200 employees or more)	4	13.2
Contract types		
Service level agreements (SLA)	9	42.9
Terms and conditions/terms and services	13	61.9
Pricing process		
Fixed	13	44.8
Dynamic	16	55.2
Duration of cloud computing use		
Less than 5 year	20	69.0
5 to 10 years	5	17.2
10 years and higher	4	13.8
Number of cloud computing applications use		
Less than 10	26	89.7
10 applications and higher	3	10.3
Cost reduction		
Less than 10%	1	3.7
10% - 30%	12	44.4
30% - 50%	10	37
More than 50%	2	7.4
No cost saving anticipated	2	7.4
Satisfaction from cloud computing		
Good	13	44.8
Very good	9	31.0
Excellent	7	24.1

The majority (98.7%) used less than 10 applications (Table 2). The use of CC was mainly web-based e-mail services (75.9%) and data storage (72.4%) followed by Business Applications-Word processor (65.5%), CRM (55.2%), utility management (antivirus/Spam/Backup) (41.4%) (Figure 3).

3.3. Perceived Benefits

CC offered number of advantages of cloud migration that motivated the business enterprises to adopt this change. Figure 4 showed that 44.8% of the respondents declared that business saw an improvement in security after switching to the CC and 75.9% said the cloud increased storage capacity. As an added security measure, 72.4% of cloud user declared disaster recovery and online back-up integrity. Cloud makes easier to meet the scalability and flexibility where

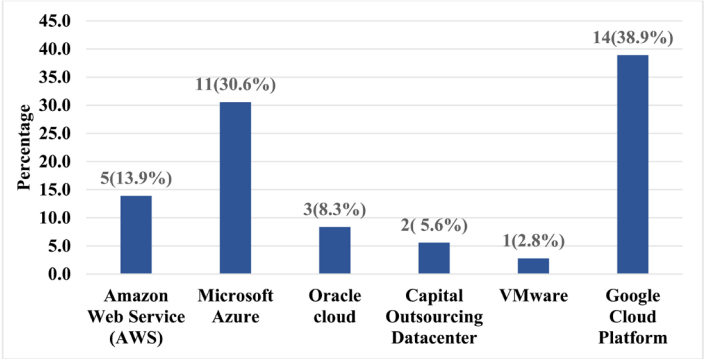

Figure 2. Cloud computing services providers n (%).

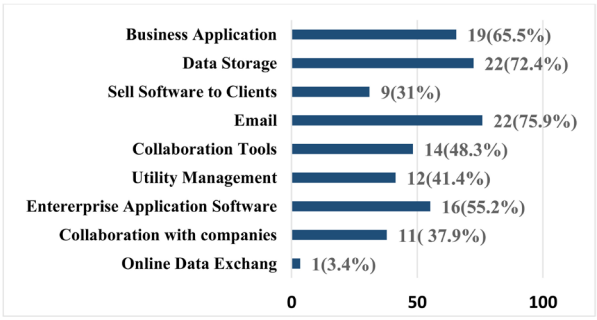

Figure 3. The expectation for using cloud computing.

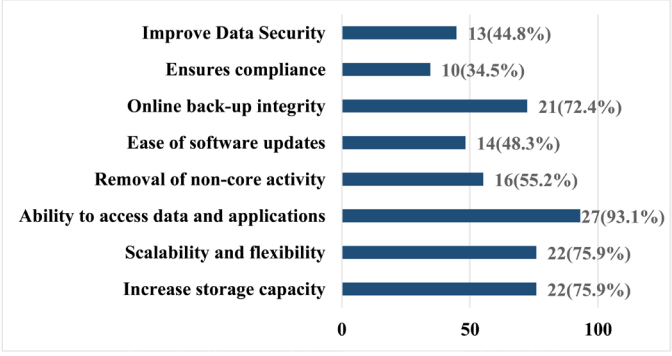

Figure 4. The benefits of cloud computing from business perspective.

a majority (75.9%) of respondents said "*the ability to quickly meet business demands*" that was one of the most important reasons a business should move to a cloud computing services. Finally, for 34.5% of respondents, CC can ensure compliance by declaring that: "*where every time a company moves data from the internal storage to a cloud, it is faced with being compliant with industry regulations and laws. CC also improves the decision making process by providing accurate and reliable data with reduced time*".

The results found that the most perceived benefits of CC are cost savings because it can reduce capital expenditures, such as procurement of computers with high performance and purchase their own server (48.3%) and staff costs (51.7%). On the other hand, the service enhances the company's internal organizational processes to accelerate decision making, expand markets, and speed up communication with customers by reducing the security (51.7%) and training costs (24.1%) (Figure 5).

3.4. Barriers for Using Cloud Computing

Fourteen (48.3%) organizations have security concerns when it comes to adopting a CC solution. The lack of trust of this new technology (27.6%), and the performance issues were declared by 27.6% and 17.2% respectively. A privacy concerns was declared by 6.9% of the respondents. The connection to internet was also a concern for users (37.9%) (Figure 6).

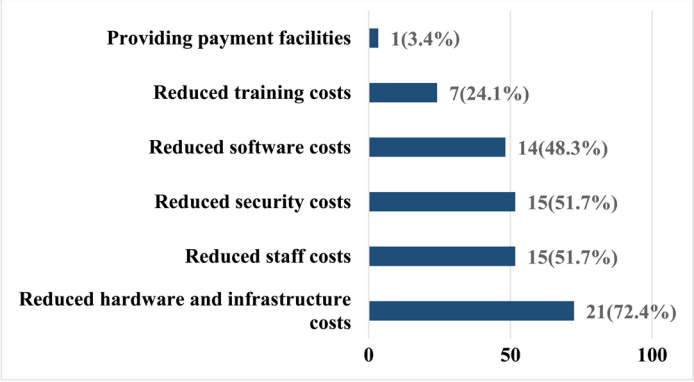

Figure 5. The benefits of cloud computing from economic views of companies.

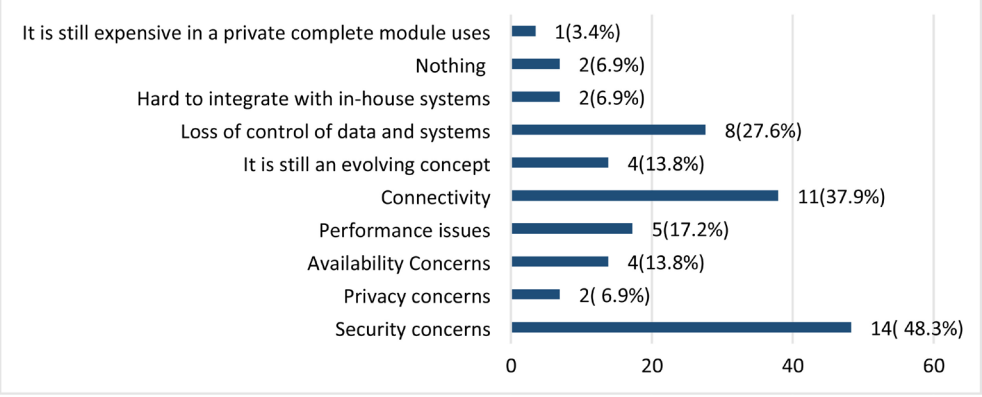

Figure 6. Barriers for using cloud computing.

One of the barriers for the technology support to adopt the CC in public healthcare setting was the cost of this new technology and legal aspects: "*The use of the electronic hospital record using CC could be the method of choice to reduce the escalating costs of data storing and sharing and to enhance the quality of care for the patients admitted in the Lebanese hospitals. But the project needs a budget that the ministry of health cannot able to pay for this time and law for service contracts*".

3.5. Satisfaction from CC Services

Overall, one third of respondents (44.8%) was a good satisfaction from CC, and 55.2% had a very good and excellent satisfaction (**Table 2**).

4. Discussion

The results of the study support the main thesis that cloud computing can generate benefits to SMEs businesses, especially that micro and SMEs sized companies form a significant proportion of the number of companies in South Lebanon.

Our findings were in line with those of Chen *et al.* [37] that reported the different types of CC produce different levels of business benefits across different sizes of businesses. As for European economy [13], it is evident that small and also the medium sized companies remain vital to the Lebanese economy. For instance, in Europe more than 99% of the firms are SMEs [3].

Similarly with European countries, the cost efficiency, scalability and flexibility, sustainability, maintenance by cloud provider, security, and improved service delivery were the main benefits that cloud offer to the business [13]. Dar [4] found that CC is considered as an innovative and enhanced technology to run business organization where the providers offer more secure, more reliable and more scalable services to the customers. Kreslins [30] mentioned that flexibility, scalability and accessibility were the main advantages of CC, it is especially beneficial for SMEs. However, in our study, the impact of CC on business flexibility and scalability (75.9%) is greater than on cost saving (75%). The finding seems to concur with what Chen *et al.* [37] suggested. So, the study found that the decision over whether to adopt CC should not be based on cost only. Kreslins *et al.* [30] reported that the managerial factor would not be an impediment for cloud solutions if the IT personnel would support the shift to new technologies. This finding was in line with our results especially the human capabilities to deal with the CC innovation.

In our study, the CC Service Providers were numerous. In fact, there is a number of companies that offer cloud-hosting services in Lebanon and work with SMEs companies that lack functional capacities and prefer that all technological services be provided through a public cloud [35]. As reported by others studies [1] [3] [13] the security aspect, the cost, and the limited provision of infra-structure remain a challenge for the adoption of CC in organizations in South Lebanon. Indeed, in Baltic countries, respondents appreciated security and backup

systems of CC providers and considered them sufficient [30].

In similarities in our results, the problem of connectivity was identified in Nigeria [40]. They have identified that SMEs in the big cities have higher accessibility to internet access but when they have to travel to remote areas their might be little or no internet connectivity [40]. Our data were in line with the Lebanese data where generally, there is a database that needs to have more privacy and must stay within the country [35]. The compliance is also one of the risks of CC facing the organizations. That is an issue for anyone using backup services or cloud storage. Every time a company moves data from the internal storage to a cloud, it is faced with being compliant with industry regulations and laws. In 2012, the Telecommunications Regulatory Authority laid out a local plan to protect and maintain the security of the cyberspace in Lebanon, while conducting a thorough study of the necessary measures to protect the national communications networks against piracy [35]. The limitation in Lebanon for IT development regarding implementation of the cloud also relates to the legal aspect [35].

Concerning healthcare organizations, CC is accompanied by many challenges, particularly the management, technology, security, and legal aspects [41] [42]. In addition, the use of cloud encourages dependence on the Internet because it must have a network to access it [1]. Lena *et al.* [16] revealed that the Malaysian government initiated a paradigm shift to use electronic hospital information and management systems, and the CC could be the method of choice to reduce the escalating costs of data storing and sharing. These findings were in line with our results.

Survey Contribution and Limitations

This study is one of the first attempts to study CC adoption in Lebanon. It provides a contribution to the body of knowledge about CC adoption in the in companies and especially the micro and SMEs in order to develop its technical characteristics and create an environment to be inconsistence with the technology development. This study is helpful for the companies to understand the main obstacles and the critical factors essential for implementing a successful cloud environment in the public and private sector in Lebanon.

While the study reveals several interesting findings, the results should be interpreted with caution. There are several limitations. First of all, the data source is from companies in South Lebanon, it was a small and a purpose sample since the number of businesses that adopted CC is very limited. Directly addressing the top managers and taking a broad approach to the subject matter provided both validation of findings and extension of existing knowledge. Finally, the nature of cross-sectional data set limits the interpretation to that at one point in time.

5. Conclusions

Our study showed the relevant factors for adopting CC in companies and espe-

cially the micro and SMEs. The majority of respondents were aware about the advantage of CC. Nevertheless, security concerns and lack of trust of this new technology still exist even among experienced users of the cloud. In addition, the lack of access to up-to-speed internet in South Lebanon constitutes a significant barrier for CC adoption. The company should plan an effective strategy to minimize the challenges of the CC. Once the users are aware of the positive impacts of the technology, they can demonstrate their full cooperation to successfully adopt CC.

In conclusion, the industry of cloud computing and the micro and SMEs should carry out a wide range of various activities to facilitate the introduction of cloud solutions in the companies and to eliminate existing barriers.

Acknowledgements

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Authors' Contributions

This work was conducted in collaboration between all the authors. HS designed the study, conducted literature searches, performed the statistical analysis, and wrote the first draft of the manuscript. HT, RC, IS, participated in the data analysis, participated in interpretation of data of the study, and assisted with the writing. All authors read and approved the final manuscript.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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