

TOWARDS THE ADOPTION OF CLOUD COMPUTING FOR BOOSTING THE JORDANIAN E-GOVERNMENT

Anas Ratib AL-Soud, Assistant Professor at the Department of Electronic Business and Commerce, AL-Ahliyya Amman University, Amman, Jordan.
a.alsoud@ammanu.edu.jo

Abstract

Global governments are enthusiastically considering cloud computing as a way for increasing efficiency and ICT development as well as reducing costs. In this paper, we explain how cloud computing can be used to help governments boost their e-government initiatives. The paper evaluates the benefits of adopting cloud computing for e-government in terms of four dimensions; namely: interaction and accessibility, location and distance, time and availability, and products and services. Jordan is a developing country that is declining in the global ranking for e-government development. We present perceptions that will help in determining whether there is a need for adopting cloud computing in the Jordanian e-government, and whether it will help in boosting the e-government development.

Keywords: Cloud Computing, E-Government, ICT infrastructure, Jordan.

1 INTRODUCTION

Governments around the world are increasingly using the Web as a tool to enhance and improve their services, understanding e-government development and exploring factors that influence and increase e-government development have become interesting research topics for researchers (Siau and Long, 2006). Contemporary governments all over the world are exploring new e-service provision approaches that can boost its e-government development as well as adhere to citizen's needs. Cloud computing has dramatically become one of the solutions for improving the Information and Communication Technologies (ICT's) infrastructure for governments struggling to develop their e-government initiatives. This is down to some of the important characteristics of cloud computing such as measured service, ubiquitous network access, on-demand and self-service, rapid elasticity and resource pooling.

In the early years of e-government, the provision of e-government services (supply-side) has been the main, if not the only, focus of governments' policy makers, but over the past years this focus tend to move towards citizens (demand-side) and their usage of these services. A growing number of governments, mostly in developed countries, are making more efforts to increase the usage of their e-government services by recognising the benefits of new technologies and provision approaches (UNPAN, 2012); in this regard cloud computing is a promising one. By cloud computing the government can facilitate new channels for citizens to access their e-services through advanced ICT's;

in this case the cloud computing service provider has become a supply-side where government turned to be in the demand-side.

Jordan, the case study of this paper, is dedicated to improve its ICT infrastructure and electronic delivery channels needed to increase citizens' adoption and acceptance for using the e-government services. The use of computers and the Internet is dramatically increasing in Jordan during the recent years; the percentage of the Jordanian people who uses a computer at home was (61.2%) in 2011 whereas it was (35.7%) in 2007 (DOS, 2011). In terms of the Internet, (35.4%) of the Jordanian people used the Internet in 2011 whereas only (15.6%) have used it in 2007 (DOS, 2011). This growth in using the computer and the Internet might be promising to a successful adoption of cloud computing for providing e-government services to the public in general and citizens in particular. However, it is not clear whether Jordan's e-government will benefit from cloud computing services. This paper explores the expected benefits, opportunities, limitations and challenges of adopting cloud computing for the Jordanian e-government program.

The remainder of the paper is structured as follows: section 2 briefly provides an overview about cloud computing; section 3 examines the importance and usefulness of cloud computing for the public sector through exploring some key opportunities and challenges of adopting cloud computing in e-government service provision; section 4 explains the need for adopting cloud computing services in Jordan as a case study; followed by key conclusions, recommendations and future work.

2 OVERVIEW OF CLOUD COMPUTING

The National Institute of Standards and Technology has defined Cloud Computing as:

"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." (NIST, 2010)

There are three delivery models for cloud computing: (1) Software as a Service (SaaS): where the user (consumer) uses a software application without controlling the hardware, operating system or network infrastructure on which the software is running; (2) Platform as a Service (PaaS): where the consumer uses a platform as an application framework for hosting a set of applications, the consumer controls the applications that run in the platform, sometimes with the ability to control the hosting framework, but as in SaaS the consumer has no control over the hardware, operating system or network infrastructure on which they are running; and (3) Infrastructure as a Service (IaaS): where the consumer uses various computing resources including networking components, processing power, middleware or storage; unlike PaaS and SaaS, IaaS enables the consumer to have control over the aforementioned computing resources (Leavitt, 2009). In terms of cloud computing deployment models, there are four deployment models that can be summarised as follows (Wyld, 2010):

- **Public cloud:** by which citizen can use governmental cloud services provided by a third party service provider and available through the Internet. The solutions provided by public cloud service providers are characterised as being elastic and cost effective.
- **Private Cloud:** by which government's processes and data can be managed within the government agencies evading the restrictions of security exposures, network bandwidth and legal requirements. Furthermore, the private cloud services offer users more control over the cloud's infrastructure. This model could be more secured than the rest of the deployment models as the used networks are designated and restricted to their users.
- **Community Cloud:** by which a group of organizations (e.g. government agencies) that have shared interests, such as specific security requirements or a common mission can share access to the data and applications in the cloud.
- **Hybrid Cloud:** by which government agencies and departments can outsource their not business-critical information and services to be based and processed in the public cloud; at the same time it keeps the business-critical data and services in their own control. In a nutshell, it is a combination of a private and public cloud that interoperates regularly.

Governments can use any of these deployment methods based on their needs for cloud services in different agencies and departments as well as the data and resources used when selecting one of these models.

3 CLOUD COMPUTING FOR PUBLIC SECTOR: KEY OPPORTUNITIES AND CHALLENGES

With the governments of the developed countries encouraging cloud adoption, governments of developing countries too are increasingly considering the adoption of cloud computing. Although limitations and concerns (e.g. privacy, security and control of data), do constrain adoption, the value proposition and the great opportunities of getting into the cloud is too attractive for the governments of the developing countries to ignore. Therefore, it is important to determine some of the key opportunities and challenges of adopting cloud computing services in the process of e-government service provision.

Cloud computing has a number of features that cloud highly benefit the hindered e-government programs, especially those in the developing countries as they suffer from lack of resources and budgets. A key feature is the potential of increasing the efficiency of infrastructure usage. This is vital for countries having limited ICT infrastructure capacity and penetration. Another key feature is the huge potential cost savings. These features, at least, should drive governments of the developing countries to consider moving to cloud computing if they are willing to boost the development process of their e-government program and initiatives. Chandrasekaran and Kapoor (2011) have listed data centre consolidation, aggregation of demand, and multi tenancy as three primary savings that would be generated from the adoption of cloud computing.

It is important to be able to determine whether adopting cloud computing in e-government programs and initiatives is beneficial before investing in this costly project. In this regard, Montagna (2005) has proposed a framework that determines the suitability for governmental action, it also determines the

benefits provided in multidimensional approaches. Zissi and Lekkas (2009) has used Montagna's framework to evaluate e-government initiatives in terms of five dimensions, namely products, time, distance, interactions, and procedures. Accordingly, Table 1 provides a brief evaluation for adopting cloud computing in e-government programs. This evaluation helps us determine the expected benefits of adopting cloud computing for e-government in terms of four dimensions: (1) interaction and accessibility, (2) location and distance, (3) time and availability, and (4) products and services.

Performance criteria	Interaction and Accessibility	Location and Distance	Time and Availability	Products and Services
Efficiency	<ul style="list-style-type: none"> -Reduces deployment cost -Reduces interaction costs -Increases cooperation -Increases participation 	<ul style="list-style-type: none"> -Overcomes geographical difficulties -Crosses agency and boundaries -Improves cooperation -Reduces distribution and delivery cost -Improves data quality due to centralization and uniformity -Improves data accuracy due to centralization and uniformity 	<ul style="list-style-type: none"> -Reduces time required to access applications and data -Reduces time required for installations and modifications -Reduces monitoring time 	<ul style="list-style-type: none"> -Provides uniform access to data and applications
Effectiveness	<ul style="list-style-type: none"> -Generates relationships -Enhances accessibility 	<ul style="list-style-type: none"> -Improves communication and interaction 	<ul style="list-style-type: none"> -Applications and resources available on demand 	<ul style="list-style-type: none"> -Improves data quality -Improves quality of services
Strategic Benefits	<ul style="list-style-type: none"> -Builds new communication and operation channels -Offers more information and increases the accuracy of information available 	<ul style="list-style-type: none"> -Introduces new services independent of geographical location -Hybrid centralization 	<ul style="list-style-type: none"> -Timely opinion and expression -Possibility of real time cooperation across agencies 	<ul style="list-style-type: none"> -Provides uniformity of solution -Introduces new services -Integrates existing infrastructure deployments
Transparency	<ul style="list-style-type: none"> -Promotes active participation -Breaks down barriers 	<ul style="list-style-type: none"> -Access services and data independently from geographical location 	<ul style="list-style-type: none"> -Timely control 	<ul style="list-style-type: none"> -Constant evaluation and control of services and application usage, reduction of expenses

Table 1. Benefits Evaluation for adopting cloud computing in e-government programs (Adapted from Zissis and Lekkas, 2009)..

This evaluation provides some insights about the benefits could be gained from adopting cloud computing in each dimension. The key benefits that can be offered to governments are summarised in some vital enabling technologies for rapid development such as: (1) high-performance virtualization for commodity hardware, (2) fast wide-area networks, and (3) powerful, inexpensive server computers. As mentioned earlier, developed countries are increasingly adopting and encouraging the

adoption of cloud computing for the aforementioned benefits. European countries have explored and used cloud-based computing in a number of areas such as: setting-up internal, private cloud environments, management of public sector housing, transportation service networks, economic development, census, health services, contracting and education services (Petrov, 2009). G-Cloud is the UK programme aims to encourage the adoption of cloud-based services by the government. It covers the processes of buying, managing and using cloud services. It also aims to creating a competitive marketplace, simplify how government buy and deliver services, encourage innovation, provide access to a wider choice, encourage the shift from custom to commodity, and change the public sector culture (Westmore, 2013). Furthermore, the 16-Point action plan for cloud computing in Europe has recommended European Cloud to encourage governments of Europe to adopt cloud services (EuroCloud, 2010). In Japan, the Ministry of Internal Affairs and Communications has launched the Kasumigaseki Cloud initiative that aims to build a large cloud computing infrastructure. This initiative aims to meet the growing requirements of the government's IT systems and achieve more efficiency through a shared pool of resources (Wyld, 2010). This, as mentioned earlier, will eliminate the need to maintain single IT systems for different government agencies and departments.

Seeing that cloud computing offers a number of attractive benefits and opportunities for governments, there is also a number of limitations to the services provided in cloud computing as well as challenges the governments will face when it comes to the adoption phase. For example, performance and availability are a key concern since insufficient service is not accepted in most of the governmental agencies due to their processes that need to be available and in full operation 24/7. Some of the computing resources owned by the government cannot be moved to the cloud due to privacy and/or security concerns; therefore, integrating these resources would require certain constraints making it more difficult to be integrated. Additionally, adopting cloud computing might call for some regulation's amendments which is not a simple task when dealing with governments. Furthermore, the lack of major suppliers especially in a developing country like Jordan is a key challenge for adopting cloud computing services. Another challenge is the process of migrating to the cloud. Researchers have presented some models and strategies about cloud migration such as Wyld (2010) migration strategy comprises six-step process: (1) learning, (2) organisational assessment, (3) cloud pilot, (4) cloud readiness assessment, (5) cloud rollout strategy, and (6) continuous cloud improvement. A similar model presented by Rastogi (2010) discusses an approach to migrate from traditional computing to cloud computing. These strategies and models can play a key facilitating role in the process of moving from traditional computing to cloud computing in the public sector.

The complex procurement process and security concerns in governments are key issues too. Mainly because governments have the full responsibility for protecting citizen's data as well as ensure high availability of the critical national infrastructure (Chandrasekaran and Kapoor, 2011). There is no doubt that the process of budgeting in the public sector is more complex than that of the private sector. Especially when it comes to IT budgets which are planned well in advance, often a few years before, constraining government agencies from last minute changes that is very common in this evolutionary world. In the public sector, the selection process of service providers is a long multi-layered process

that usually attempts to reduce the number of suppliers and procure services at a lower cost; this is quite important for a country with a limited number of natural resources like Jordan. However, the complexity of this process generate a challenge of procuring cloud IT services from a service provider that can offer innovative and niche services at low costs. Therefore Chandrasekaran and Kapoor (2011) have argued that government agencies need to change the traditional procurement models if they are willing to procure ICT resources from the cloud.

4 THE NEED FOR CLOUDY JORDAN

The Hashemite Kingdom of Jordan (Jordan) is one of the developing countries in the Middle East; it is a small country with a limited number of natural resources, with the population size estimated to 6,387,616 million (DOS, 2013). Jordan is governed by a constitutional monarchy headed by HM King Abdullah II. Jordan is striving for its social and economic survival due to its location in an unstable region, with a total area of 89,342 sq. km (of which 99% is land and only 1% is water). The rapid development of ICT's and the Internet brought with it a significant push towards e-government in most of the countries around the world; Jordan was no exception. Therefore, and as part of modernising and reforming government organisations and processes, Jordan has introduced new rules, regulations and legislations which liberated some services from the government control in order to regulate the privatisation and to encourage foreign investments as well as to follow some of the best practices around the globe. These new rules and legislation have been set as foundation blocks to the derivation of the Jordanian e-government strategy and vision by adopting new ICT's. Therefore, moving from traditional computing to cloud computing should not be a challenge in terms of governmental regulations and policies.

Jordan's telecommunication infrastructure is still developing and the diffusion rate of technology has increased over the last seven years; however, it is still lower than the required level when compared globally and this is mainly due to socio-economic factors. Since 2009 the observer of Jordan's e-government development can determine that there was a noticeable lack of development of Jordanian G2C e-services provision due to the poor ICT infrastructure (UNPAN, 2010; UNPAN 2012). This lack of development will make the Jordanian e-government program encounter a number of challenges which will hinder achieving its crucial objectives. Thus, Jordan's e-government has to look for alternative approaches for boosting the ICT development. At this juncture, cloud computing can offer a great support to this development due to the aforementioned benefits and opportunities.

To determine the main reasons behind the poor development in Jordan's e-government, we have assessed Jordan's e-government performance compared to the world countries by using the United Nations E-Government surveys, which have always been an important indicator of how the member states are performing in their e-government programs. Recent reports have analysed how governments of the world are employing their e-government programs and policies to support effectiveness, efficiency, and inclusiveness as the parameters of sustainable development efforts worldwide (UNPAN, 2012). When considering the United Nations E-Government Readiness reports, it should

always be kept in mind that the E-government Readiness Index is a composite of three components: (1) web measure; (2) telecommunication infrastructure; and (3) the human capital. When using these three components to assess the overall e-government readiness, it was noticed that many of the developing countries that have invested in e-government development have tended to lose out in the set of world comparative rankings due to lack of support from human capital and telecommunication infrastructure components (UNPAN, 2004; 2005). It is not surprising that the majority of the top 20 positions in the rankings belong to high income countries due to their ability to invest in developing their e-government programs and initiatives.

The telecommunication infrastructure and human capital components (which have two-thirds of the total weight of the e-government development index) have contributed in achieving higher rankings in the survey for developed countries as these components require long-term investment (UNPAN, 2012). However, this is clearly not the case for the developing countries although some of them have the financial ability to develop advanced e-government initiatives, and this was due to lack of human capital and/or telecommunication infrastructure (UNPAN, 2012). As mentioned earlier, Jordan as a UN member has been assessed on its e-government readiness and development since the year of 2003, Figure 1. Jordan's progress in the three indices of the UN e-government development surveys 2003-2012.

shows Jordan's scores in each index of the assessment, the horizontal axes shows between parentheses Jordan's ranking in each year of assessment, while the bars show the scores of three indices of the UN e-government development surveys. Each year shows Jordan's performance in the web measure index (represented by the blue bar on the left of each year), the telecommunication infrastructure index (represented by the red bar on the middle of each year), and the human capital index (represented by the silver bar on the right of each year).

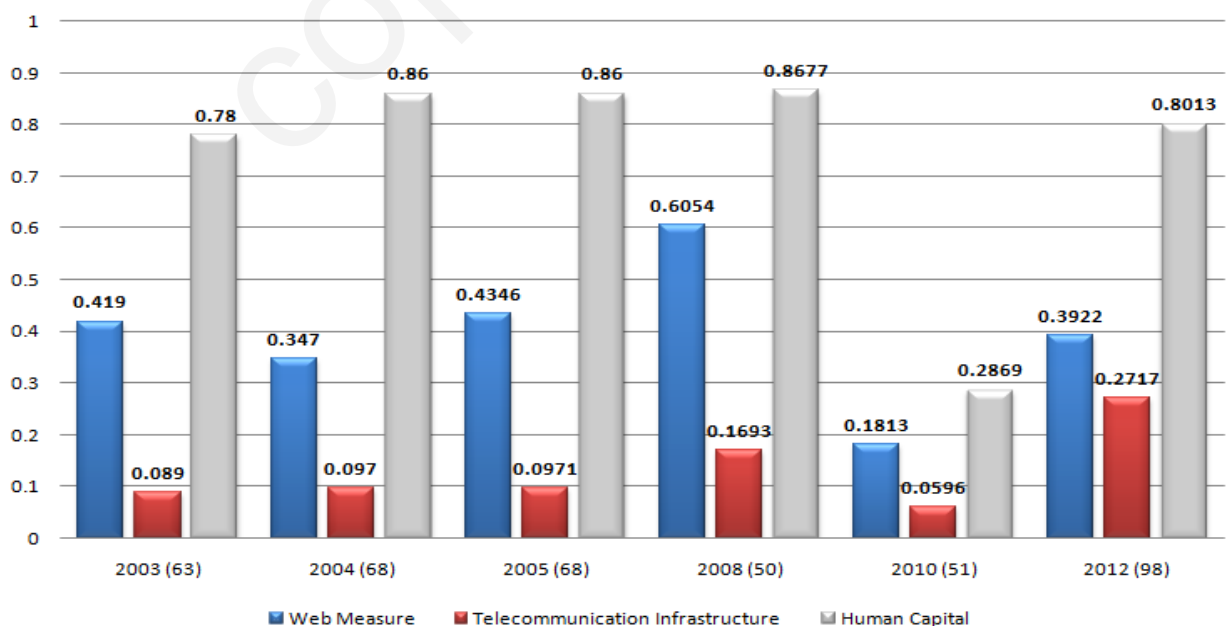


Figure 1. Jordan's progress in the three indices of the UN e-government development surveys 2003-2012.

It is a vague and not easy decision to make for a government, especially a government for a developing country like Jordan, whether to host its e-government information and service in the cloud, or whether investing in cloud computing will be beneficial over the long term. In Table 2, we summarise some of the expected value proposition for the adoption of cloud computing in the Jordanian e-government.

Benefit	Description
Reduction in ICT Spending	As Jordan is suffering from its poor ICT infrastructure, adopting cloud computing enables the government agencies to create a central pool of shared resources (software and infrastructure). The consistency of resources as well as the cost effectiveness of cloud computing will decrease the ICT spending across Jordan.
Access to Most Updated Technology	Cloud computing offers the government agencies the ability to have a constant access to the most updated infrastructure and software. The responsibility of updating technology and upgrading applications is on the cloud service provider in this provision model who guarantees access to the latest updates and solutions.
Elimination of Procurement & Maintenance	With the services of cloud computing the government of Jordan does not need to procure, monitor, and maintain IT resources as it is the responsibility of the cloud service provider. Accordingly, the government workload and the need for IT professionals will be reduced; which in turn enables the government agencies and departments to focus on their primary functions and operations.
Universal Resource Access	As Jordan is suffering from its poor ICT infrastructure, cloud computing only requires an Internet connection to ensure a universal access to resources across the kingdom.

Table 2. Value propositions for e-government in Jordan (adapted from Chandrasekaran and Kapoor, 2011).

As mentioned earlier, the benefits of cloud computing offer governments around the world a great opportunity to boost the development process of its e-government programs. In this regard, we summarise these expected benefits to Jordan's e-government in the following points:

- Access anywhere: it enables the government employees (especially those working on designing, implementing, developing and maintaining e-government services) to access governmental services and information using mobile computing, this crucial in a country like Jordan where the ICT infrastructure is not consistent all over the country.
- Significant Cost Reduction: cloud computing services are much less expensive than the traditional IT services; the costs are reduced especially for the upfront capital expenditures and IT administrative charges.
- Sharing documents and group collaboration: by cloud computing applications and documents are accessible from anywhere in the world, enabling group collaboration on documents and projects from different governorates.
- Elastic scalability and pay-as-you-go: the government of Jordan can increase or decrease capacity as the needs change. It will only pay for what the actual use is.
- Easy to implement and maintain: there is no need to recruit IT professionals for implementation and maintenance services or purchasing hardware and/or software licenses. It is the responsibility of the cloud service provider.

- Service quality: government agencies and departments, especially those in remote areas, will enjoy reliable computing services (mainly virtual infrastructure), large storage and capacity, and a service that is available at all times.
- Latest software and updates: the government will not need to send IT professionals to update the software's used in different governmental offices, departments, and agencies due to the automatic updates offered by the cloud service provider.

These benefits are crucial to Jordan's development of e-government due to the geographical distribution of citizens. Jordan has 12 governorates including (1) Irbid; (2) Ajloun; (3) Jerash; (4) Mafraq; (5) Balqa; (6) Amman (the Capital); (7) Zarqa; (8) Madaba; (9) Karak; (10) Tafilah; (11) Ma'an; and (12) Aqaba (see Figure 2). ICT infrastructure is better in Jordan's large cities (e.g. Amman, Irbid, Zarqa) than the rest of the governorates due to the population density as well as the government support. Therefore, citizens of the other governorates can feel the difference of the ICT infrastructure readiness. Adopting cloud computing will help the government of Jordan to bridge the ICT readiness gap between the governorates by offering a shared pool of IT resources on the cloud through the knowledge stations (KS) distributed all over the kingdom, as these stations has played a role in empowering the ICT use for people in the rural areas of Jordan (see Alemayehu and Al-Jaghoub, 2007; AL-Rababah and Abu-Shanab, 2010).

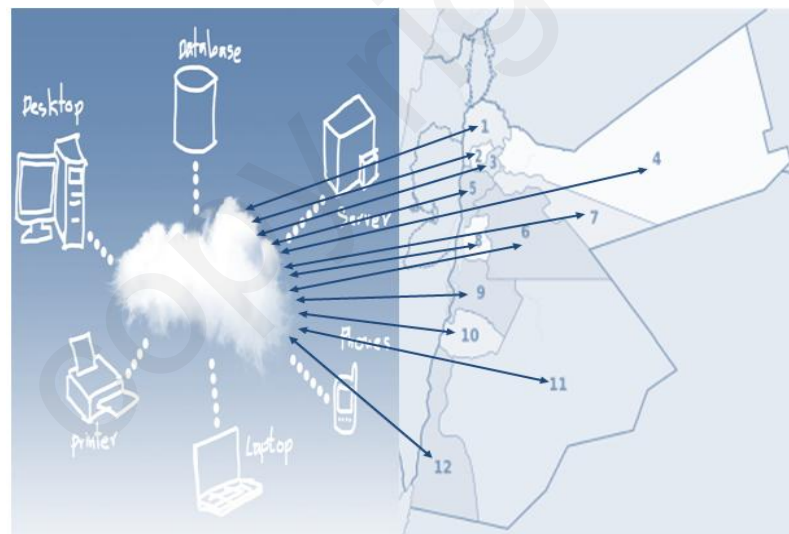


Figure 2. A single pool of resources for Jordan's e-government in the 12 governorates

Finally, cloud computing provides all government offices, departments and agencies an instant access to advanced IT resources regardless of their level of technical competencies and/or location (Cellary and Strykowski, 2009). This is what Jordan really needs after more than a decade from launching its e-government program that is declining in the global ranking of e-government development, mainly due its poor ICT resources and infrastructure.

5 CONCLUSION AND FUTURE WORK

There is no doubt that the most of the developing countries are suffering from their poor ICT infrastructure and electronic delivery channels which adversely affects the implementation of their e-government services. Cloud computing can offer a number of benefits that can help governments overcome key challenges. The benefits evaluation has provided some key insights that can help governments in determining the worth and significance of cloud computing before making a decision whether to adopt it or ignore it. The paper has also provided perceptions about some key benefits and opportunities the government of Jordan can gain if they decide to make use of cloud computing.

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