

# Trends towards IOT in Egypt: Cloud Computing System Implementation in Egypt – Challenges and Benefits

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**Abstract:** This research aims to investigate the benefits of implementing the cloud computing system over the currently used IT system, as well the challenges of applying Cloud computing that companies in Egypt could face. This research applies mixed methods of research. Both qualitative and quantitative methods of research are used in the form of semi-structured interviews and questionnaires, respectively. The semi-structured interview was targeting the supply chain and IT managers of three different companies at Coca Cola Egypt, Nestle Egypt and Carrefour Egypt. A SWOT analysis was conducted to serve as a guide to many companies in Egypt that are willing to implement such a system and can then avoid the weakness points and the threats that they could be faced with during the implementation. The importance of this research adds to the literature by focusing on the application of IOT in Egypt in terms of the implementation of a cloud computing system in Egypt and it analyzes whether it could increase the efficiency of the companies in Egypt.

**Keywords:** Cloud computing System; IOT; SWOT

## 1 INTRODUCTION

In the today's global supply chain, companies from different industries face many challenges such as increased selection, competition, uncertainty and information sharing. Many of these challenges can be seen as one of the primary performance setbacks of any company. Faced by ferocious competition and the ever-changing customer demands, organizations need systems capable of adapting and advancing their company through these tough waters.

One of the newest advances or systems to be used on supply chains is Cloud Computing, which supports many activities such as product innovation, strategic material sourcing, outsourced manufacturing, integrated logistics, omni-channel fulfillment, and integrated demand and supply planning. The main idea behind Cloud computing is to consolidate and manage computing resources in central locations, make them available to users anywhere and move maintenance and operational management burdens away from the enterprise to a third party. Nonetheless, despite the benefit of the SCM cloud, companies tend to fear losing their information or having their information leaked to their competitors, which can have a counter negative effect on their market status.

This paper researches the benefits and challenges of applying Cloud computing in companies in Egypt, using Carrefour Egypt, Coca Cola Egypt and Nestle Egypt as samples for data collection. A comparison between the current system used by the industries and the Cloud computing system will be discussed in order to find out the different factors and barriers stopping organization in Egypt from applying the Cloud computing application to manage their business processes and the supply chain process.

In this research, two companies from different sectors and a company whose U.S. inhabiting branch uses the Cloud computing technology to manage their supply chain activities are researched. The research took place two years ago. The three companies are Carrefour Egypt (a retail company),

Coca Cola Egypt - an FMCG whose US counterpart applies Cloud Computing, and Nestle Egypt (a FMCG). The research analysis focuses on applied semi-structured interviews with the IT manager and the Supply Chain or Operations Manager of each business. Moreover, fifteen questionnaires were handed out to employees in different departments, to further research the state of the currently applied IT systems, their problems and performance barriers based on usage experiences. The systems were compared to the Cloud computing system, whilst allowing the participants to analyze the system's pros and cons and leaving their professional opinions and suggestions regarding the application of Cloud computing.

## 2 BACKGROUND

### 2.1 Trends towards IOT in 2020

The Internet of things (IOT) is changing the industrial and consumer world. Smart Technology is now spreading to every business from healthcare and finance to logistics. Nowadays, any company will fail in achieving its strategic goals as long as it stops innovation. The year 2020 will focus on 4 IOT models; one of them is the Cloud computing system. By the end of 2020, IOT is expecting to increase revenues by 344 B\$ and reduce costs by 177 B\$. It is also expected that investments on IOT will hit 1.4 trillion dollars by 2021 [1]. IOT plays an important role in making production more efficient, less risky and more profitable through data integration and analyses by using one of the IOT technologies such as the cloud computing system [2].

### 2.2 Cloud Computing Service Models

Cloud computing growth has taken the attention of various communities such as researchers, students, business, consumer and government organizations. Big data is the main reason for the introduction of Cloud computing. Cloud computing can be defined as a model for enabling

convenient, on-demand network access to a shared pool of customizable computing resources, such as networks, servers, storage, applications and services, that can be rapidly edited and released with a minimal management effort or service provider interaction [3, 4]. In other words, a cloud can be considered a collection of hardware, software and other resources that can be accessed over the Internet, and used to assemble a solution on demand at the time of request in order to provide a set of services back to the requester.

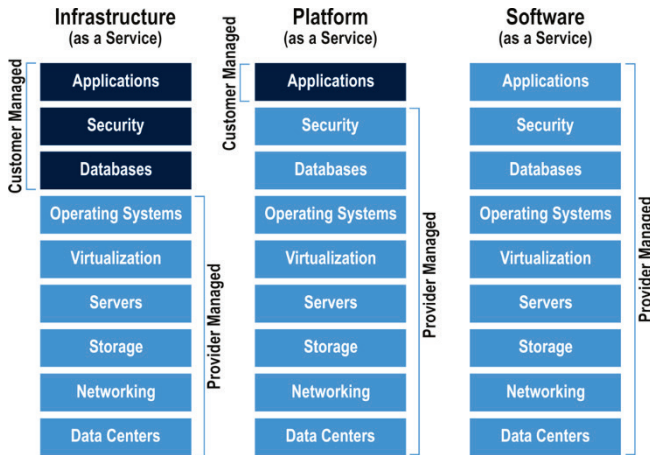


Figure 1 Cloud Computing Service Models [21]

Cloud computing presented a vital shift in the way businesses pay for and access IT services, as well as in creating new opportunities for IT services providers and outsourcing vendors who now have to modify their strategy to take advantage of this new computing exemplar [5]. Cloud computing is a new model of computing that is widely used in today's industry and society [6]. According to the cloud report 2020 [6], Cloud computing is one of the latest computer industry trends. The concept is derived from the idea of an Internet cloud, in which the term "cloud" is traditionally used to represent the Internet or some large networked environment. The idea presented is that client data and applications are stored and accessed somewhere out there [7]. In Cloud computing, resources are located in virtualized and distributed environments geographically interspersed [8]. One definition offered for Cloud computing is the virtualization of resources that maintains and manages itself [8]. Beal (2018) [9] also stated that Cloud computing can be described in an abundance of manners, such as the one that the phrase Cloud computing means a type of Internet-based computing', where different services – such as servers, storage and applications – are delivered to an organization's computers and devices through the Internet. To simplify, Cloud computing can be defined primarily as the use and sharing of applications and resources of a network environment to fulfill work without concern about ownership and management of the network's resources and applications. The cloud computing system consists of three main elements; Infrastructure as a service (IaaS), Platform as a Service (PaaS) and Software as a Service (SaaS). IaaS consists of virtual resources, servers, networks, storage and operating systems offered by the cloud provider. PaaS

consists of an operating system and software development kit to be deployed into the cloud infrastructure by using a programming language, library services and support tools provided by the providers. SaaS is an application installed by the provider to be easily accessed by consumer devices through web browsers or a program interface, which avoid wasting the time of installation, running, managing and controlling the application by the consumer as shown in Fig. 1 [20].

### 2.3 Impact of Cloud Computing on Supply Chain Management in Organizations

The biggest competitive contribution that an IT system can provide is the enabling of collaboration within an organization in itself and with its business partners and customers [10]. Organizations that have joined their systems have increased and improved both the collaboration and economic performance of each partner involved. The use of such suitable technology has helped firms differentiate from competitors by enhancing their relationships with suppliers and customers [11, 12]. Cloud computing as a new technology offers an opportunity to many firms to harness the tools, equipment, and expertise necessary to aid collaborative relationships. It offers a possible solution to some organizations to increase their capacity without huge investments [13]. As such, Cloud computing provides faster implementation times and lower upfront investments in the sense that organizations do not have to spend their resources acquiring infrastructure [14].

Multiple business processes can be managed across businesses by using cloud technology. A growing number of third party logistics providers, or 3PLs, are turning to the Cloud computing technology to successfully support customers, enabling them to see further along both sides of the supply chain [15]. Collaborative relationships are allowing shippers to improve decision making and the costs are spread across users. Cloud computing also offers an opportunity that will enable small organizations to share the same services as larger companies, including the benefits from the ability to transparently interact and manage processes outside the organization, which reduces the cost of ownership for a supply chain collaboration.

### 2.4 Cloud Computing Pros and Cons

The cloud computing technology has now become a vital part of any business. It has a many advantages, but it also has disadvantages which result from its implementation that can be explained as follows.

#### 2.4.1 Cloud Computing Pros

The biggest advantage of Cloud computing for a company is cost reduction, which is achieved by eliminating the investments of software or servers, saving the licensing fees and eliminating overhead charges such as the cost of data storage and software updates. Moreover, Cloud computing helps in reducing the cost of ownership through the sharing

of infrastructure, as it depends on service providers for various low-level management and service levels of their multi-tenant applications, platforms, and infrastructures [16]. Cloud computing also allows for an easy access to data and information, which increases the end users' satisfaction to access their need anytime from anywhere with no cost. Cloud providers have a vital role in backing up data, which could under any circumstances be lost due to technical errors. Finally, Cloud computing is environmentally friendly, because when servers are not used, the infrastructure scales down, thus clearing up resources and consuming less power, i.e. only the resources that are truly needed are consumed by the system [17].

## 2.4.2 Cloud Computing Cons

Data security is considered as the biggest concern of potential cloud users. This is because the company is forced to provide the consultant with private, sensitive data and information. The cloud service provider has to manage, protect and retain the confidential information; therefore, end users are afraid to give their information to a third party. Another challenge is that the company could lose its expertise, as it would be obliged to outsource the system from another company. Companies using Cloud computing need a reliable Internet service. As the majority of the critical work done by Cloud computing is done on the Internet, if the Internet connection's speed is not reliable, Cloud computing is not a suitable solution for the company. Finally, data transfer bottlenecks are also a drawback of Cloud computing when applications become data-intensive, which will complicate data placement and transport, and as a result, cloud users and cloud providers have to think about the placement at every level of the system if they want to minimize costs [16, 17].

## 2.5 Cloud Computing Status in Egypt and Its Benefits to SMEs in Egypt

According to the Global Connectivity Index (GCI 2019), Egypt ranked as 58<sup>th</sup> over 79 countries. Investments on fixed line broadband and mobile broadband increased in 2019, which led to an increase in the demand for downloaded applications and cloud migration. Egypt uses its competitive advantage in its geographical location connecting to numerous cables that interconnect different parts of Europe with the Middle East and Asia. This helped Egypt to rank a high score in terms of Internet downloads speeds, Cloud computing and Internet usage. Egypt also has a good infrastructure in its data center and it has been well prepared since 2019 to grow its Cloud computing industry. Accordingly, it was ascertained the Egypt is classified among the starters that have a growth of GDP, and it finds itself in the fast lane to reach digital and sustainable growth. Consequently, GCI recommends that Egypt should focus on setting up more connectivity with a wider coverage and faster speed. Concerning the four technology enablers, Egypt is ranked below the average in terms of a cloud system as it ranked as 45<sup>th</sup> compared with the average calculated as 51.

This indicates that Egypt is still at the beginning in the IOT and Cloud computing usage [18].

SMEs are defined as enterprises with an established volume of business of less than a hundred million Egyptian pounds, with categories going down to less than one million Egyptian pounds - medium, small, very small and micro finance. Micro, small and medium enterprises (MSME) are considered to be the backbone of domestic and international business. Based on recent research, in Egypt, MSMEs contribute with about 99% of the private organizations. [18] Generally, SMEs are amongst the most vital elements of any economy. With a focus on the Egyptian economy, SMEs account for nearly seventy to eighty percent of the Gross Domestic Product, i.e. GDP. They employ nearly sixty-six percent of the total workforce and seventy-five percent of non-agricultural work force. They contribute to nearly fifty-nine percent (thirteen for small enterprises and forty-six for medium ones) of the total industrial production. As a result, the SMEs contribution to the economy is quite significant. The last official report done in 2016 by the Central Agency for Public Mobilization and Statistics, or CAPMAS, in regards to SMEs, stated that they reached 2.45 million enterprises, accounting for more than ninety percent of total private enterprises in Egypt. In 2015, it was estimated that the number of SMEs reached nearly 2.78 million, where the annual increase in SMEs was nearly thirty-seven thousand [18]. Cloud computing promises to deliver many business benefits to SMEs, mainly in the form of much lower costs, as they would only need to pay for the resources they need and at a much better ROI of their limited resources. As a result, these enterprises get to focus on their core competencies, and as such, they deliver better value to their customers and they gain competitive advantage [18].

## 3 RESEARCH PROBLEM

To investigate the current status of implementing the Cloud computing system in Egypt, the paper identifies the benefits and challenges that the companies in Egypt face.

## 4 RESEARCH METHODOLOGY

The data collection process consists of two main phases; semi-structured interviews were conducted first to help the researcher formulate the questionnaire, which was conducted as the second phase, in addition to the literature review. Questionnaires were conducted with fifteen employees from different departments, and face-to-face semi-structured interviews were conducted with the Supply Chain or Operations managers and IT managers. The questionnaire consists of eleven questions divided into two main sections, starting with the questions collecting demographics – the department and corporate title – and are then followed by Rating Scale questions, Yes/No questions and open-ended questions collecting input on how each individual would rate the current system in terms of functionality, such as whether it supports business' processes well enough, and in terms of compatibility, such as the ease of access and transparency; there were also questions to test individuals' familiarity with Cloud computing, the system's benefits and challenges and their openness to using it. Semi-structured interviews were

held with six current managers and operators from both the supply chain and IT department at Carrefour Egypt, Coca Cola Egypt and Nestle Egypt. We have chosen them according to their positions that carry a lot of expertise and knowledge about their managerial and operational factors that are applied in both departments, all in order to help us understand the major barriers that affect Cloud computing.

**5 DATA ANALYSIS**

Data was collected in the form of semi-structured interviews conducted with the IT Managers and Supply Chain Managers of each of the three companies followed by questionnaires issued to 15 employees of different departments within the three companies. It was noted that the awareness of the Cloud computing system is in general low, and that many of the respondents were not familiar with the system due to the lack of awareness on becoming better acquainted with technology. Furthermore, in terms of benefits, Cloud computing’s benefits were all rated very highly and during interviews, the most highly rated benefit was that of cost reduction. On the other hand, in both the semi-structured interview and questionnaire answers, the biggest challenge seemed to be data security, as it is hosted on a server with other companies. Most managers also noted that the need for an efficient Internet service was also of concern due to the general nature of Internet services in Egypt, which is not very good. In terms of resolving challenges, most managers focused on the means of resolving the security issue by applying some form of authorization means to disallow unauthorized individuals and service provider personnel from accessing sensitive firm data. The respondents in questionnaires also applied a similar idea regarding that data security issue. Finally, although data security was considered as a very sensitive challenge, most managers and respondents seemed to support changing the current IT system into a Cloud based system, which supports the assumption that the system’s benefits outweigh the risks. Regarding the Respondent Familiarity with the Cloud computing System, the results showed that most respondents were not in fact familiar with the system of the Cloud computing technology and its application on supply chain management.

Concerning the ratings of the benefits of the Cloud computing system, this question helped achieve the second objective, which is to establish an idea about the benefits and drawbacks of Cloud computing in the mind of a related professional. The question was showed in the survey as follows:

**Rate the following benefits of the Cloud computing system from 1 to 5, with 1 being lowest and 5 the highest.**

Cost reduction (no capital cost but only an operational, pay-per-use, cost)
No large capacity computers needed as software is run by the service provider
Ability to use anywhere, at any time
Easy start-up with minimal delay, as transferring to the cloud is a simple, quick process
Tailored to the firm’s needs
Elasticity in decreasing or increasing processing and work-load demands
Power saving and environmentally friendly (is only powered when needed for use and does not require full time operation)

The results of the survey showed that the benefits rated as follows:

- **Cost reduction (no capital cost but only operational, pay-per-use cost)**

The results suggest that 71% of the respondents would view this benefit as very high, meaning that it is a huge benefit of Cloud computing, which supports speculations regarding the high costs that arise with applying a desktop ERP system.

- **No large capacity computers needed as software is run by the service provider**

The results suggest that 53% of the respondents would view this benefit as one that deserves a very high rating.

- **Ability to use anywhere, at any time**

71.1% of the respondents showed this benefit to be of very high importance.

- **Easy start-up with minimal delay, as transferring to the cloud is a simple, quick process**

The results show that most respondents rated this advantage as very high, suggesting that most of them view it as a benefit of a very high value.

- **Tailored to the firm’s needs**

The results suggest that most respondents viewed this benefit to have a very high rating.

- **Elasticity in decreasing or increasing procession and work-load demands**

This suggests that most respondents with 80% rated this criterion to be of very high importance. Cloud computing also has faster time to market launch on demand, elastic IT services which enable the applications and infrastructure to be in one place, thus leading to facilitation in traditional IT services.

- **Power saving and environmentally friendly (is only powered when needed for use and does not require full time operation)**

The results show that 73% of the respondents rated this benefit with a very high value supporting the strength of the benefits provided by the Cloud computing system and matching with what was discussed earlier in the cloud benefits. Thus, the benefits found can be summarized as follows:

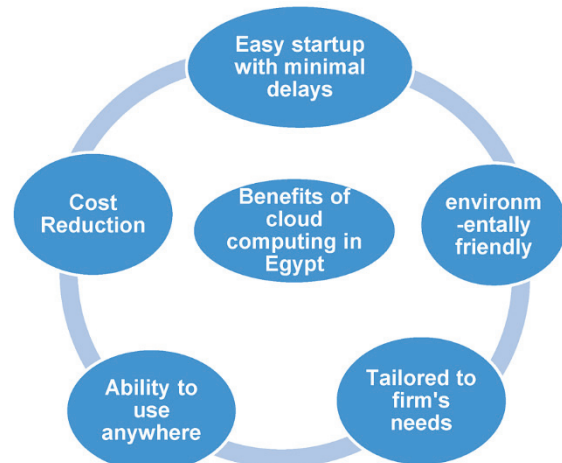


Figure 2 Cloud Computing Benefits in Egypt by the author

Considering the evaluation of the drawbacks or challenges facing the companies in Egypt towards implementing the Cloud computing system, the question was showed in the survey as follows by using the Likert scale:

**Rate the following drawbacks of the Cloud computing system from 1 to 5, with 1 being the lowest and 5 the highest.**

	Data can be accessed by the service provider
	Multiple users are hosted on the same computer by the service provider
	The need to outsource computer services
	The need for an efficient Internet service
	Data bottlenecks must be considered and resolved to avoid cost buildups

The survey showed the following results:

**Rating drawbacks of the Cloud computing system**

This question helped achieve the objective two of understanding the views of professionals on the benefits and drawbacks of the system.

**- Data can be accessed by the service provider**

The results show that almost all respondents, with an exception of 1, (97.8%) would view the value of this drawback, which is the accessibility of data through the service provider, as very high, which provided support to the literature stating that data security is a significant drawback of Cloud computing systems.

**- Multiple users are hosted on the same computer by the service provider**

77.8% of the respondents rated this drawback as having a very high value, supporting the idea that one of Cloud computing’s most prominent drawbacks is data confidentiality in terms of the level of access that can allow installation of data to unauthorized users.

**- The need to outsource computer services**

33.3% of the respondents were on moderate, followed by low, which is only 1 respondent less than moderate, thus the majority of them suggesting this challenge as moderate or low in risk. This supports the assumption that the majority of Cloud computing’s drawbacks are not very risky. However, it is still a challenge because they could lose their existing experts by being obliged to outsource the system to another company.

**- Need for an efficient Internet service**

The results show that the highest number of respondents (48.9%) rated this challenge to be of a very high risk. This result puts weight on the assumption that due to the Internet service quality being low in Egypt, applying Cloud computing may be risky and hard for companies in Egypt, which contradicts with what was found in the literature review that described this challenge as less risky and the application depending on the Internet speed, which is a common problem in Egypt.

**- Data bottlenecks must be considered and resolved to avoid cost buildups**

The results show that most respondents (57.8%) rated the issue of data bottlenecks to be of high importance. The data transfer bottlenecks are also a challenge when applications become data-intensive. If applications could be pulled across the boundaries of clouds, this would complicate data

placement and transport, and as a result, cloud users and cloud providers would have to think about the placement at every level of the system if they wanted to minimize costs.

The results received from this question were the following: 3 very high rating averages, 1 high and 1 moderate, suggesting that the drawbacks of Cloud computing carry a relatively high risk to the respondents, especially in terms of data security, as supported by literature. The answers from this question acted as a means to address the problem statement regarding the risks and barriers preventing companies in Egypt from applying Cloud computing in the Supply Chain management. Thus, all Cloud computing challenges found under the study in Egypt could be summarized as follows:

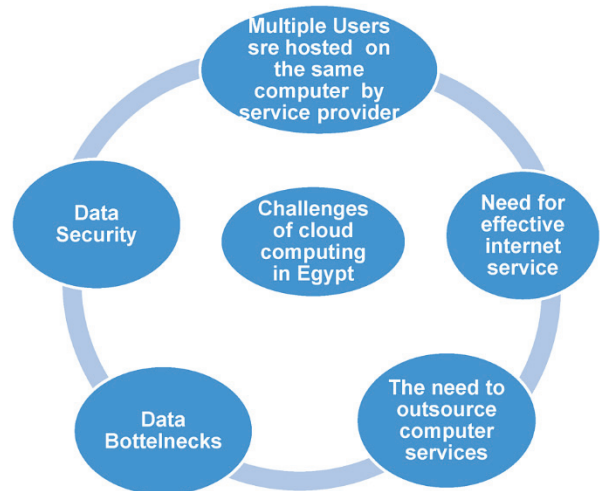


Figure 3 Challenges of Cloud computing in Egypt by the author

Regarding the respondents’ personal opinions on the Cloud computing system’s drawbacks minimization:

Only four respondents gave an answer to these questions, while the rest did not have a suggestion to give other than that data security was a vital issue to be addressed. The four respondents were:

- the IT supervisor in Carrefour who said that password protection that does not allow any unauthorized access to sensitive data and requires permission for access could be added,
- the ERP Application Consultant in Coca Cola who said that the service provider could create a means for an IT employee within the firm to be the one systemizing the access and activities on the system so that the service provider would not need to access the firm’s data, thus maximizing security and decreasing the need to outsource services,
- the IT specialist in Coca Cola who said that a passcode could be installed on sensitive data,
- the IT specialist in Nestle who said that data security could be increased if the service provider could create walls to protect the users on the system from accessing the information of other users on the same server.

Regarding the respondents’ support on the application of the Cloud computing system, it was found that most participants were in accordance with the transition to Cloud computing.

These results provided a backing for the idea that the Cloud computing benefits outweigh the risks, and that the Cloud computing system is considered to be better than the currently used IT systems. This result provides an answer to the first question of this research about whether the Cloud Computing system is better than the currently used IT system as the respondents’ support to changing to the Cloud Computing system shows that it must be better in some aspects than the existing IT system. Furthermore, this also provides an answer to the research question of whether the system’s benefits outweigh its drawbacks as the results state that although the system has several significant challenges, the respondents are still supportive of applying the Cloud Computing system.

Accordingly, a SWOT analysis was conducted based on the above-mentioned data, collaborated with what was found in the literature review, GCI and with the results of the respondents. It was found that the implantation of Cloud computing in companies in Egypt will help in the reduction of costs, improvement of the customer service and easy access from anywhere, i.e. without restriction to the workplace. Hence, this will open a new market to the companies and increase their competitive advantage in addition to the green trends provided, and there will also be less paperwork. However, some problems may arise in terms of a lack of awareness from the customer side, and security problem. Some threats could be faced in terms of the severe competition in the local and international market, see Tab. 1.

**Table 1** SWOT analysis of switching to cloud in Egypt

<p><b>Strengths:</b></p> <ul style="list-style-type: none"> <li>• Reducing costs</li> <li>• Delivering better value to customers</li> <li>• Ability to use anywhere, at any time</li> </ul>	<p><b>Weaknesses:</b></p> <ul style="list-style-type: none"> <li>• Lower awareness of the Cloud computing system</li> <li>• Data security followed by being hosted on a server with other companies</li> <li>• Inefficient Internet services in Egypt</li> <li>• Data can be accessed by the service provider</li> </ul>
<p><b>Opportunities:</b></p> <ul style="list-style-type: none"> <li>• Green IT</li> <li>• New markets</li> <li>• Competitive advantage</li> </ul>	<p><b>Threats:</b></p> <ul style="list-style-type: none"> <li>• Severe competition</li> <li>• Security and frauds</li> </ul>

Source: Author

## 6 CONCLUSION

While analyzing the questionnaires and the answers gained from the semi-structured interviews, it was noted that the currently used IT systems are all desktop ERP systems, supporting the information from the researched literature. Moreover, it was also noted within the questionnaires that the lowest rated criteria of the currently used IT system is cost friendliness, which is in contrast with Cloud computing that offers cost friendliness as a benefit. Furthermore, it was discovered that for the larger part, the Cloud computing system is not a familiar concept within businesses around

Egypt, particularly anyone outside the IT department. Following that, it was prominent that the majority of the respondents of the questionnaire supported the idea that Cloud computing has major benefits that are mostly rated as having a high or a very high importance. On the same note, the highest ranked benefit of Cloud computing with most interviewees was once again cost friendliness, in contrast with the currently used IT or ERP systems. On the other hand, the biggest challenges of the system from the perspective of the respondents and managers were that the service provider has access to the data, several hosts being on one computer and the reliance on an inefficient Internet service. Those challenges are seen as the vital deficiencies with which the majority of the companies are faced. Additionally, it was found that the need for an efficient Internet service in Egypt is also seen as big challenge. However, nowadays, Egypt is going forward to improve its main communication and connection infrastructure as it has been mentioned before. Another major challenge, which could hinder the use of the Cloud computing system in companies in Egypt, is the data bottlenecks, while the lowest ranked drawback was the need to outsource IT services, which was not a challenging risk from the respondents’ point of view. Last but not least, it was discovered that due to the discovered benefits, most respondents and managers said that they would support changing the current IT system into a Cloud computing system, supporting the theory that the Cloud computing’s benefits outweigh its risks, and that it is better than the currently used IT systems.

Based on the analyzed and interpreted data, we have several recommendations regarding the application of the Cloud computing system in companies in Egypt:

- The awareness of new technology in Egypt is very low and this issue must be addressed as advancements in technology help companies achieve their maximum potential in the market, and that is vital to a firm’s performance.
- Before applying Cloud computing in Egypt, further means to protect data security must be developed and researched by the service providers and developers. Moreover, protection against data loss during Internet cuts must be installed in order to ensure that the system fits the Egyptian business environment in the most optimal manner, keeping in mind the setbacks that might occur in the environment.

## Notice

The paper will be presented at MOTSP 2020 – International Conference Management of Technology – Step to Sustainable Production, which will take place from 30<sup>th</sup> September – 2<sup>nd</sup> October 2020 in Bol, island Brač (Croatia). The paper will not be published anywhere else.

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