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# PROPOSED DEVELOPMENT MODEL OF E-GOVERNMENT TO APPROPRIATE CLOUD COMPUTING

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**ABSTRACT**

E-government projects face a lot of challenges that may lead to failure of e-government. Most important of these challenges include the human resources are not qualified and the high cost of infrastructure and the traditional infrastructure cannot scale, scalability demands change over time. The solution of these challenges in cloud computing to cost saving, professional management of resources and applications, and the ability of scalability. But the transition of e-government to cloud computing not easy. We need thoughtful and orderly transition and we need to assess the e-government. In this paper, we propose a new development model of e-government called *Before Cloud E-government Model BCE-government model* that satisfy the cloud computing.

**Keywords:** *E-Government Models , Cloud Computing , BCE-Government Model*

## 1. INTRODUCTION

E-government means the using of Information Communication Technologies (ICT) especially the internet to delivery the information and services of government to citizens [5][4]. A lot of development models of e-government appeared at sequential time by international organizations and scientific institutions and some researchers. These previous models include different sequential procedural steps that describe the operation of adoption and development of the e-government from different perspectives according to growing requirements [6][15].

Appeared on the horizon, the term of *cloud computing* that means new technology depending on the transition of the processor power and hard disk storage from your computer to the *cloud* [1][2]. These clouds are datacenters and servers that we can access these servers via internet. This mean, the computing resources will transfer from products to services. These services include:

*Software as a Service (SaaS)* : Software as a service, we sometimes called (On-demand software) that means the operation of distribution and delivery for software as services to customers by providers or vendors of these services via the internet [12][3]. These software will be rented instead of purchased. Instead of you buy software and you will need to buy the price of updates and upgrades every period, the subscription in SaaS gives to you all these updates and upgrades during the period of subscription. When the period of subscription is over, these software will not act[7][10].

*Platform as a Service (PaaS)* : The same properties of SaaS apply to PaaS, and the platform as a service is a collection of product development tools provided as services by vendors or providers of these services via internet. The developers can construct their applications on a platform of providers over the internet. And the beneficiary of this service are the applications developers as well [21].

*Infrastructure as a Service (IaaS)* : Infrastructure as a service is the operation of outsourcing for all equipment that are used to support and build any system. That includes storage, hardware, network components, and servers. The service providers have all these equipment and responsible for maintenance and preservation of infrastructure. And the customer will pay for using [2][3].

The exploitation of cloud computing benefits for e-government projects will make a revolution in the world of e-government and in cost saving, to ensure the actual use for resources, get a professionalism in the use and management of applications and also human resources, and the

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ability for scalability of infrastructure high or low at any time.

For all these issues, the solutions in cloud computing for e-government will be very useful.

But the pervious models of development of e-government did not take into account the state of transition of e-government to cloud computing what we need to assess and re-develop.

Some problems can be occurred from the random transition of e-government to cloud computing, such as redundancy of services and security concerns that related to the ownership of information and the privacy of government transactions and ensuring that e-government in cloud computing will not affected by any political issues in the future. And the ability to return to the natural state without cloud computing in any time without barriers.

For all that, we need to think and propose new development model of e-government takes into account all these issues and fits the cloud computing. This new proposed model called *Before Cloud E-government model (BCE-government model).*

## 2. RELATED WORK

There are many development (maturity) models of e-government. The difference among these models refer to the nature of the analytic study and refer to the distinction between the countries and areas wherein the possibility is different. We will list the following previous models:

**2.1. Gartner's four-stage model:**

Gartner is an international consultancy company, which proposed four-stage model. This model has the following stages: Web presence stage, Interaction stage, Transaction stage, and Transformation-personalized stage [11].

**2.2. Deloitte's six-stage model:**

This model consists of six-stag as follows: Information publishing stage, (Official) two-way transactions stage, Multi-purpose portals stage, Portal personalization stage, Clustering of common services stage, and Full integration and enterprise transformation stage [25].

**2.3. Accenture five-stage model:**

In 2003, Accenture submitted five-stage model for the development of e-government consists of five stages as follows: Online presence stage, Basic capability stage, Service availability stage, Mature delivery stage, and Service transformation stage [24].

**2.4. UN's five - stage model:**

According to the United Nations and American Society for Public Administration, the main goal of the e-government is to offer efficient web-based public services. accordingly, they proposed this model which consists of the following stages: Emerging presence stage, Enhanced presence stage, Interactive presence stage, Transactional presence stage, and Seamless or fully integrated presence stage [23].

**2.5. World Bank's three-stage model:**

Centre for Democracy and Technology proposed this model, which consists of three stages as follows: Publish stage, Interact stage, and Transact stage [24].

**2.6. Asia Pacific six-stage model:**

Taking into account, their own experience; the Asia Pacific countries presented this model, which consists of six stages as follows: Setting up an e-mail system and internal network stage, Enabling inter-organizational and public access to information stage, Allowing two way communications stage, Allowing exchange of value stage, Digital democracy stage, and Jointed –up government stage [22].

**2.7. Layne and Lee's four-stage model:**

Four-stage model was suggested by Layne and Lee as follows: Catalogue stage, Transaction stage, Vertical integration stage, and Horizontal integration stage [24].

**2.8. Moon's five- stage model:**

Moon has submitted his maturity model, which has five stages as follows: Simple information dissemination (one way communication) stage, Two-way communication (request and response) stage, Service and financial transactions stage, Vertical and horizontal integration stage, and Political participation stage [24].

**2.9. West's four-stage model:**

Suggested by Darral West, this model consists of four stages as follows: Billboard stage, The partial service-delivery stage, The portal stage with fully executable and integrated service delivery, and Interactive democracy stage [22].

**2.10. Siau and Long Synthesize E-government stage model:**

Siau and Long have synthesized a new development (maturity) model from different models using the meta-synthesize method, which is relatively new in the field of information technology. By combining several development models and joining the similarities; the four stage model has the following stages: Interaction stage, Transaction stage, Transformation stage, and E-democracy stage [24].

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**2.11 Howard's three stage model:**
Howard developed a three stage model. The stages of the model as follows: Publishing stage_ this is the initial stage, Interacting stage_ this is the advanced stage, and finally Transacting stage_ based on the model design -this is the highest stage of e-government development [23].

**2.12. The 6I model to evaluate the e-services in the government:**
This model consists of six stages by using of the meta-synthesized approach on many models, New framework model suggested called the 6I model, which has six stages as follows: Inform stage, Interact stage, Intercommunicate stage, Individualize stage, Integrate stage, and Involve stage [24].

**2.13. Hiller and Belanger's five-stage model:**
Hiller and Belanger identified a five-stage model as follows: Information stage, Two-way communication stage, Transaction stage, Integration stage, and Participation stage [22].

**2.14. Chandler and Emanuel's four stage model:**
Chandler and Emanuel developed a four stage model as follows: Information stage – this is a preliminary stage, Interaction stage – this is an advanced stage, Transaction stage – refers to services that enable transactions of values between citizen and government, and Integration stage – this is the final stage [23].

**2.15. Public Sector Process Rebuilding (PPR) model:**
Andersen and Henriksen proposed PRR model, which was an extension of the Layne and Lee Model which consists of four stages as follows: Catalogue stage, Transaction stage, Vertical integration stage, and Horizontal integration stage [25].

From all these models, we can note that all models almost intersect or depend on three main stages. These stages are:

1- Web presence / information publishing.
2- Interaction.
3- Transactions.

From this point, the success at transition of e-government to cloud computing occurs if the results of the assessment of e-government refer to the stage of transaction in any model.
In other words, If any e-government satisfies or in transaction phase, the transition to cloud computing will be useful because in the transaction stage the e-government will be able to deliver transactions services to their citizens; that means the e-government needs high infrastructure and professional staff to manage and offer this kind of services and also needs trained human resources, just in this case or stage the cloud computing is very required.
This means, we need to assess the e-government to determine its current stage first, on the grounds that e-government in the stage of transaction in this case comes the effectiveness of our proposed model.
Our proposed model consists of supplementary stages start at the end of transaction stage in any development maturity model of e-government. Accordingly, we put into account before we proposed our model, we went to the Ministry of Administrative Development in Egyptian government that mange the e-government project in the Arab Republic of Egypt, we discussed the previous models with the specialists in e-government of Egypt, we made interviews with them about any model can be implemented, assessed the e-government in Egypt to declare the possibility and readiness to move to cloud computing, and we collected the problems that related to the transition of e-government to cloud computing. After the operation of analyzing the collected data that we gathered from the layer of experts and specialists, the result was the following model:

## 3. OUR PROPOSED MODEL (BEFORE CLOUD E-GOVERNMENT MODEL) BCE-GOVERNMENT MODEL

Our proposed model is the final advanced stages of any maturity development model of e-government wants to transit to cloud computing. These stages start after the transaction stage in any applied development model of e-government. BCE-government model fits any e-government model decided to transit to cloud computing.
Our proposed model consist of five stages to the transition of e-government to cloud computing with taking into account that one of previous models is applied and in transaction stage.

**3.1. Assessment Stage**
This is the first stage in our proposed model , In this stage we need to assess the e-government according to specific scientific basis to determine the current state of e-government, we need to suggest several domains and make some indicators for every domains. These domains include information publishing domain, interaction domain, and transaction domain. The indicators of every domain will be suggested carefully

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according to the questionnaires and interviews with specialists to collect all data and analyze it. The result of this stage will show the current maturity stage of e-government that includes two options, first the e-government is not in transaction stage then stops and submits plan to develop your project of e-government, second the e-government is in transaction stage then moves to the next stage.

### 3.2. Re-construct the applications of services according to SOA Service Oriented Architecture Stage

After we make sure that the e-government in transaction state from stage one, we need to re-construct the applications of services according to Service Oriented Architecture SOA. Service Oriented Architecture in simple term means the construct of the application as an independent units and services. Every unit or service is not related with another unit or service. That means, we can delete or add any service to the application easily without effectiveness on the total application. This makes the transition of e-government to the cloud computing more flexible, and we can determine which service will be transited to cloud and which will remain, if we need partial transition to cloud computing.

The operation of re-construct of applications needs to re-engineering the applications in specific scientific steps, must include re-analysis, re-design then re-implementation for these applications in Service Oriented Architecture SOA environment.

The result of these stage will be new flexible applications. We can divide or combine its services according to demand. This means, the e-government will be a collection of independent services that are separated in the work and integrated in the goal. After this result, we can move to the next stage of *classification of services* simply.

### 3.3. Classification of Services Stage

After we reached the Service Oriented Architecture SOA applications, the operation of classification of services will take into account more precise criteria, and the operation of classification of services will be comprehensive and easy. New domains of classifications can be opened with SOA. In this stage and with SOA government applications for cloud computing, we need to classify the services to a lot of main classes: Static services, dynamic services, inquiry services, interactive services, procedural services, costly services, cheap services, secret (privacy) services , and less secret services.

There are many relationships between the classes, such as the relations between classes of static services, inquiry services, and cheap services. In addition, the relationships between the classes of dynamic services, interactive services, procedural services, and costly services. Generally with perspective of government and its possibilities and security considerations , we can determine which class of services will move to cloud computing and which will not.

Often, e-government will not move all its services to cloud computing, because any government has its state, privacy and special considerations that differ from government to another. The result of this stage will declare which classes of services move to cloud and which is not, according to feasibility study, cost benefits ratio study, security study, and also political decisions that differ from government to another.

After we classified the services and decided the kind of services that will move to cloud computing, we should aggregate the moved services to reduce the redundancy of these services and we can move to the next stage of *aggregation stage* simply.

### 3.4. Aggregation Stage

After we finish the classification of services and determine the class of services moved to cloud computing, these moved services should overcome to the operation of *aggregation*. The aggregation can comprise the service oriented architecture applications also. There are many similar requirements for different local governments, these requirements sometimes are different few according to the nature and confidentiality of the local governments. But these requirements in general are similar. Such as the applications that related to accounting purposes and human resources management applications that every local government needs to these applications, but with little customizations from local government to another. The transitions to cloud computing in this setting will generate redundancy of services. This redundancy of services will generate additional dispensable costs in the cloud computing. With the operation of aggregation for these applications according to the functional purposes, and with the operation of re-construct the applications with service oriented architecture SOA, we can reduce that redundancy, get one united functional SOA application with all optimization services, and distribute this application to local governments with little customizations according to the privacy and requirements of local governments. After the operation of aggregation, we can get that one

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united functional SOA application with all optimizations services from cloud computing.

After we achieved the operation of aggregation successfully, we can move to the next step "*legal contract stage*" simply.

### 3.5. Legal Contract Stage

The security issues are crucial cases in the cloud computing. All security concerns that related to the ownership of information in the cloud, the privacy of some government transactions, ensuring that e-government in cloud computing will not be affected by any political issues in the future, and the ability to return to the previous natural state "without cloud computing" in any time without barriers. All these issues should be taken into account at this stage. In this stage, we should set law texts carefully. This law demonstrates the ownership of information, and puts specific penalty to the leak of any governmental transaction. This law will separate between e-government and any political issues can be produced. And the law coerces the company of cloud computing to return e-government to the previous state "without cloud computing" on demand without any technical problems. The law also allows to government to copy any specific transaction services at local servers as back up. In this stage, we can put law texts to sharing the information of ID national between e-government and cloud computing to solve the problem of electronic signature. The law allows to government to create *private cloud* at any time to mange and control the privacy transactions at any time.

## 4. RESULTS

We submitted our model as case study in Ministry of Administrative Development that manage and adopt the e-government project in Egypt. We selected a large segment of managers, experts, system analysts, technical project managers, systems specialists, technical support specialists, needs specialists and finally with the director of the program for development of government services. The results for every stage were as the following:

### 4.1. Assessment Stage

At the assessment stage, the results were, 83.3% confirming, 8.3% resistant, 8.3% this stage is not important, 0% neutral . As figure 1:

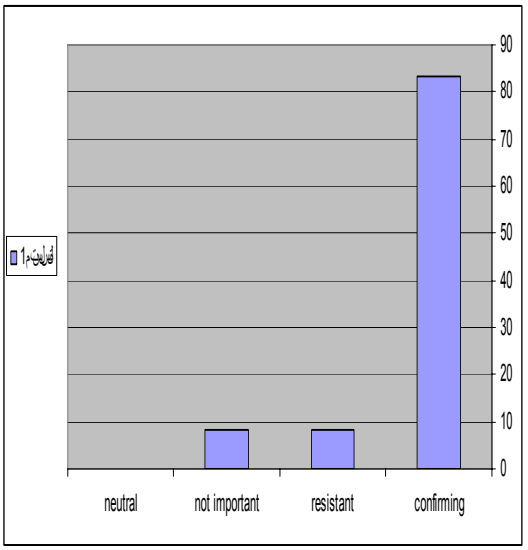


Figure1: The results of Assessment Stage

### 4.2. Re-construct the applications of services according to SOA Service Oriented Architecture Stage

During the re-construct the applications of services according to SOA Service Oriented Architecture stage, the results were, 75% confirming, 8.3% resistant, 8.3% this stage is not important, 8.3% neutral. As figure 2:

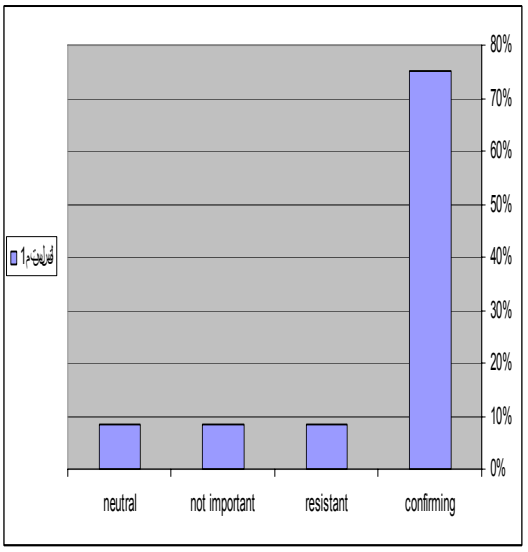


Figure 2: The results of Re-construct the applications of services according to SOA Service Oriented Architecture Stage.

### 4.3. Classification of Services Stage

While in the classification of services stage, the results were, 100% confirming, 0% resistant, 0% not important, 0% neutral. As figure 3:

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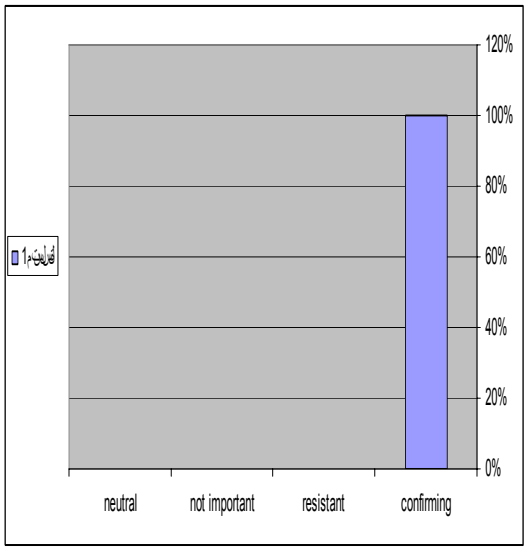


Figure 3: The results of classification of services stage

### 4.4. Aggregation Stage

While in the aggregation stage, the results were, 66.7% confirming, 8.3% resistant, 25% this stage is not important, 0% neutral. As figure 4:

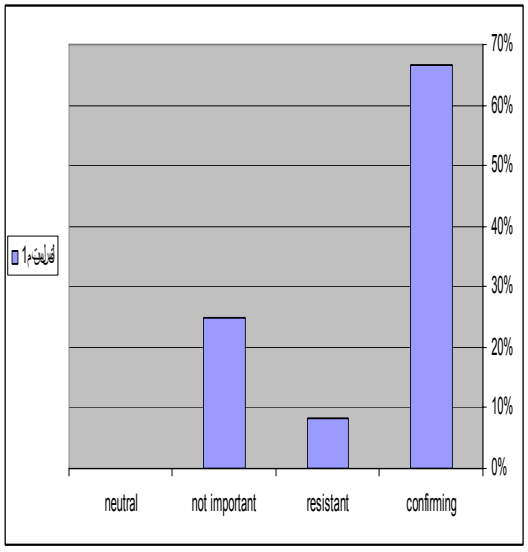


Figure 4: The results of aggregation stage

### 4.5. Legal Contract Stage

At the legal contract stage, the results were, 91.6% confirming, 0% resistant, 8.3% this stage is not important, 0% neutral. As figure 5:

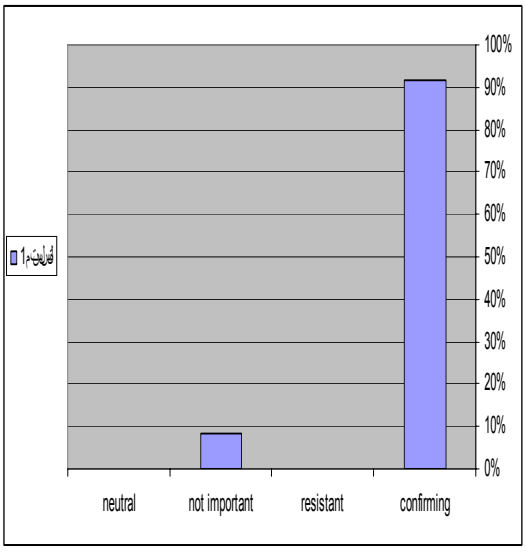


Figure 5: The results of legal contract stage

## 5. CONCLUSIONS AND FUTURE WORK

From all results, we observed that our model achieved full success at classification of services stage by rate 100% excellent, followed by legal contract stage by rate 91.6% excellent, followed by assessment stage by rate 83.3% very good, followed by re-construct the applications of services according to SOA Service Oriented Architecture stage by rate 75% good, and finally the aggregation stage by rate 66.6% passable.

From these results, we can determine that two stages of ,aggregation stage ,and re-construct the applications of services according to SOA stage, need to little of development in the future to raise its rate. This may be fully future work.

## REFERENCES

[1]- K. MUKHERJEE AND G. SAHOO. (2010) Cloud Computing: Future Framework for e-Governance. *International Journal of Computer Applications*.

[2]- W. CELLARY AND S. STRYKOWSKI. (2009) E-Government Based on Cloud Computing and Service-Oriented Architecture. *ACM*.

[3]- A. KHAJEH HOSSEINI, D. GREENWOOD AND I. SOMMERVILLE. (2010) Cloud Migration: A Case Study of Migrating an Enterprise IT System to IaaS. *IEEE Computer Society*.

[4]- UNITED NATIONS. (2008) E-Government Survey 2008 from e-Government to

ISSN: 2076-3328 www.ijric.org E-ISSN: 2076-3336

Connected Governance. *United Nations publication*.

[5]- ARI-VEIKKO ANTTIROIKO. (2009) Electronic Government: Concepts, Methodologies, Tools, and Applications. *Information Science Reference*.

[6]- AKE GRONLUND. (2008) Electronic Government: Design, Applications and Management. *Idea Group Publishing IGP*.

[7]- VASUDEVA VARMA. (2009) Cloud Computing for E-Governance. *International Institute of Information Technology, IIIT, Hyderabad*.

[8]- LIZA M. LOWERY. (2006) Developing a Successful E-Government Strategy. *Department of Telecommunications & Information Services City/County of San Francisco, CA.*

[9]- HAIYAN QIAN. (2009) Report of the Expert Group Meeting E-government Survey: Getting to The Next Level. *United Nations Publication.*

[10]- LIZHE WANG AND GREGOR VON LASZEWSKI. (2008) Scientific Cloud Computing: Early Definition and Experience. *Rochester Institute of Technology*.

[11]- E. ALIVIA MARANNY. (2011) Stage Maturity Model of M-Government (SMM m-Gov) Improving e-Government performance by utilizing m-Government features. *Information Technology University of Twente*.

[12]- PETER MELL AND TIM GRANCE. (2009) The NIST Definition of Cloud Computing. *National Institute of Standards and Technology, Information Technology Laboratory*.

[13]- SAMIA MELHEM, SUSANNE DORASIL AND BERND HOFF MANN. (2010) E-Government for Development A Conference Documentation. *Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) GmbH*.

[14]- MALGORZATA PANKOWSKA. (2008) National frameworks' survey on standardization of e-Government documents and processes for interoperability. *Journal of Theoretical and Applied Electronic Commerce Research*.

[15]- SISTER CITY PROGRAM TECHNOLOGY. (2010) Beijing E-Government Vision and Framework. *Beijing Municipal Office of Informatization, Copyright © 2004 by The Sister City Program of the City of New York.*

[16]- ZHIYUAN FANG. (2002) E-Government in Digital Era: Concept, Practice, and Development. *International Journal of The Computer, The Internet and Management*.

[17]- BERTOT, J.C., JAEGER, P.T., & MCCLURE, C.R. (2008) Citizen-Centered E-Government Services: Benefits, Costs, and Research Needs. *The Proceedings of the 9th Annual International Digital Government Research Conference*: 137-142. Montreal, Canada, May 18-211, 2008.

[18]- D. WALSH, AND S. DOWNE. (2005) Meta-synthesis method for qualitative research: a literature review. *Journal of Advanced Nursing*.

[19]- LENNART NORDFORS, BO ERICSON & HEMMING LINDELL. (2006) The Future of e-Government - Scenarios 2016. *VINNOVA – Swedish Governmental Agency for Innovation Systems.*

[20]- DELOITTE. (2010) Information Security Briefing 01/2010 Cloud Computing. *Centre for the Protection of National Infrastructure CPNI*.

[21]- HUGH WILLIAMS. (2009) Spatial Cloud Computing (SC2) White Paper, a New Paradigm for Geographic Information Services. *Published in august 2009 by SKE.*

[22] - G. KAROKOLA AND L. YNGSTROM. (2009) DISCUSSING E-GOVERNMENT MATURITY MODELS FOR DEVELOPING WORLD – SECURITY VIEW . *Stockholm University/Royal Institute of Technology, Sweden*.

[23]- M. FALLAHI AND G. ALI MONTAZER. (2005) E-Government Model Adoption: A Comparative Study among Multi-Stage E-Government Implementation Frameworks. *Tarbiat Modarres University,Tehran,Iran.*

[24]- M. H. BTOUSH, J. SIDDIQI, M. GRIMSLEY, B. AKHGAR, J. ALQATAWNA . (2006) Comparative Review of e-service Maturity Models: 6I Model . *Informatics Group Sheffield Hallam University (UK).*

[25]- H. AL-KHATIB. (2009) A Citizen Oriented E-government Maturity Model. *Business School Brunel University*