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Factors Influencing SMEs' Adoption of Cloud Computing Services in Lebanon: An Empirical Analysis Using TOE and Contextual Theory

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ABSTRACT An increasingly important advancement in information and communication technologies is cloud computing, and a remarkably increasing trend is its adoption by various organizations. The trend is attributed to the potential of this growing computing paradigm to improve the scalability, efficiency, and reliability of IT systems. Diffusion of cloud computing innovation is changing the way business information systems are developed, paid for, and maintained Alshamaila *et al.* 2013, Low *et al.* 2011, thus contributing to efficiency and better value for enterprises. This not only applies to large organizations, but also progressively more to small and medium-sized enterprises (SMEs). However, little is known about the factors most likely to be associated to the adoption behavior of cloud computing services among small and medium enterprises operating in Lebanon. This study deploys the technology–organization–environment (TOE) framework and the Contextual Theory to empirically examine the determinants of cloud computing service adoption in a developing country, namely Lebanon. A model is proposed, and data collected from 139 respondents working in SMEs in Lebanon and analyzed using confirmatory factor analysis and logistic regression in SPSS provide strong support for the model. Results indicate that technological (i.e., complexity and security) and organizational (i.e., top management support and prior IT experience) factors are positively related to the decision to adopt cloud computing services. Moreover, one of the areas of potential interest is the effect of country-specific, or contextual factors, among those who intend to adopt cloud computing. The analysis shows that context-specific factors (i.e. poor infrastructure and lack of government initiatives) are negatively related to the adoption decision. Implications and limitations are discussed, and recommendations for future research are proposed.

INDEX TERMS Computing services, TOE framework, contextual theory, logistic regression, IS adoption, SMEs.

I. INTRODUCTION

Due to fierce market competition and a rapidly innovative business environment, firms in all industries and sectors have opted to adopt information and communication technologies (ICTs) to improve their business operations and enhance their business value Aljabre [4], Marston *et al.* [36], Low *et al.*, Sultan [59]. Cloud computing, a new computing paradigm, is growing at a rapid pace and is witnessing a high rate of adoption Sallehudin *et al.* [60], Gens 2009, owing to its features that made it a compelling solution to a myriad of client organizations looking for high performance computing at low costs. Scalability, contribution to a greener innovative environment El-Kassar and Singh [19], shared resources, shared user-interface technologies, advanced processors, broadband internet and wireless connections, elasticity, and high-speed low-cost servers have all contributed in making cloud computing an attractive paradigm to adopt and use by organizations of all types and sizes.

The increased usage of cloud computing adoption in organizations worldwide highlights the significance of examining the aspects that might have impact on the adoption of this computing paradigm in small and medium companies (SMEs) operating in different industries and sectors.

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It is well agreed upon by researchers that cloud computing service models, especially the Software as a Service (SaaS) model, have significant effects on achieving cost efficiency and better payoffs and return on investments in information technologies and systems. However, this computing model is still relatively recent and represents a fraction of the total Information Technology (IT) invested, even if it is growing at a faster pace compared to traditional computing models.

To start with, cloud computing in this study refers to an emerging platform or architecture that allows a global on-demand access to data and applications in a shared pool of computer resources retrieved through internet connectivity Horrigan [61]. It involves the sharing and storage of users' data on non-local servers that are controlled by a third party company offering a cloud service Gellman [62]. Cloud computing could be deployed in the form of a public, private, hybrid, or community cloud, offering a triad of services comprising Infrastructure-as-a-service (IaaS), Platform-as-a-Service (PaaS), and Software-as-a-Service (SaaS) Martha *et al.* [63], Diakakos *et al.* 2009. This study focuses on the last type, SaaS, whereby the CSP offers software applications and data storage locations that users will either purchase or rent on a pay-as-you-go plan Martha *et al.* [63], Diakakos *et al.* 2009.

With this in mind, and in an era where digitalization has become ubiquitous, there are opportunities to migrate and host data and applications to the cloud. Migration includes data storage, computations, or even whole services which has a huge effect on nearly all businesses in all sectors. However, the reasons for adopting or not adopting these technologies are still not amply examined as regards SMEs operating in Lebanon. This is specifically important since Lebanon is considered a fertile ground for SME development Fahed-Sreih *et al.* [20]. To contribute to this knowledge and understanding through this study, a survey is developed to collect data that would help build insights in regards to the main factors that can impact the adoption of this new computing paradigm in the operation of SMEs, especially in the Lebanese market.

The effect of Information Technology (IT) on the performance of organizations has been broadly discussed in the present body of literature (e.g., Yunis *et al.* [54]). Other technologies including cloud computing have secured support in the IT field. As a matter of fact, cloud computing is a cost-efficient service that allows effectiveness in business activities. More precisely, it helps in lowering capital expenses of buying new hardware and software and by providing the efficient amount of electricity, bandwidth, operations and storage when it is needed. Furthermore, cloud computing does not require IT staff to spend time on routine daily work, instead companies will focus on improving services and applications to reach business goals. Furthermore, customers pay only for the needed and used computing resources since cloud services are delivered on-demand by vendors and can be scaled up or down according to the need of the customer. Companies, in general, and SMEs in particular invest in cloud computing mainly to achieve these strategic objectives of efficiency and better performance. According to Global Finance survey, small business startups have become a wave that riveted the Middle East and North Africa (MENA) region Domat [64]. According to the report, 2018 was again a record year for this region, with 366 deals, attracting $893 million in investment. Probably, the figure would be regarded as modest compared to Europe and the USA, but the momentum is strong and is building fast Domat [64]. The trend is also changing regarding the adoption of digital services, where the region is witnessing the availability of lots of technologies, such as artificial intelligence, cloud computing, data management, block chain, and others. Nevertheless, while the adoption and use of these advanced technologies are driven by their advantages and their added-value input to the organizations investing in them, they are also highly hampered by certain challenges that could slow down their adoption.

Studies demonstrate that the establishment of Small and Medium Enterprises (SMEs) have increased enormously during the last decade in developing countries, owing to the important role SMEs are playing in providing job opportunities and contributing in the development of an economy. SMEs are increasingly becoming the dominant form of an enterprise, with approximately 99% of all firms being SMEs. They account for about 70% of jobs, and contribute majorly to providing value, where on average, 50% and 60% of value added could be attributed to them (OECD, 2016). At a lower level, SMEs contribute up to 33% of Gross Domestic Product (GDP) and 45% of total employment in emerging economies. Additionally, developing SMEs may play an important role in economic diversification, resilience, and greener working environments (OECD, 2017).

However, when it comes to digital transition, SMEs are lagging behind. Although digitalization provides SMEs with new opportunities to enter the global market, evidence shows that SMEs are still behind large firms when it comes to digital transition or technology adoption. While the divide between large organizations and SMEs is narrow for simple connectivity and web presence, the gap becomes bigger when considering more sophisticated applications, such as ecommerce and enterprise resource planning (ERP). While the distance between large organizations and SMEs is narrow for basic connectivity and web presence, when considering more complex applications such as e-commerce and business resource planning (ERP) the gap increases. For instance, ERP software solutions to manage business processes are highly adopted by large organizations, but less considered for adoption by SMEs. Furthermore, according to the OECD report (2017), it is found that there is a large gap between large organizations and SMEs for cloud computing adoption in several countries.

Cloud computing is an innovative technology that can help entrepreneurs and IT experts to execute their plans, their work and their system development exercises and deal with their IT undertakings from anyplace, anytime. They can get to the

information, and documents they need via their cell phone or tablet. Indeed, they can share the greater part of their work and documents with their representatives, customers, and clients.

In organizations, in general, and in SMEs, in specific, the operational impact of cloud computing will reduce the pressure from IT managers. It is because the IT maintenance and support will be implemented by the external cloud providers. The cloud providers deliver the standard options and packages for IT maintenance and support, but the cost will be much affordable than traditional service provider applications.

Regulatory and security enforcement measures also play an important role as they become more powerful with the use of cloud-based services. The cloud providers manage the majority of regulatory issues and IT managers get rid of direct responsibility for some security issues. This makes cloud computing an appealing option to SMEs.

Furthermore, the cultural impact of the transition to the cloud also plays a crucial role. It involves redefining the roles of business owners, and IT experts, and restructuring IT support for users. IT professionals need to determine who will make a decision regarding the selection of applications and cloud vendors. Similarly, end users can redirect their IT help desk issues from internal IT resources to the cloud provider's IT service.

It is then worth specifying that if SMEs have access to scalable technology, they could potentially deliver products and services that in the past only large enterprises could deliver. This way they will be flattening the competitive arena.

II. RESEARCH PROBLEM

Academic research and industry reports show that SMEs have not benefited as they should from the advantages of cloud computing technology. This is to be expected, given the fact that many organizations worldwide reported a failure in cloud migration projects. According to a survey conducted by iLand, it was found that about 57% of Amazon Web Service (AWS) users have stated that cloud adoption was delayed or failed. Similarly, but to a lower extent, failure was also reported by 44% of Microsoft Azure users Musiienko [65]. The survey reported that 56% of the respondents perceived a major concern due to their ignorance in regards to cloud security and the best practices compliance, 55% claimed that they lacked a clear understanding of the business case building to have a solid cloud migration, and finally 44% admitted that their organizations had insufficient planning for the cloud adoption project.

In fact, moving enterprise systems and data to the cloud has already been proved to be an unsettled course for several businesses, which makes it prudent to examine the factors that enable the success of adopting digital technologies in SMEs. This is further compounded by the fact that there is a lack of literature providing sufficient insight into the general and country-specific factors that influence the adoption of cloud computing by SMEs in a developing country like Lebanon.

III. STUDY GOAL AND OBJECTIVES

The purpose of this paper is therefore to (1) identify the main factors that would help SMEs reap the benefits of a digitization technology, such as cloud computing; (2) draw on TOE and contextualization theory frameworks to propose a model in order to present the various types of factors that would facilitate the adoption of cloud computing by SMEs in a developing country like Lebanon; and (3) empirically test the model through a quantitative analysis conducted on data collected for this purpose. The main research questions of this study are: (1) What main factors are most likely to impact the adoption of cloud computing by SMEs operating in the Lebanese market? (2) Are there specific factors related to the Lebanese market context?

This study, empirically, will serve as a useful platform for both researchers and practitioners in developing countries who are interested in assessing the factors that may influence the adoption of IT/IS in general, and cloud computing in specific. The results of this study will help specialists to understand the best practice in setting policies and to make optimal decisions regarding an efficient and effective investment in cloud computing. They will be able to assess the context and prevailing conditions in light of the factors derived and decide about the proper timing as well as the facilitating conditions that would help in a successful implementation of this advanced technology. As for researchers, the study will provide a useful reference, not only for assessing the applicability of TOE framework factors in cloud computing adoption in SMEs in Lebanon, but also for assessing the country-specific factors that might influence the decision to adopt such technology. This would help in closing gaps in the literature, assessing the practicality of factors included, and considering more context-related, behavioral, political, or other factors to be included in future research Agnihotri *et al.* [2].

The remainder of this research is organized as follows. Section 2 will provide the literature review and the theoretical foundations underpinning successful adoption and deployment of cloud computing. Consequently, the study hypotheses are stated and the conceptual model of the study are presented. Following this, Section 3 will be a presentation of the methodology followed, and section 4 will report the main results derived from the analysis done. Lastly, the final section will present the conclusion of the study and state the main study limitations, as well as the authors' suggestion that might aid future studies.

IV. THEORETICAL FRAMEWORK AND CONCEPTUAL MODEL

The theoretical frameworks used to support IT adoption research in general could be used to serve as a foundation for cloud computing adoption research. Therefore, and in reference to literature, several frameworks are utilized in order to understand cloud computing adoption. These include, among others, the Technology Acceptance Model Davis [66], the Diffusion of Innovation theory Rogers [56], as well as

the Technological, Organizational and Environmental (TOE) framework developed by Tornatzky and Fleischer [67]. The interesting common point among these frameworks is the socio-technical perspective each model is based on. In other words, each model empirically showed that a successful IT adoption is a factor of not only technical factors—rather, it is a blend of technological, individual, social, and environment-related aspects.

Most importantly, these models aim to determine which factors affect the adoption as well as the attitude of the organization. The proposed framework in this study includes selected elements from diffusion of innovation (DOI) theory, the technology-organization-environment (TOE), as well as the context-based elements framework. What follows is a discussion of these frameworks. DOI theory is developed by Rogers [56], described as the mechanism through which an innovation is transferred via specific channels over a period of time between social system members. An innovation can be a new idea, object, or practice, according to a person or other unit of adoption. Moreover, organizations usually use the DOI theory to find predictors of IT diffusion adoption Frambach [68], Hameed *et al.* [69], Lee [70], Oliveira and Martins [39], Zhu [55].

There are three adoption groups' predictors according to Rogers [56]. The groups are divided according to individual characteristics such as individual innovativeness, internal and external firm factors such as business size, available resources and the ICT management procedures. Rogers [56] also pointed out the importance of the technological characteristics' impact on possible adopters. However, these technological characteristics do not emphasize the subjective features of decision-makers' minds, concentrating instead on the main objective aspects of technology. Researchers have therefore theorized the relationship between innovation attributes and the tendency to deploy cloud computing in SMEs operating in the Lebanese market, along with IT personnel characteristic.

As for TOE, an organization-level theory, Tornatzky and Fleischer [67] established a multi-perspective system. TOE is a part of the innovation cycle that represents how business context and components of enterprises affects the adoption of innovation Baker [71]. These components are categorized as the (1) technological contexts which includes IT software and hardware issues, (2) organizational contexts applies to internal and external forces such as the market competition, and (3) environmental contexts of an organization as its scope, size and management structure, which explores the frameworks and theories that applied in previous Oliveira and Martins [39].

Previous IS research has utilized the TOE framework in order to inspect the process of adopting new technology. In addition to the TOE framework, other studies used a combination of other theoretical frameworks to further examine the process of adoption Alshamaila *et al.* [5]. It is worth mentioning that the technological element of the framework represents both the implemented technologies at the firm and the prospect technologies that are not currently in use Hsu and Lin [25], Alshamaila *et al.* [5], Tornatzky and Klein [72].

Oliveira and Martins [39] conducts a review of the literature available on the models that are considered with IT adoption at the firm level; he identifies that most practical studies are a result of the DOI theory and TOE framework. Oliveira concludes that the TOE framework could be considered an enhanced model to explain intra-firm innovation adoption since it comprises the environment context. Combining the two frameworks would provide a holistic model that embraces individual, technological, organizational, and environmental factors. This study adopts Oliveira's approach, and also argues that context-specific factors need to be taken into consideration, given the special economic and political conditions and situations characterizing Lebanon. The importance of contextual factors has been highlighted by previous researchers in international business, arguing that the contextual aspect impacts decisions, strategies, and policies Poulis *et al.* [73]. In the IS adoption research stream, previous research highlighted the importance of context-specific variables as well. For example, Thong and Yap [48] stressed the importance of including the distinctive characteristics of context in developing a strong theory to study the adoption of innovation. Moreover, four important components were highlighted by Assaker *et al.* [7] using the destination competitiveness theory: core resources (e.g. climate), supporting resources (e.g. infrastructure), context management (to maintain and improve core and supporting resources), and situational conditions (including government policies, exchange rates, political situation, national security, and so on) Fahed-Sreih *et al.* [20], Bandaly *et al.* [10].

Based on the literature review and the theoretical information background provided by previous studies, a four dimensional model is proposed in this study. The model includes the variables of technology, organization, environment, and the Lebanese-market-specific-context factors as main influencers in the decision to implement cloud computing in the SMEs operating in the Lebanese market.

A. TECHNOLOGICAL FACTORS

Researchers highlighted the technical factors that influence cloud computing adoption. Examples of these factors are relative advantage, ambiguity, compatibility, difficulty, and triability. For example, Abolfazli *et al.* [58] pointed out that IT friendliness has a worldwide effect on cloud adoption, which might lead to significant different rates of cloud adoption in several countries. In contrast to the features of traditional computing models that are even high performance, cloud computing has unique features which include high availability, lower complexity, reduced total cost of ownership, low capital investment, and elastic scalability Abolfazli *et al.* [58]. In addition, Avram [74] mentioned technological factors such as security and privacy to be crucial in the adoption decision. He emphasized that companies face several different requirements in their efforts to proper handle individuals' data to ensure data privacy, and it has not yet been determined

whether the cloud computing model ensures enough data security or whether companies will not abide to the regulations due to the new paradigm.

Concerning connectivity, Avram [74] emphasizes that it is a critical enabler for an organization to widely embrace cloud computing. Another era of industrial revolution and the increase need of advanced consumer products are facilitated by the access of information through cloud. In addition, it is important for businesses to provide 24/7 support through having reliable applications Avram [74]. Disaster and emergency planning must be implemented smoothly by firms in order to have minimum disruption in the event of failure or outages Avram [74].

Alshamaila *et al.* [5] states that the main factors which includes relative advantage, uncertainty, compatibility, and triability play an important role in the adoption of cloud services when it comes to SME. It was found that the probability of adopting cloud computing increases when businesses determine the advantage in an innovation; Therefore, SMEs need to have a clear vision and recognize the benefits of applying cloud services. Previous research suggests that the level of uncertainty towards cloud computing in SMEs affect adoption decision. In Alshamaila's research, it is also evident that trust in the service providers is highly important to the majority of early adopters and prospectors.

It is found that for SMEs to adopt cloud computing in their industry it is essential for them to try the service before deploying it since SMEs expect that cloud services to be compatible and user-friendly which, in return, will affect their decision in adopting cloud computing. However, vendors, cloud service providers, claim that cloud services fit most of the adopters needs in their firms to bring consistency and add business value. To adopt cloud computing, SMEs expect that the services provided should be compatible and user-friendly. Therefore, it is useful for the client to try the service as this will helo them to decide whether to buy it or not Alshamaila *et al.* [5].

With respect to the challenges, Kuyoro *et al.* [57] considers security issues as one of the most significant challenges that hinder the growth of cloud computing. It is argued that firms fear from insufficient security when it comes to entrust their data to another party and vendors should confirm their ability to protect clients' data from serious threats like data leaks as well as data breaches like phishing and botnet (which is a network of Internet-connected machines running remotely). Additionally, firms appear to be discouraged about having hosting their own software on servers controlled by the providers Kuyoro *et al.* [57].

Furthermore, many SMEs are not ready to try new technological innovations, especially those that are not well established and tested. This is due to the ''presumed cost of acquisition and perceived cost of failure'' Stieninger *et al.* [75]. Many developed countries around the world (excluding African nations), have conducted surveys on cloud computing. However, because of the shortages of references in this area, SMEs do not trust cloud computing when relevant information on how to use cloud services is needed Makena [76].

Based on the above discussion, the following hypotheses were formulated:

H1: The benefits provided by cloud computing is positively related to cloud computing adoption.

H2: A company intend to adopt cloud computing services when it is noticed that the services when it leads to a lower financial costs. Therefore, cloud computing cost effective benefits that is provided to the organization will encourage decision makers, who recognize the benefits of cloud computing, to adopt cloud services.

H3: Security controls are positively related to an orgaization's readiness to adopt and use cloud computing services.

H4: Cloud compatibility with the users' jobs and organizations' processes is positively associated to the adoption of cloud computing.

H5: The perceived complexity of using cloud computing services negatively impact its adoption and use by SMEs.

H6: Trialability- the level to which Cloud computing may be partially tested - is positively related to Cloud computing adoption.

B. ORGANIZATIONAL FACTOR

Previous research focused on the organizational factors that affect cloud computing adoption decisions in firms. Kuyoro *et al.* [57] addresses other issues that delay the adoption of cloud computing, such as the Service Level Agreement (SLA), data migration, and the question of cloud scalability. The study also points out that there's a lot to be careful about when it comes to cloud adoption. One needs to understand the concerns and the challenges related to the application of these technological innovations Kuyoro *et al.* [57]. In other words, organizations should have the technical readiness to successfully adopt such a computing paradigm. This is specifically crucial, taking into consideration the high failure rate in cloud computing projects mentioned earlier.

Moreover, Avram [77] concludes that one of the factors that need to be considered when using Cloud Technology by an enterprise is the changes in the IT organization. The author cautioned that before deciding to implement cloud computing, the organization should understand its processes and asses the risks and benefits that it can bring to its business.

In addition, Alshamaila *et al.* [5]states that factors such as the size of the organization, the support of top management, as well as prior experience all play a role in SMEs' adoption of cloud services. Organizational size considers to be a significant factor for small businesses and start-ups; small companies believe that their size enables them to adopt new innovations as they are able to change their vision and mission easily and with flexibility. It is also agreed that start-up companies tend to be attracted more in adopting cloud computing since it can aid in avoiding capital expenditure. However, it was discovered that the chief executive and managing

director of a firm usually encourages IT staff to investigate cloud adoption further. Finally, service providers, prospectors and adopters have established that using similar technological tools, especially virtualisation services, have made adopters more familiar with the new technology, and will become even more comfortable with cloud services.

According to the aforementioned previous studies about organisational factors affecting the decision of Cloud computing adoption, the following hypotheses were established:

H7: Organizational size consider to be a significant positive factor the adoption of cloud computing; small firms compared to larger firms adapt quickly to the changes in their environment.
H8: The support of the firms' top management is positively associated with cloud computing adoption.
H9: Testing new solutions before adopting it buy decision has a positive impact on the adoption of cloud computing.
H10: Prior technological experience provides familiarity with technological innovations which is positively associated with cloud computing adoption.

C. ENVIRONMENTAL FACTORS

Besides technological and organizational factors, previous research emphasized the importance of environmental factors as determinants of cloud computing adoption. Alshamaila *et al.* [5], for example, listed the market scope as a factor that impacts cloud computing adoption worldwide. The results showed that when companies operate in a wide market area, they tend to adopt cloud services which in return might increase their efficiency. Another factor that impacts the adoption of technology is the business sector in which a company operates in. For instance, adopters and prospectors, believes that sectors which need a high computing requirements tends to use more cloud services. A further factor emphasized by the study is the supplier computing support – an external computing support- in the process of decision-making. These factors were emphasized by the majority of participants, who are grouped either as providers, adopters and prospectors. Alshamaila and Papagiannidis research did not show sufficient evidence concerning the competitive pressure as a significant determinant of Cloud computing adoption.

In view of the above research regarding the environmental impact on the adoption of Cloud computing, certain hypotheses were posited:

H11: A high rivalry level among companies within an industry is positively related to a company's decision to adopt cloud computing.
H12: Market scope is positively related to cloud computing adoption.
H13: The level of outsourced support offered by vendors such as training, customer services and support is positively related to the tendency of the firms to adopt cloud computing services.

D. CONTEXT (COUNTRY)-SPECIFIC FACTORS

In reference to the Contextual theory, understanding the phenomena and the prevailing situations in a certain context can provide a better understanding of IT adoption, including cloud computing adoption. A country like Lebanon faces major challenges at the economic, infrastructure, and political levels. Accordingly, an investment in a new computing paradigm cannot ignore such challenges.

Previous research on cloud computing in the MENA region, though very few, considered the impact of the environment on adoption decisions. Abolfazli *et al.* [58] demonstrates that many factors, including financial wealth, political stability, and geographical location, impact cloud adoption worldwide.

Avram [77] deduced that eco-political issues are among the environmental factors influencing adoption decisions in companies. It is found that political stability plays an important role in regards to cloud adoption since it is unclear where the actual data is stored and accessed from, and where the data-processing takes place, as each area may apply different privacy rules and regulations when it comes to storing and accessing data. By this token, politics affects the adoption of cloud computing, and should therefore be separated from cloud computing in order to evolve into a borderless and global tool.

Moreover, the global competitiveness index that is issued by the world bank shows that the challenges facing technology and innovation adoption in Lebanon are due to:

(1) Low levels of investment in research and development,
(2) Low collaborative research between universities and industry,
(3) Low reliance on technological sophistication among among new start-ups and SMEs,
(4) Weak state of cluster development, i.e. according to the GCI, Lebanon ranks 109 in 2012, and 108 in 2012 according to the GII.

In addition, a survey performed by the Ministry of Economy and Trade in Lebanon revealed that investments face significant hurdles that include the political status-quo, business regulations, infrastructure readiness, as well as the macro-economic environment. Additionally, a report on the economy of cloud in developing countries states that the readiness and interest of developing countries, including Lebanon, in the adoption of cloud computing technology services are slow and discouraging El Khoury [78]. This is expounded by the fact that these countries face a lot of power outages, poor connectivity, poor infrastructure and other challenges related to economy and politics.

Contextual factors vary across studies and locations. Previous research highlighted the importance of a variety of context-related factors, such as context management, supporting context (e.g. infrastructure), and situational conditions (such as government policies, exchange rates, political situation, and national security).

For this study, after gathering the data we ran a principal component analysis which showed that the main contextual factors are Political issues, Lack of government initiatives, Poor infrastructure. This will be more elaborately explained in the methodology section and result section later in the study.

Thus, it is clear that Lebanese SMEs are delayed in applying innovation and technology to their businesses. However, the successful implementation of cloud computing in these developing countries necessitates an organizational change, a step that is requires time and new investments, especially in a turbulent economy with unstable political conditions like Lebanon. As a matter of fact, unstable political situation in Lebanon, the wars, and the lack of a sense of security, do not help in the future planning to adopt this technology. With this in mind, the study contends that country or context-specific variables should be included for a comprehensive and holistic conceptual model for cloud computing adoption in a MENA country like Lebanon. Consequently, the following hypotheses could be postulated:

H14: Political issues and instability negatively impact cloud computing adoption.

H15: Lack of government initiatives negatively impacts cloud computing adoption.

H16: Poor infrastructure negatively impacts cloud computing adoption.

In addition to the above literature review, both the theoretical framework and derived hypotheses could help formulate the proposed conceptual model of the study as shown in Figure 1. As revealed in the diagram, the proposed model is an integrated framework of DOI, TOE, and Context-based factors. To implement cloud computing in an organization that is aware and that has knowledge of the technology characteristics, several factors are considered Karkoulian *et al.* [27], Karkoulian *et al.* [28]. These represent critical elements that are considered in the innovation process, i.e. what the firm considers in the process of the adoption and implementation of the cloud computing innovation. The central indicator for this innovation in the above model is the adoption of this computing paradigm. Since there are several factors that would influence this adoption decision, a multi perspective framework is taken into the account. Based on this, the framework includes Technological, Organizational, Environmental, and Context-based factors that are very crucial in the decision and process of adopting an innovation.

The following section explains the methodology followed to collect the data and conduct the analysis. This is followed by a presentation of results and main conclusions derived. This is anticipated to help in identifying possible areas for development, especially at the context levels.

V. METHODOLOGY

A. SAMPLING AND INSTRUMENT

For this study, a questionnaire was deployed in order to collect data, and a sample was selected from SMEs belonging to various sectors and located in different areas in Lebanon (Beirut, 51%; North, 30%; Mount Lebanon, 11%; South, 8%). In the questionnaire, 30 survey items for nine constructs are designed similar to prior literature, but were modified where necessary to fit the context of cloud computing. The questionnaire had two parts: (a) the demographic characteristics, as shown in Table 1, which includes the number of employees, adoption status of cloud computing services, as well as prior IT experience; and (b) the measurement of the nine factors. If you are using *Word,* use either the Microsoft Equation Editor or the *MathType* add-on (http://www.mathtype.com) for equations in your paper (Insert | Object | Create New | Microsoft Equation *or* MathType Equation). ''Float over text'' should *not* be selected.

Before conducting the survey, two steps were made. First, a focus group of 5 experts in the field from a pioneer university in Lebanon was formed and asked to identify the factors related to adoption of cloud computing in general. This step was done to ensure the domain content of the study, and to identify the contextual factors relevant to this country. After that, a pilot test was given to 30 randomly selected IT professionals working in universities and SMEs to assess the clarity of the questionnaire items. The responses from the pilot study that met the sample selection criteria

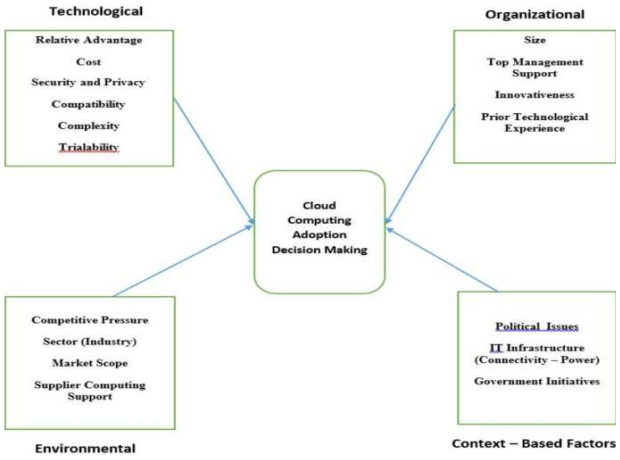

FIGURE 1. Conceptual framework.

TABLE 1. Sample characteristics.

Characteristic			
Number of Employees		*Gender*	
<50	32 (23)*	Male	108 (78)
50-200	27 (19)	Female	31 (22)
201-1000	61 (44)	*Cloud Adoption Experience*	
> 1000	19 (14)	Adopters	89 (64)
Sector		Potential Adopters	50 (36)
Education	41 (29)		
IT	37 (27)		
Fin/Banking	15 (11)		
Healthcare	13 (9)		
Telecom.	10 (7)		
Food & Bev.	6 (4)		
Int'l/NGO	5 (4)		
Media	4 (3)		
Construction	3 (2)		
Public/Gov't	2 (1)		
Other	3 (2)		

*Values in parentheses are the percentages

TABLE 2. Scale measurement sources.

Constructs	Variables	Reference
Technology Context	Relative Advantage	Slyke et al. (2004), Wang et al. (2010),Tan et al (2008), To and Ngia (2006)
	Cost	Kuan et al (2001)
	Security and Privacy	Oliveira et al (2010), Chau et al (2001)
	Compatibility	Slyke et al. (2004), Wang et al. (2010), Lin et (2008), Hong and Zhu (2006), Tan et al (2008), To and Ngia (2006), Oliveira et al (2010)
	Complexity	Slyke et al. (2004), Wang et al. (2010), Tan et al (2008)
	Trialability	Tehrani et al (2013)
Organization Context	Size	Hong and Zhu (2006), Oliveira et al (2010), Pan and Jang (2008), Wang et al. (2010), Zhu et al (2004)
	Top Management Support	Wang et al. (2010)
	Innovativeness	Thong et al (1995)
	Prior Technological Experience	Thong et al (1995)
Environment Context	Competitive Pressure	Lin and Lin (2008), Oliveira et al (2010), Pan and Jang (2008), To and Ngia (2006), Wang et al. (2010), Zhu et al (2004)
	Supplier Computing Support	Tehrani et al (2013)

(SMEs, adopted/intention to adopt cloud computing, prior IT experience) were included in the study. During the interviews, IT managers were asked about the contextual factors relevant to Lebanon. Many of these items were added to the survey after coding the responses through the help of 2 university professors. The survey was sent online to SMEs in various zones in the Lebanese market, and were distributed to IT managers, professionals, and employees. The non-probability convenience sample was adopted in this study due to its several advantages, and although it is a non-random sampling technique, its use in this study deemed important since the study adopted IT professionals working in SMEs that either adopted or had some intention to adopt cloud computing Teo *et al.* [47]. Thus, the findings can be generalized to represent the population in Lebanon, as the respondents are from SMEs operating across all Lebanese Mohafazat (zones). The approach is also comparable with Teo *et al.* [47] study on m-payment in Malaysia. Survey was conducted online using Google Forms, generating 230 responses. 91 questionnaires were dropped out because of incorrect or inconsistent answers, thus yielding 139 complete questionnaires. The construct measures were adapted from existing validated instruments, and certain items were modified to fit the cloud computing context. The research studies from which the aforementioned items were adapted are listed in Table 2. Moreover, in survey studies, non-response could be a source of bias Fowler [79]. To address this issue, we followed Armstrong and Overton [6], and conducted t-tests for early and late respondents considering the size of the SME (number of employees) and its annual revenues. Results showed that there were no significant differences, signifying that the response bias was not significant.

B. CONFIRMATORY FACTOR ANALYSIS AND SCALE RELIABILITY

Each item was measured using a five-point Likert scale, and the principal-component analysis method, along with Varimax rotation, was utilized in order to assess the construct validity of the various factors. The fit between the items and their factors/constructs is determined when factor loadings exceed the threshold value of 0.5, and have no cross-loadings with other constructs Hair *et al.* [23]. Due to cross-loading, few items were eliminated. The confirmatory factor analysis was performed again, leading to nine factors being identified as explaining the cloud computing adoption in SMEs (eigenvalues greater than 1). The results explained 77.9 (∼80) per cent of the independent variables, signifying a satisfactory level of construct validity. Moreover, the Kaiser-Meyer-Olkin (KMO) measures the sample adequacy, and in this analysis, the KMO was 0.831 (whereby KMO >= 0.8 is excellent Kaiser [80]), revealing the adequacy of the matrix of correlation for the confirmatory factor analysis. The adequacy of individual variables was also shown through the KMO values. The nine factors are as follows: relative advantage (RA), cost effectiveness (CE), security and privacy (SP), compatibility (CM), complexity (CX), top management support (TMS), technology experience (TE), competitive pressure (CP), and supplier support (SS). The results of reliability analysis and confirmatory factor analysis are shown in Table 3.

C. DATA ANALYSIS

The logistic regression technique was run with all nine independent variables in order to test the research model and stated hypotheses. Multicollinearity was assessed, and the VIF values ranged between 1.151 and 6.627, which were below the threshold of 10. Based on this, and in reference to Hair *et al.* [23], it is safe to say that there is no multicollinearity problem among the independent variables.

Coming to the logistic regression results, shown below, the omnibus test, with a significance value less than 0.05, shows that the derived model outperforms the null model. Moreover, the likelihood ratio (94.941) indicates a strong relationship between the predictor and dependent variables. The Nagelkerke R2 showed that the logistic model explains about 63.6 per cent of the data variation.

Omnibus tests of model coefficients.

		Chi-square	df	Sig.
Step 1	Model	86.663	14	.000

Model summary.

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	94.941[a]	.464	.636

Using the Wald statistics, the importance of the regression coefficients of the hypothesized predictors was examined. As shown in Table 4, the coefficients of Poor IT Infrastructure (P = 0.036), Lack of Government Initiatives (P = 0.000), Security and Privacy (P = 0.043), Complexity (i.e. ease of use) (P = 0.034), Top Management Support (P = 0.002), and Technology Experience (0.033) were all significant at the 95% confidence level. This gave supporting evidence for hypotheses H3, H5, H8, H10, H16, and H17. The other variables lacked significance, and thus the hypotheses

TABLE 3. Scale measurement sources.

	RA	CE	SP	CM	CX	TMS	TE	CP	SS
RA1	.801								
RA2	.839								
RA3	.872								
RA4	.845								
RA5	.857								
RA6	.878								
RA7	.857								
RA8	.765								
RA9	.685								
RA10	.804								
CE1		.815							
CE2		.873							
CE3		.845							
CE4		.801							
SP1			.882						
SP2			.892						
SP3			.815						
SP4			.885						
SP5			.792						
SP6			.717						
CM1				.904					
CM2				.889					
CM3				.835					
CM4				.763					
CM5				.701					
CX1					.902				
CX2					.906				
CX3					.799				
CX4					.878				
TMS1						.915			
TMS2						.851			
TMS3						.912			
TMS4						.918			
TE1							.919		
TE2							.891		
TE3							.885		
TE4							.898		
TE5							.875		
TE6							.912		
TE7							.870		
TE8							.816		
TE9							.804		
CP1								.849	
CP2								.881	
CP3								.835	
SS1									.849
SS2									.852
SS3									.843
SS4									.679
Eigenvalue	6.762	2.784	4.164	3.380	3.043	3.236	6.895	2.195	2.619
Variance	67.615	69.588	69.403	67.592	76.086	80.911	76.615	73.162	65.472
Cronbach α	0.942	0.836	0.909	0.804	0.769	0.920	0.961	0.813	0.820

RA: Relative Advantage; CE: Cost Effectiveness; SP: Security & Privacy; CM: Compatibility; CX: Complexity; TMS: Top Management Support; TE: Technology Experience; CP: Competitive Pressure; SS: Supplier Computing Support

TABLE 4. Logistic regression results.

Predictor	*B coefficient*	*SE*	*Wald statistics*	*Sig.*
Political Issues	.845	.533	2.507	.113
IT Infrastructure	-.589	.282	4.378	.036
Government Initiatives	-3.006	.752	15.996	.000
Relative Advantage	.435	.512	.722	.395
Cost effect	.204	.385	.281	.596
Security and Privacy	.621	.307	4.100	.043
Compatibility	.087	.267	.107	.744
Complexity	-.731	.344	4.516	.034
Trialability	.411	.393	1.097	.295
Top Management Support	2.674	.856	9.756	.002
Innovativeness	.426	.339	1.586	.208
Technology Experience	1.413	.665	4.521	.033
Competitive Pressure	.157	.303	.267	.605
Supplier Computing Support	.118	.336	.123	.726
Category Classification		*Yes*	*No*	*Correct (percent)*
Adopter firms		83	6	74.0
Non-Adopter firms		13	37	93.3
Overall				86.3

Notes: χ^2 = 86.663 , Sig. = .000 , -2 Log likelihood = 94.941^a , Cox & Snell R Square = .636 , Nagelkerke R Square = .636

corresponding to them were not supported. Worth noting is the fact that none of the factors pertinent to the environment dimension of the model showed significance, whereas two of the three country-specific factors were significant and thus included in the model. In reference to the sign of the coefficient, we may say that perceived complexity, poor IT infrastructure, and lack of government initiatives are negatively related to SMEs likelihood of adopting cloud computing, whereas the perceived privacy and security of the cloud, prior technology experience, and top management support are positively associated with the likelihood of cloud adoption by SMEs.

The results shown in Table 4 also depict the overall discriminating power of the model. According to the output results, the logistic regression model has 86.3% classification (or prediction) accuracy. With 89 adopters and 50 non-adopters in the sample, the cloud adoption by SMEs' random choice would yield (89/139)2 + (50/139)2, i.e. 54%, which is far less than the prediction power of our regression model. Hence, in this study, the logistic regression has a higher discriminating power or classification than the random choice model.

VI. DISCUSSIONS

The purpose of this research study is to further our understanding of the adoption of cloud computing by SMEs in a developing MENA country like Lebanon, by identifying the factors that influence these firms' decision to adopt and by distinguishing adopters from non-adopters. Six drivers for this computing paradigm were identified. These are: Poor IT Infrastructure, Lack of Government Initiatives, Security and Privacy, Complexity (i.e. perceived ease of use), Top Management Support, and Technology Experience.

Referring to the dimensions included in the model, and underpinned by the TOE framework and context-based factors, the results of the analysis as pertinent to the Lebanese market supported 3 out 4 dimensions. To start with the technological dimension, expected benefits provide a solid reason for innovation technology adoption and expansion Low *et al.* [34]. According to our results, the benefits that the IT managers and professionals perceive as important for cloud computing adoption are perceived user-friendliness as well as the technology's ability to provide the firm's data with more security and privacy measures. The result related to complexity with a negative relation with cloud computing adoption is consistent with the literature (e.g., Sabi *et al.* [43] and Oliveira and Martins [39]). As for the security factor, it is well known that users, in general, report security and privacy concerns as a major barrier hindering the rapid adoption of the cloud technology. In fact, surveys on cloud technology stated that among users, the highest priority and highest concern goes to the security of data Chang and Ramachandran [13]. This could be attributed to the fact that security incites trust Ghazali *et al.* [22], Wu [53] and trust matters in the decision to adopt an internet-based technology, such as cloud computing. Accordingly, as users' perceived security of the technology increases, their trust in its safety grows, thus promoting higher adoption rates.

Surprisingly, in contrast to the results reported by previous research, relative advantage, cost effectiveness, compatibility, and trialibility, these variables were not significantly related to cloud computing adoption. Relative advantage of cloud computing could be derived from aspects like improving business communications speed, coordination efficiency among firms, communication with customers, and effective access to market information Gangwar *et al.* [21], Low *et al.* [34]. As for cost effectiveness, it is a main driving factor for cloud computing adoption Wu *et al.* [52], Changchit and Chuchuen [14]. The compatibility of the technology, or the extent to which it can be aligned with the existing processes

and value systems of a company, is also an important driver for the adoption of cloud technology Oliveira *et al.* [40]. However, previous research reported mixed results regarding the significance in the relation between compatibility and IT adoption (e.g., Lee and Kim [31]). Tralibility, the degree to which a technology may be tried or experimented, is also an important factor for adoption Molinillo and Japutra [37] since it increases the awareness about the technology and assessing its fit with the firm and its processes. The insignificance of the relationship between these factors and cloud computing adoption in this study could be attributed to the possibility that cloud computing is still an immature technology in this market, and firms still have a low level of cloud computing know-how. Moreover, certain types of cloud computing services (e.g. private cloud) could be high, and the maintenance and other service costs may also be very high Chou [17]. Further, regarding if a firm previous experience with information technologies showed incompatibility with the business core processes and value system, cloud computing could be perceived the same Low *et al.* [34]. Finally, the insignificance of the compatibility factor could also be attributed to the nature of the sample used in this study. The fact that the participants of the study are mainly IT professionals could be a possible reason for not thinking of the business part of the technology. With the above in mind, training and workshops to enhance awareness and knowledge about cloud computing and its functionality would most likely improve users' perception about it, allowing firms to use it in a better way and reap its benefits.

As for the organizational dimension, prior research reported that firm characteristics impact to a large degree the decision making process involved in adopting an IT innovation Hsu and Lin [25], Wu [53]. This research contends that, based on the positive effect top management and technology experience have, both are important factors in the determination of cloud computing adoption and in discriminating between adopters and non-adopters of the cloud computing technology. This concurs with previous research which reported a significant positive relationship between top management support and cloud technology adoption (e.g., Borgman [12] and Low *et al.* [34]). This is logical since the successful implementation of any technology solution necessitates top management support and high skill levels in technology integration to business Oliveira *et al.* [40]. Firm size and innovativeness did not demonstrate any significant relationship with cloud adoption. This contrasts with previous research suggesting that service-oriented architecture adoption is positively influenced by a larger firm size and innovativeness in firms MacLennan and Van Belle [35], Wang [50]. Again, the lack of significance could be attributed in this study to the IT professionals' (who are the main participants in this study) lack of knowledge of the business perspective of the cloud computing adoption process. At the same time, they are highly aware of the level of top management support, and can very easily give information about their own existing IT experience.

In the environmental context, supplier computing power as well as competitive showed unanticipated results, as their relationship with cloud computing adoption turned out to be not significant. The finding related to supplier computing power conforms to the results reported by Alhammadi *et al.* [3], but contrasts with the findings reported by Peng *et al.* [42]. This can be explained by the fact that unlike Peng et al's study, this research work is conducted in a country that is not technically developed. As for competitive pressure, the insignificant relationship also conforms to Alhammadi *et al.* study [3] as well as Oliviera *et al.* [40]. In contrast, Aboelmaged [1] discovered that competitive pressure has a significant relationshiop to cloud computing. A possible explanation could be the nature of the sample in this study, where many respondents were chosen from different sectors. Probably, studies that reported a significant connection between cloud computing and competitive pressure were confined to one industry sector (e.g., Low *et al.* [34]).

Finally, in a turbulent context like the Lebanese one, it is important to consider context-specific factors that correspond very strongly to the conditions and situations characterizing the Lebanese market. These challenging conditions may form hindrances in the process of adopting new systems and technologies, as most companies may be following survival, rather than expansion or growth strategies. Lack of government initiatives, poor IT infrastructure, and political challenges are crucial factors that may negatively impact the adoption and implementation of cloud computing by SMEs operating in the Lebanese market. To start with, government initiatives are important to support SMEs and new start-ups investments in technologies that may enhance performance and lower costs Julian *et al.* [26]. Initiatives are also pivotal to enforce laws that would ensure data security, privacy, and confidentiality. The importance of government initiatives in supporting IT adoption and investments in SMEs has been highlighted in previous research in Denmark and Australia Dwivedi *et al.* [18], in Africa Awiagah *et al.* [8], in KSA, and in developing countries in general Taylor [45]. Moreover, poor IT infrastructure could be a big barrier against adoption of technologies, especially internet-based technologies like the cloud Charbaji and Mikdashi [15]. The negative impact of poor infrastructure on IT adoption in general, and e-commerce in particular has been emphasized in many research articles related to developing countries (e.g., Hamad *et al.* [81] and Mzee *et al.* [38]). The results of this study conform very well to the just mentioned previous research. Finally, although political instability may have an adverse impact on SMEs' investments, including IT investments Bala and Feng [9], our results showed that political issues are not significantly related to the decision of cloud computing adoption. This could be due to the possibility that SMEs and other companies in the country have been living this type of turbulence since a very long time, and thus they are focusing more on direct factors, like infrastructure and government support initiatives rather than the general political issues prevailing in the country.

VII. CONCLUSION, IMPLICATIONS, LIMITATIONS, AND RECOMMENDATIONS

The increased rate of cloud computing adoption in developed countries reflects the awareness of these organizations about the strategic benefits that this computing paradigm possesses, as well as their intention to fully exploit the benefits that this technology offers to organizations. Despite this understanding, slow adoption rates are observed among SMEs in developing countries, in general, and the MENA (Middle East and North Africa) region, in particular. To foster cloud computing adoption, it is mission critical to examine the factors that determine this adoption in firms across different industries and sectors. This study examined the factors that are associated to cloud computing adoption among SMEs in the Lebanese market. Drawing on two theoretical frameworks, TOE and country-specific factors, the study proposed a conceptual model and examined the impact that technological, organizational, environmental, and country-specific factors may have on adopting and deploying cloud computing technologies and services by SMEs working in the Lebanese market. Using quantitative analysis, and deploying logistic regression, most of the TOE and the country-specific factors were verified and supported. The analysis also led to an extension of the TOE-DOI factors by including context-specific factors pertinent to Lebanon, a country in the MENA region. The study has a significant contribution at the theoretical and practical levels.

At the theoretical level, this study offers a holistic model that not only combined Roger [56] DOI and Tornatzky and Fleischer [67] TOE frameworks, but also added macro-level variables that could be of significance to research pertinent to IT adoption in general, and cloud computing in particular, in SMEs operating in Lebanon. This combination of relevant theoretical perspectives is valuable if we are to understand how various environmental, technological, organizational as well as specific context-based factors affect the adoption of cloud-based by SMEs within different sectors in the Lebanese market. The main theoretical contribution is the introduction of context-based macro factors pertinent to the Lebanese market and other countries in the region with similar conditions and prevailing situations.

The study also has some practical implications. Managers and IT strategists in organizations should take into consideration the technological characteristics, especially the security and ease-of-use aspects, related to cloud computing. For example, a strategy to mitigate or deal with the security issues or risks of cloud computing would probably lead to increase the adoption of the cloud technology by SMEs in the Lebanese market. Care should be given to enhancing the know-how of users regarding this computing paradigm and its functionalities. Also, the technology-task fit should be considered to enhance compatibility and reduce errors and inefficiencies. Therefore, researchers should analyze the level of cloud readiness and potential implications of cloud adoption. In addition, policies should recognize the diversity of business models and services within the cloud, the diversity of customers of cloud services, and the complexity of the cloud economic system. Then an effective cloud strategy (addressing areas, such as infrastructure, legal and regulatory issues, the supply side of the cloud economy ecosystem, human resources, government cloud use and financial implications) should be designed for a successful implementation of cloud computing.

It is essential to determine the factors (such as data privacy and security, reliability of services etc.) which help Lebanese cloud service providers and technology policymakers develop solutions and strategies that meet the needs of Lebanese SMEs so as to empower and increase the rate of adoption. It is important to mention, thus, that if SMEs have access to scalable technologies, they could potentially deliver products and services that in the past only large enterprises could deliver, flattening the competitive arena.

The Lebanese market was selected because of the lack in empirical studies and research in this field as well as to help Lebanese SMEs in decision-making processes and subsequent use of this new technology to enable them to compete with large firms, to keep up with western technology, to rival foreign markets in order to develop, and to boost the Lebanese economy. The contribution of this research draws on the fact that there is an urgent need to identify the facilitators, obstructions, and other influential factors relevant to this problem.

Despite these positive contributions, the study also has certain limitations. First, the respondents were all IT managers. Examining the perceptions of other managers and prospect users in the organization could probably give more insights regarding how employees and managers in different departments view the cloud computing adoption and use. Nevertheless, the choice of IT managers was due to the need for respondents who have a good idea of what cloud computing technology and services are. Another limitation is the sample size. 139 surveys won't allow for certain methods, like SEM to be deployed. Finally, certain factors like employee training and behavioral aspects of users were not examined.

Future research is needed in order to test the proposed model and hypotheses in another context, in order to assess the dependability and cogency of the measures used to help organizations better understand the enablers and challenges facing cloud computing adoption in other developing or emerging economies. Future research is also recommended to upgrade the sample, both in size and in type of respondents. For example, gathering data from respondents other than IT managers and professionals can provide understanding of the perceptions related to the adoption of this technology from various perspectives and interests. Another recommendation is to expand the scope of work to cover further organizations in the Lebanese market in different sectors, both qualitatively and quantitatively. Having more participants per sector could allow for more reliable comparisons. Finally, additional factors, like employee training, corporate culture, and terms of agreement with the cloud service provider can provide better insights regarding what really influences the technology

adoption. Cloud computing is embracing almost everything we do. It is thus crucial to understand its aspects in detail, enhance its fit with the business strategy and processes, and promote the technical readiness of firms. It is clear that the next wave of digital transformation will fundamentally involve cloud computing. Getting well prepared and developing the required understanding of his technology will help a lot in its successful implementation and in reaping its benefits.

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