An Analysis of Cloud Computing Adoption Framework for Iraqi e-Government

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Abstract—**This paper presents an analysis of the factors which could have possible affect over the adoption of cloud computing via the Iraqi e-government. A conceptual framework model for cloud computing within Iraqi e-government is proposed, analyzed, evaluated and discussed.**

Keywords—e-Government; cloud computing; framework; Iraq; Iraqi e-government

I. INTRODUCTION

The government of Iraq realizes the significance of the e-government concept and the role of e-government to serve the Iraqi citizens and   started the e-government project in 2004 after signing a memorandum between the Iraqi Ministry of Science and Technology (IMST) and the Italian government [1].

Unfortunately, like many growing countries, Iraqi's e-government system still has a lot of obstacles, problems, challenges and difficulties which affect its development [2], [3].

Poor management of resources, infrastructure problems, lack in IT specialists who are required for developing and maintaining the Iraqi e-government system beside the problem of growing amount of data are some examples of obstacles which the Iraqi e-government project is actually facing [2]-[6].

Cloud computing, as a new technology has changed the way that organizations think about and use ICT from many perspectives. Within this subject, e-governments around the world are really looking into cloud computing as a solution for many problems like increasing efficiency, reducing cost, providing more reliable and efficient services, and reducing cycle time [7].

This paper presents a review of the factors which could have possible affect over the adoption of cloud computing via the Iraqi e-government in a new point of view to overcome its obstacles which already exist. A conceptual framework of cloud computing adoption for Iraqi e-government is proposed and evaluated by IT specialists in IMST who are actually in charge of this project in Iraq.

II. E-GOVERNMENT

A. E-Governmnet Systems

E-government systems have rapidly been implemented by developed as well as developing countries in different ways. Still, these implementation programs have varied widely in their scope, effectiveness, levels and benefits which they provide [8].

Shareef et al. defined e-government as a way for governments to use the most innovative information and communication technologies, especially web-based internet applications to provide their citizens and businesses with more suitable access to government information and services [9]. While the Organization for Economic Co-operation and Development (OECD) uses the term "e-government" to the internet usage in making government's services and/or information available for its citizens[10].

Most developing countries have experienced problems in implementing e-government systems, and most have remained at the early stages of their implementation [11]. Krishnan and Teo give a percentage for e-government systems' implementation in developing countries as a 35% for complete failure, 50% for partly failure and they consider that only 15% of such systems were considered to be successful [12].

Al-Khouri stated that the majority of e-government in Arab countries have failed and are stuck in the access phase of Forrester's maturity model, while the other evolved Arab countries in e-government are still in the early steps of the interaction phase [13]. Forrester's maturity model portrays three phases to evaluate e-government transformation era namely access, interaction, and integration.

B. Benefits of E-Governmnets

The adoption and use of the e-government strategy can provide significant benefits for government in delivering a more effective and efficient information and services to all e-government sectors. It enables government agencies to align their efforts as needed to improve service and reduce operating costs [14].

Some of possible benefits of e-government implementation could be summarized in Table I.

Cost effectiveness is at the top of benefits which could be gained from a successful e-government system. Financial benefits are gained through cost reduction in reducing government transaction operations, reducing citizens' wasted time and efforts. Government's agencies will perform enhanced service quality for citizens and business and minimizing corruption and get the benefit of sharing information between them. This will built a better trust between government and its citizens.

TABLE I.   POSSIBLE BENEFITS OF E-GOVERNMENT IMPLEMENTATION

Benefits	Authors
Financial	[15], [17], [18]
Social	[15], 17, [18], [19]
Government agencies	[15], [16], [19], [20]
Economy	[17]
Time Reduction	[18], [19], [20]
Achieve government's objectives	[15], [16], [19]
Sharing information	[16]
Built trust between government & citizens	[16]
Improve efficiency	[16], [19], [20]

C. Barriers of E-Government Implementation

Implementing any e-system could also have its own barriers and challenges. The implementation, development and management of an e-government system could have possible barriers and challenges which could be classified to major barriers. Each of these barriers has its own sub-barriers and all of them must be taken into great attention. Technical barriers are considered the most challengeable ones when implementing a new e-government system, they affect over the development and implementation of an effective e-government system, especially in a developing country like Iraq. Within this category we can count the readiness of ICT infrastructure, privacy and security as the most challengeable barriers which most literature reviews agreed on.

Other main category is the organizational category counted the top management support and the existence of qualified people to develop, manage, supervise and maintain the e-government system as sub-category's barriers do affect the implementation of e-government system, especially in developing and Arab countries like Iraq.

Table II shows a summary of possible barriers and challenges of E-Government implementation.

TABLE II.   POSSIBLE BARRIERS OF E-GOVERNMENT IMPLEMENTATION

Categories	E-government Barriers	Authors
Technical	The Creation of ICT Infrastructure	[20], [21]
	Privacy	[22], [23]
	Security	[14], [24], [22], [20], [25], [26]
Organization	Top management support	[2], [27], [19], [29]
	Lack of Qualified Personnel and Training	[28], [29], [30]
	Lack of Collaboration	[28], [31], [32]
	Resistance to change to electronic ways	[28], [30]
Social	Digital Divide	[19], [33]
	Culture	[19], [34]
Financial Barriers	Cost	[35], [36]
Regulation and Policy Issues	Laws and legal subjects	[37]

III. CLOUD COMPUTING BENEFITS AND CHALLENGES FOR E-GOVERNMENT

The most official and countable definition about cloud computing was introduced by the National Institute of Standard and Technology (NIST), which defined it as

"*Cloud computing is a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service-provider interaction*" [38].

For an effective e-government system deployment, some necessary facilities and characteristics are vital to be available; such as easy maintenance, reliability, mobile access, and more available data storage. Beside that for most of developing countries, the cost of construction an e-government system is considered a major difficulty against establishment.

Cloud computing can offer great benefits for e-government systems and solve problems of high cost establishment, ease of use, more data storage, mobile access, scalability and automatic backup and recovery [39]-[43].

For that, researchers, IT specialists and other involved stakeholders evolved many researches and studies concerning the adoption of cloud computing via e-government systems.

Today, many governments in the world are already using cloud services or adopting some kind of cloud computing solutions within their e-governments' systems. Other governments are investigating and studying the possible affecting factors about adopting cloud computing within their e-governments' systems through strategic migration plans to assist their required daily functions and improve the service delivery level for their citizens [44].

Accordingly, the affecting factors about this adoption should be clearly discovered, discussed and understood before taking the adoption decision. A strategic mechanism should be held and a migration strategy into the new cloud computing adoption technology must be completely investigated in order to welcome a good decision making when steeping towards cloud computing adoption in an e-government system.

Possible benefits and positive influences in adopting cloud computing via an e-government system is shown in Table III.

TABLE III.   BENEFITS IN ADOPTING CLOUD COMPUTING VIA E-GOVERNMENT SYSTEM

Benefits	Authors
Easy to use & easy Implementation	[46], [47], [48], [49], [42], [53]
Scalability	[45], [46], [47], [48], [51], [42], [53]
Cost Reduction & Saving	[45], [46], [47], [48], [49], [42], [53]
Backup and Recovery	[45], [47]
Reduce local Data storage	[45], [51], [54], [50]
Availability & Accessibility	[45], [46], [47], [48], [42], [53]
Green computing	[45], [46], [47], [49], [52]

TABLE IV.   POSSIBLE CHALLENGES IN ADOPTING CLOUD COMPUTING VIA E-GOVERNMENT SYSTEM

Challenges and Barriers	Authors
Security	[45], [48], [42], [54]
privacy	[45], [48], [42], [54]
Internet dependency	[55], [64]
Open standards and interoperability	[45], [42]
Law and National and International Regulatory	[54]
Business Reliable issues	[48], [42], [50], [54]
Identity and access management	[45]

Although the attention of most countries in adopting cloud computing within e-government systems is significantly rising, still there are some countries which have a little knowledge and leadership's concerns regarding this adoption [55].

Most of governments' concerns come from the fact that they are uploading their confidential information to their e-government systems and by adopting cloud computing within e-government system, the process of this information could be somewhere else outside the country beside the possibility of having a third party access to information.

This leads us to specify that security and privacy are the most important challenges which any government concern about when they are willing to adopt or use cloud within their e-government systems [56], [57].

Internet dependence and regularity issues are other concerning matters which should be encountered before choosing the appropriate cloud service provider(s), cloud service model(s) and cloud service deployment model(s).

Possible challenges in adopting cloud computing via e-government system in Table IV.

IV. ADOPTION MODELS FOR CLOUD COMPUTING IN E-GOVERNMENT SYSTEMS

To predict the adoption of new technology, like cloud computing, many well-known theories in information system (IS) field could be suggested and/or applied. Choosing suitable technologies and methods are compulsory for a good adoption practice to gain its valuable results.

Iraqi e-governments, as mentioned before, has some limitations, obstacles, challenges and some problems regarding its development and implementation process, which obviously have affected negatively on its completeness [3], [5] and [2]. For that, adopting cloud computing in the Iraqi e-government system requires a comprehensive analysis regarding the factors that could influence such adoption.

Pointing out such factors, will eventually leads to propose a realistic valuable framework that could be used to assists Iraqi government to step over problems and difficulties which the e-government system in Iraq is suffering from. Within this perspective, there are two adoption models are discussed in this paper and considered to be used for the proposition of Iraqi cloud computing e-government adoption framework.

TABLE V.   SUGGESTED ADOPTION MODELS FOR CLOUD COMPUTING IN E-GOVERNMENT SYSTEM

Adoption Model of Cloud Computing in E-Government	Author
TOE framework +People	[44]
TAM+ (TRA)	[60]
TOE framework	[61]
TOE model + conceptual model of Cloud Computing adoption	[62]
TOE framework	[63]
Technological & Organizational factors	[64]
TAM	[65]

First, we discuss the Technology, Organization, and Environment (TOE) Framework, which is a theoretical framework that was developed by Tornatzky and Fleischer in 1990 and still widely used by IS researchers till now[58]. Within this framework, the components of an organization which is studying the adoption of new technology are classified into three major classifications; namely: Technological, Organizational and Environmental elements and the second model to be discussed here is the Technology Acceptance Model (TAM), which is mainly used to examine the user's interaction with the new innovation from two major points. The perceived usefulness (PU) which points to the degree of user's trust towards the new system and perceived ease of use (PEOU) which is the degree to which the user believes that using a particular system would be free of effort [59]. Table V shows a summary of suggested models in adopting cloud computing within e-government.

V. FACTORS AFFECTING THE ADOPTION OF CLOUD COMPUTING VIA E-GOVERNMENT

Scientific analysis with reliable bases should be implemented in order to drive a conceptual framework for the adoption of new technology. This matter is a big matter of importance, especially when the adoption decision could affect and affected by a system which is employed and operated by a government and used by all citizens. In addition, the local, region, religion, culture and legal characteristics and issues beside the uniqueness of each country should be considered and investigated.

Because of all the mentioned points, studying factors which may have affects over the adoption of a new technology from different perspectives, as researchers went through should be considered and taken care for.

Factors have their own positive or negative impact over the adoption of any new technology. The adoption of cloud computing via e-government is not an exception of this.

Possible affecting factors which could affect the adoption of cloud computing via e-government, from literature is summarized in Table VI.

TABLE VI.   FACTORS AFFECTING THE ADOPTION OF CLOUD COMPUTING VIA E-GOVERNMENT

Affecting Factors		Authors
Technological context	Cost saving (+)	[66], [67], [70], [71], [73], [74], [75], [76], [46], [45], [77], [78], [69], [79], [47], [49], [80], [81], [68], [82], [64], [72], [83], [87]
	Scalability (+)	[66], [70], [71], [73], [75], [76], [46], [42], [74], [62], [79], [47], [80], [81], [61], [63], [82], [64], [72], [87]
	flexibility (+)	[67], [49], [50], [73], [74], [75], [62], [79], [80], [81], [44], [61], [63], [82], [64], [72], [83], [87]
	Compatibility(+)	[75], [78], [79], [81], [81], [61], [64], [72]
	Complexity(-)	[75], [78], [79], [80], [81], [61], [64], [72], [86]
	Security & privacy(-)	[66], [67], [70], [71], [73], [74], [75], [76], [42], [77], [78], [62], [44], [82], [63], [64], [86], [87]
	Resource Utilization (+)	[66], [67], [70], [73], [45], [77], [44], [70], [82]
Environmental Context	Reliable(+)	[67], [73], [74], [69], [80] ,[81], [61], [83], [86]
	Available (+)	[67], [73], [62], [79], [80], [81], [68], [83], [86]
	Ownership (-)	[67], [73], [74], [79], [81], [63]
	Mobile Access(+)	[66], [67], [71], [73], [76], [45], [62], [79], [46], [82]
	Migration(-)	[70], [71], [73]
	Internet Connection	[70], [82]
Organizational Context	Top Management (+)	[75], [78], [79], [80], [81], [44], [61], [70], [64], [72]
	IT infrastructure(+)	[75], [42], [80], [81], [61], [63], [64], [72]
	IT Human Resources(+)	[75], [70], [81], [44], [61], [63], [82]
Easy of Use (+)		[67], [70], [73], [74], [46], [42], [47], [49], [82], [83]
Regulation Issues		[62], [70], [83]

VI.   FACTORS AFFECTING CLOUD COMPUTING ADOPTION VIA IRAQI E-GOVERNMENT

According to Table VI, there are 19 affecting factors which most researchers agreed on and they are divided into 5 major categories: namely, technological context, environmental context, organizational context, ease of use and regulation issues.
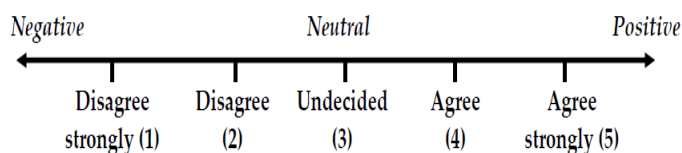

Fig. 1.   Straightforward Notion for Likert [84].

However, these factors should be tested and evaluated by Iraqi IT specialists who are responsible of the e-government system within IMST to see if they are appropriate for Iraq or not. For that a questioner was conducted to evaluate these factors by above mentioned employees besides semi structured interviews to reach common understandings and solutions.

The sample included 25 participants, 15 participants were male and 10 of them female who have different job titles; namely: programmers, IT engineers, managers and experts, all of them working within the Iraqi e-government project in IMST / Information Technology section. They work as technicians, technical administrations, information engineers, programmers, managers and experts and varied in age between 20-60 years old.

Likert scale, which is one of the most important and frequently used tools by researchers in sciences was used to test whether the factors that affect the adoption of cloud computing within the Iraqi e-government have positive or negative impact over the adoption [85].

Likert suggested that a successful attitude measurement is to carry out the fundamentals measurements to review the respondents' options which best reflect their position on the

measurement. Fig. 1 shows the Likart's measurements' notation [84].

For this paper's requirements, the respondents were asked to disclose the factors that could influence the adoption of cloud computing within e-government in Iraq. A 5-point Likert scale was used for questioner , where 1 point is accorded to strongly disagree, 2 points for disagree, 3 points for neutral (neither agree nor disagree), 4 points for agree and 5 points is a scale of strongly agree.

Table VII shows the main and sub categories with a suitable question statement representing the possible affecting factors which could have impact over the adoption of cloud computing via Iraqi e-government. This was the sample which

was delivered for IMST employers who were the participants in this survey accompanied by Likert 5-point scale to select the suitable selection by them.

The results from this part of questioner were analyzed according to Likert's scale and the mean as well as the standard deviation (S.D) were calculated to validate suggested factors. These results which are illustrated in Table VIII shows clearly that most of suggested factors (all except the migration factor) have an excepted mean value (>3.0) which means they are acceptable by the IT experts and employees who are actually working in the Iraqi e-government project at IMST.

S.D also pointed out a non-acceptable value (< 0.7) for migration factor.

TABLE VII.   SAMPLE OF QUESTIONER FORM

Technological Context	
Statement	
1	Is adopting cloud computing in Iraqi E-government system has a cost saving advantage impact factor over the system?
2	Is adopting cloud computing in Iraqi E-government system has a flexibility advantage impact factor over the system?
3	Is adopting cloud computing in Iraqi E-government system has a scalability advantages impact factor over the system?
4	Is adopting cloud computing in Iraqi E-government system has a compatibility advantages impact factor over the system?
5	Is adopting cloud computing in Iraqi E-government system has a complexity disadvantage impact factor over the system?
6	Is adopting cloud computing in Iraqi E-government system has a security disadvantage impact factor over the system?
7	Is adopting cloud computing in Iraqi E-government system has a privacy disadvantage impact factor over the system?
8	Is adopting cloud computing in Iraqi E-government system has a resource utilization advantage impact factor over the system?
Organizational Context	
Statement	
9	Is the top Management Support has a positive impact over the adoption of cloud computing within Iraqi E-government?
10	Is adopting cloud computing in Iraqi E-government system has a positive impact over the IT infrastructure?
11	Is adopting cloud computing in Iraqi E-government system has a positive impact over the IT Human Resources?
Environmental Context	
Statement	
12	Is adopting cloud computing in Iraqi E-government system has a Reliability advantage impact over the system?
13	Is adopting cloud computing in Iraqi E-government system has the availability advantage impact over the system?
14	Is adopting cloud computing in Iraqi E-government system has an Ownership disadvantage impact over the system?
15	Is adopting cloud computing in Iraqi E-government system has a Mobile Access advantage impact over the system?.
16	Is adopting cloud computing in Iraqi E-government system has a Migration disadvantage impact over the system?
17	Is adopting cloud computing in Iraqi E-government system can have the Internet Connection advantage impact over the system?
Ease of Use	
Statement	
18	Is adopting cloud computing in Iraqi E-government system has an Easy of Use advantage impact over the system?
Legal Issues	
Statement	
19	Is adopting cloud computing in Iraqi E-government system has a Legal Issue disadvantage impact over the system?

TABLE VIII.   QUESTIONER RESULTS

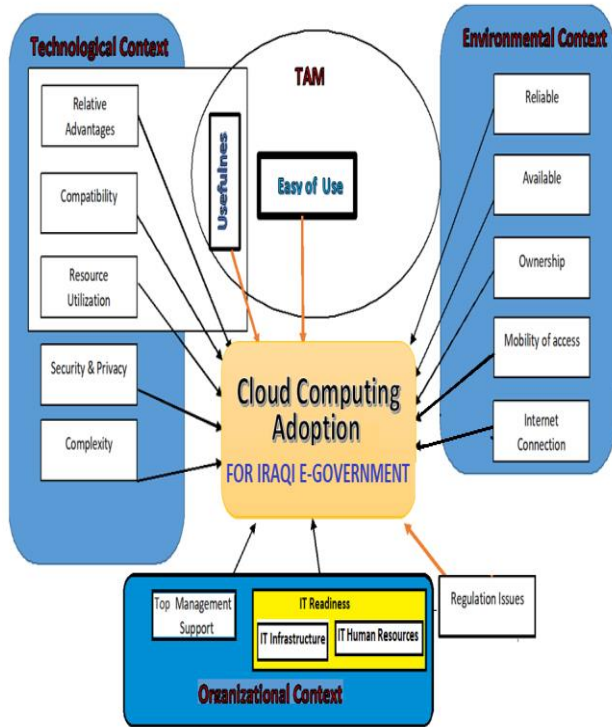| **Technological Context**			
Statement		Mean	S.D
1	Is adopting cloud computing in Iraqi E-government system has a cost saving advantage impact factor over the system?	4.6	0.63245553
2	Is adopting cloud computing in Iraqi E-government system has a flexibility advantage impact factor over the system?	3.96	0.91564185
3	Is adopting cloud computing in Iraqi E-government system has a scalability advantages impact factor over the system?	4.52	0.75471849
4	Is adopting cloud computing in Iraqi E-government system has a compatibility advantages impact factor over the system?	4.04	1.28
5	Is adopting cloud computing in Iraqi E-government system has a complexity disadvantage impact factor over the system?	4.32	0.96829747
6	Is adopting cloud computing in Iraqi E-government system has a security disadvantage impact factor over the system?	3.64	1.05375519
7	Is adopting cloud computing in Iraqi E-government system has a privacy disadvantage impact factor over the system?	4.4	1.0198039
8	Is adopting cloud computing in Iraqi E-government system has a resource utilization advantage impact factor over the system?	4.6	0.48989795
Organizational Context			
Statement		Mean	S.D
9	Is the top Management Support has a positive impact over the adoption of cloud computing within Iraqi E-government?	3.64	1.29243955
10	Is adopting cloud computing in Iraqi E-government system has a positive impact over the IT infrastructure?	4.92	0.2712932
11	Is adopting cloud computing in Iraqi E-government system has a positive impact over the IT Human Resources?	4.44	0.89799777
Environmental Context			
Statement		Mean	S.D
12	Is adopting cloud computing in Iraqi E-government system has a Reliability advantage impact over the system?	3.52	1.38910043
13	Is adopting cloud computing in Iraqi E-government system has the availability advantage impact over the system?	4.2	1.16619038
14	Is adopting cloud computing in Iraqi E-government system has an Ownership disadvantage impact over the system?	4.08	1.16344317
15	Is adopting cloud computing in Iraqi E-government system has a Mobile Access advantage impact over the system?	4.4	0.8
Statement		Mean	S.D
16	Is adopting cloud computing in Iraqi E-government system has a Migration disadvantage impact over the system?	2.92	0.56
17	Is adopting cloud computing in Iraqi E-government system can have the Internet Connection advantage impact over the system?	3.56	0.89799777
Ease of Use			
Statement		Mean	S.D
18	Is adopting cloud computing in Iraqi E-government system has an Easy of Use advantage impact over the system?	3.92	0.97652445
Legal Issues			
Statement		Mean	S.D
19	Is adopting cloud computing in Iraqi E-government system has a Legal Issue disadvantage impact over the system?	3.64	0.97488461

Fig. 2.   Conceptual model for factors affecting cloud computing adoption for Iraqi e-government.

According to that, the migration factor was excluded from the conceptual framework model relating to the adoption of cloud computing in Iraqi e-government. Fig. 2 shows the resultant conceptual model for the factors affecting cloud computing adoption for Iraqi E-government.

VII. CONCLUSION

There are many factors which need to be considered before adopting cloud computing in a new environment.

For a developing country like Iraq, which has its own circumstances and issues, developing a conceptual framework about the adoption of cloud computing should rely own solid scientific bases and goes through a lot of investigation and validation by specialized IT expertise and employees.

The conceptual model for factors affecting cloud computing adoption in Iraqi e-government was derived upon deep and wide verity of related literature review and has its own bases and theories of adoption which should be accounted to assure the right adoption context for a new innovation technology. From analyzing factors we saw that a TOE framework and TAM model with addition and modifications which researchers did concerning the uniqueness characteristics about Iraqi e-government was suitable as a theoretical framework and a model to be tested.

The outcomes was very corrigible and most factors extracted through literature review (all except one) were conferred to be affected factors if a cloud computing is to be chosen via Iraqi e-government system.

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