National Research University Higher School of Economics

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INDIVIDUAL STUDY

CLOUD COMPUTING

APPLICATIONS OF CLOUD COMPUTING IN PUBLIC ADMINISTRATION

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Table of Contents

Essay

The developed countries around the world have adopted electronic government at all levels to provide services to their citizens in public sector. But, the many the countries including developed and under developed, faced difficulties and challenges like lack of resources, poor management cost, infrastructure, digital divide and lack of IT infrastructure to implement E-services for public sector. The continuous advancement in technology guides countries to overcome these barriers and implement e-services for public sector efficiently. Therefore, public administration bodies and local governments look into cloud technology as source of reducing cost, providing more reliable and efficient services, increasing efficiency and reducing cycle time. Cloud computing can be really helpful to improve e-services for government, citizens and institutions. Cloud technology can provide multiple benefits to local governments that want to provide eservices to their citizens with easiness. Public administration bodies in various parts of the world are increasingly interested in the use of cloud computing technology because of reduction of expenses in IT infrastructure as well as the potential for the rapid introduction of e-services for public sector. This essay would discuss cloud strategy for public sector across Europe, cloud infrastructure for public sector across Europe, application of cloud for public sector and conclusion.

The cloud initiative is taken in Portugal to take advantage of cloud computing to provide a more effective use of ICT resources at lower costs and higher security levels. The objectives of the initiative are the introduction of cloud services in public administrations. Main strategic objectives of Portuguese cloud initiative are: Cost savings, the improvement of existing public services, and the economic impact for the private sector.

The Netherlands' Cloud Computing Strategy provides an implementation of the use of cloud computing within the Netherlands. The main identified problems of cloud computing are the immaturity of the market and data protection requirements. There are three main elements in the Dutch cloud computing strategy: the 'closed' cloud, phased implementation and 'cloud first' policy.

The cloud computing in Slovenia is a base for economic growth. The strategy of cloud computing for public sector is focused on cost savings and economic impact for the private sector. The main objective are: (1) promotion of the reuse of open data and open service solutions in cloud environments, in particular published by public administrations, (2) reaching the high level of standardization by setting

up secure reference architecture for cloud computing along the development the appropriate reference development environment with priority on security. There are three different deployment models of cloud services: State cloud (IaaS), Hybrid cloud (IaaS) and Innovative development cloud (PaaS).

The Italian strategy for cloud computing in public sector is focused on cost reduction of IT infrastructure and the main objective is the Rationalization of data centers.

This section would discuss best applications of cloud computing in public sector across European countries. The Italian Ministry of Foreign Affairs has developed a private Cloud ("Maecloud" project) to ensure service continuity for Italians citizens abroad. Public administrations, foreign offices and central offices of the ministry are connected by SIFC (integrated system board functions), a platform that integrates the management of services for citizens abroad and for enabling co-operation between public administrations, to increase the effectiveness of communication with and from the public abroad.

In Netherlands, open data is offered by central government to society and is supported by various public cloud-based solutions. These solutions are developed based on cloud computing for free public services. The solution includes National Georegistry, PDOK viewer and open data portal. PDOK enables Web services available nationwide geo-information from governments. This data comes directly from the source, i.e. government organizations source holder of this data. Therefore, the data up to date and reliable.

One of the best known cloud infrastructures developed Austrian government through the shared service portal "Portal Austria – portal.at", based on the enterprise "eGov Portal Services" portal solution. This central governmental portal solution represents a shared-ICT-service portal. The examples of services, accessible through Portal Austria are the central federal personal management, the federal billing allocation, the system of resident registration or the central land registry.

In Slovenian government has developed many online portal using cloud infrastructure for public administration. The portal e-VEM - one stop shop has been operating since 1 July 2005. The basic purpose of the e-VEM project is to provide a suitable information support for the future entrepreneur and enable him/her to start business operations in the shortest time possible. The e- Democracy portal allows coverage of all essential steps in the process of adopting a legal act, operating uniformly in all spheres of competence, which are involved in the process of preparing and adopting legislation.

In conclusion, the cloud computing technology has revolutionized the public administration through online services for public. It also helps public administration authorities to reduce cost and provide reliable e-services to their citizens with easiness.

Chapter 1

INTRODUCTION

The public sector, namely state administration and local governments, in almost all EU countries address similar problems: how to balance what is needed and what is affordable using the public budget. The question is whether to accelerate or, on the contrary, decelerate investments in modernizing the administration, what areas to concentrate on, whether to use shared services and outsourcing or look for new, more innovative ways. One of the possible ways forward is cloud computing [2].The cloud computing approach provides multiple benefits to states and local governments that want to efficiently meet the needs of citizens. Public administration bodies in various parts of the world are increasingly interested in the use of cloud computing technology, and there are frequent examples and solving individual problems with this approach. The main reason is the possibility of multiple reduction of expenses related to IT infrastructure, as well as the potential for the rapid introduction of services oriented towards the citizens [1].
The European Union has strategically addressed this issue with the Digital Agenda for Europe. The focus of this document is on the use of cloud computing solutions in line with the Europe 2020 strategy related to smart, sustainable and inclusive growth. The aim is for IT solutions in public administration to be transferred to the cloud environment, which would allow the integration of public resources and optimal use of ICT owned infrastructure, and result in savings of more than four billion euros annually [1].

On the other side of the Atlantic, is the world leader in the use of cloud computing solutions. In the US, the introduction of cloud computing technology in the public sector brought the improvement of services for citizens, standardization of services in all locations, advances in education, science and research, as well as the transformation of large sectors such as health, energy, manufacturing, banking and so on. The US government has adopted the policy Cloud First primarily in order to drastically reduce IT costs. Private cloud was created by US agencies with high requirements for security, while the public cloud transforms the online training of its staff and the information made available to citizens for greater transparency in government. Thus the US, in only 22 days, launched a service in a public cloud that allowed the citizens to see how money collected from taxes intended for the creation of new jobs was used [1].

The public sector in Serbia has a significant impact on economic development, but its efficiency largely depends on the availability of IT resources. Some institutions, because of the number of employees and complex organizational structures, have greater difficulty accepting new technologies, while others have more sophisticated IT resources, but often underutilized. A modest budget that is set aside for investment in this area is slowly inducing institutions to rationally use and invest in IT resources. In such a situation, cloud computing imposes itself as the right solution [1].

However, despite the obvious benefits of cloud computing solutions, public institutions are more reluctant in deciding to implement this approach, primarily because they want to know exactly who has access to data and who controls this access. In order to eliminate concerns regarding data security in the cloud, and on the basis of numerous examples of public organizations that have migrated into the cloud and are satisfied with the level of security and privacy provided, the Ministry of Trade, Tourism and Telecommunications has adopted a strategy for the Digital Agenda, which defines activities to be undertaken in the future development of information society in Serbia. This strategy involves the use of modern information technology in all public sectors. To ensure an easy and

painless IT modernization in the public administration, this strategy requires that special attention be paid to the development and future wider application of cloud computing solutions [1].

Numerous examples of using cloud computing solutions in the public administration show that this approach brings tremendous financial savings of millions of euros. While data security for many is the main concern when adopting this decision, the fact is that the issue of security is now more reliably solved in the cloud – numerous successful implementations, where sensitive data is stored in this type of cloud solution, indicates that a large number of states have growing confidence in cloud computing.

The Essex District has 1.3 million inhabitants and is the largest in England. Within six months, it implemented software that runs under the SaaS model, designed to manage payroll and other services in the field of human resources. The result is a shortening of the time for the payment process from 18 to four hours, as well as more than 800,000 euros savings on IT costs [1].

The Danish IT and Telecommunications Agency migrated the national system of electronic invoicing to a public cloud. This was done to reduce operating costs and increase the capacity of the system. By applying the IaaS model this was achieved, but the additional benefits were more flexible maintenance and development of applications [1].

This study would present applications of cloud technology in public sector of different countries around the globe. I would discuss public administrations solution of different countries across Europe.

Chapter 2

EUROPEAN STRATEGY FOR CLOUD IN PUBLIC ADMINISTRATION

This section contains public cloud policy and strategies from six European countries that have developed an initial approach to cloud computing technology. The goal is to identify policy drivers that boost cloud implementation and the objectives to reach by some EU Governments [3].

European strategy for cloud in public administration			
Country	Date of Strategy	Drivers	Main Objectives
Portugal	2012	• Cost savings • Economic impact for the private sector • Improvement of existing public services	• The introduction of cloud services in public administrations • Establish a framework agreement for the procurement of cloud computing services • Implementation of the GO-Cloud (Governmental Open Cloud), a platform with shared cloud services;
Italy	2013	• Cost savings	• Rationalization of data centers
Spain	2011	• Cost savings • Economic impact for the private sector • Improvement of existing public services • Development of new public services	• The SARA network is a national network interconnecting national, regional and local administrations. It is connected to

			sTesta. It is now evolving to provide cloud services, in a private cloud model. This network includes a data center dedicated to common services provided to administrations. This datacenter is currently growing over time, as the number of cloud services is growing.
Netherlands	2011	• Improved and new modes of working for the central government • Cost saving	• Closed cloud • Phased implementation • Cloud first policy
Slovakia	2013	• Cost savings • More flexible and scalable information system • Faster deployment of public services • Robustness of public administration information system solutions	• Creating a secure environment for citizens, businesses and public administration • Optimum use of information technologies in public administration through a shared services platform • Provide all type of cloud services • In order to make the use of cloud services easier for the consumers, they will be listed in a catalogue • Information systems to be set

			up as part of new projects will be implemented within the framework of the eGovernment cloud platform (the “cloud only” rule)
Slovenia	2014	• Cost savings • Economic impact for the private sector	• Increased innovation opportunities for service providers, including SMEs and public administrations, evidenced through implementations of advanced cloud infrastructures and services • Promotion of the reuse of open data and open service solutions in cloud environments, in particular published by public administrations

Chapter 3

STANDALONE CLOUD APPLICATIONS

3.1 ITALY

3.1.1 DEPARTMENT OF TREASURY CLOUD

The Department of Treasury of the Minister of Economy and Finance has a cloud platform (DT Cloud) providing services that can be used internally and by other public administrations, with the prospect of creating a national cloud [3, 4].

3.1.2 MINISTRY OF FOREIGN AFFAIRS

The Ministry of Foreign Affairs has developed a private Cloud ("Maecloud" project) to ensure service continuity for Italians citizens and enterprises residing abroad, by strengthening active and passive security as well as the ICT safety of diplomatic consular offices located in areas of high conflict. Public administrations communicate with each other through networks of public connectivity: S-RIPA and SPC. Public administrations, foreign offices and central offices of the ministry are connected by SIFC (integrated system board functions), a platform that integrates the management of services for citizens abroad and for enabling co-operation between public administrations, to increase the effectiveness of communication with and from the public abroad. In terms of services to citizens, there is "SECOLI", the online portal of consular services. In this framework, "LIMES" is a line computer dedicated to communication and migration for data security in all situations of emergency where you can find the registered diplomatic consular [3, 5].

3.1.3 INSTITUTE FOR SOCIAL PROTECTION – INPS

The National Institute of Social Security (INPS) has implemented a private cloud, offering a catalogue of services provided in the cloud direct to internal and external users, and to public and private entities with a view of subsidiarity [3,6].

3.1.4 EMILIA ROMAGNA REGION

A first example of a regional approach to cloud is the "fedERa system" (Federation of Organizations for the authentication of Emilia-Romagna Region). It was created to make it possible for citizens to have access to all the online services of organizations and the public of the Emilia-Romagna region through a single access credential. The objective is therefore to be a technical and organizational infrastructure, common to public agencies in the Emilia-Romagna region, to manage shared access to online services provided by the federated entities.

Currently the federation involves the municipalities of the region of Emilia-Romagna, but also some universities, local health authorities, professional associations, WISP (service providers of connectivity over Wi-Fi). All online services that expose these individuals the citizen accesses with the same credentials in a way that allows the access provider to be certain of the identity of the citizen and to allow the citizen to secure access to all the data and services on display. FedERa is a project promoted by the Emilia-Romagna region telematics plan 2007-2009 [3, 7].

3.1.5 TUSCANY REGION TIX 2.0

The Tuscany region has inaugurated the "TIX 2.0 project" which aims to transform the data center physical infrastructure to a virtual mode service center in order to deliver on-demand services, selected

from a catalogue service, to public administration bodies in Tuscany. In particular its goals are to create:

- A service center and technical support center for the more than 400 public entities constituting the Tuscany region telecommunications network (RTRT), tasks previously performed by the regional structures;
- An interchange point between the network operators' commercial internet (internet service provider) networks and public administrations. This is to allow the communication infrastructure of the RTRT to evolve into becoming multi-supplier, anticipating the purposes of the public connectivity system, as defined in legislative decree no. March 7, 2005 n. 82 Digital Administration Code (CAD) [3].

3.2 THE NETHERLANDS

3.2.1 OPEN DATA PORTAL

Open data is offered by central government to society and is supported by various public cloud-based solutions [8, 9, 10].

3.2.2 INTERNAL COLLABORATION: YAMMER

For informal internal communication a group of civil servants (but certainly not all) use Yammer. Cloud-based social media platforms like Facebook and Twitter are used for formal and informal communication [3, 11].

3.2.3 MOBILE SERVICES

Within the central government, multiple cloud-based mobile device management platforms are in use. Those platforms run at their own on premise data centers [3].

3.2.4 CLOUD-BASED DISASTER RECOVERY

The government site crisis.nl is will be used in case of a disaster or national emergency. Crisis.nl runs on the Microsoft Azure cloud [3, 12].

3.3 ROMANIA

It is intended that the following services are to be offered by using governmental/public cloud infrastructures:

- Easy and rapid information exchange with the public
- Participative governing
- Sharing points of view, news and events within the government
- Internal messaging
- Rapid intra-governmental messaging
- Faster, more efficient technical support
- Standardization
- Interoperability
- Migration of previous systems to a SOA
- Web-hosting for the government

3.4 PORTUGAL

Despite not being pure cloud solutions, commercially speaking, since those are merely internet portals whose features are accessible without the need to install software on the user computer, Portugal has several applications available for citizens and public administration entities, in the scope of social security, fiscal services, as well as financial and human resources management.

Regarding citizens, the Portuguese public administration provides internet portals with information, features and services for key administrative areas, particularly in the context of social security, taxes and customs administration:

- http://www.portaldasfinancas.gov.pt/
- https://www.seg-social.pt/consultas/ssdirecta

Note that currently the majority of citizens manage their affairs and submit their tax declarations electronically. Likewise, communications between the tax authorities and citizens are preferably electronic.

The access to these services is achieved by user authentication (login/password) or by using the Portuguese citizen card that has on-chip integrated digital signature and authentication certificates.

In the services domain where stakeholders are central and decentralized public administration entities, the Ministry of Finance, through ESPAP, provides several tools such as shared services finance (GeRFiP) or human resources management (GeRHuP).

The GeRFiP (https://mfap.gerfip.gerap.gov.pt) integrates logistics, financial, budgeting and assets management and has 310 user entities. It processes 13,150 invoices or documents per month. The system aims to provide quality services and contribute to the reduction of costs supported by integrated, standardized and best practices in financial (budgetary accounting, general accounting, receivable and payable accounts, assets or contract managements) and logistics management (goods and services purchases or sales and distribution management).

For its part, the GeRHuP (https://gerhup.gerall.pt/) supports the processes of the life cycle of the public servant, in the context of administrative human management, particularly in the areas of organizational management, employee archives and temporary or permanent work suspension.

Currently, 1,820 public servants have their salaries processed by GeRHuP. There are around 600 participating entities that achieved, using the application, more than 151,000 workers' performance evaluation processes [3].

3.5 SLOVAKIA

As mentioned in 7.1.5, DCOM is the major project for the establishment of a Slovakian cloud infrastructure in 2016. The specific benefits of DCOM regarding application are manifold. Within the DCOM infrastructure 138 SaaS services will support the competencies of municipalities through unified services delivery even to small villages, e.g., certified back office solutions for municipal offices, central support and upgrades.

3.6 AUSTRIA

3.6.1 E-GOVERNMENT PORTAL - PORTAL.AT

One of the best known cloud infrastructures, which plays a major role in Austrian eGovernment (and governmental ICT) comes through the shared service portal "Portal Austria – portal.at", based on the enterprise "eGov Portal Services" portal solution. This central governmental portal solution represents a shared-ICT-service portal and has been running since 2001.

Portal Austria offers a central web-based entry point (single sign on) for more than 130,000 governmental users and works as an overarching organizational access management system for more

than 400 applications and more than 40 intranet and internet portals. Examples of services, accessible through Portal Austria are the central federal personal management, the federal billing allocation, the system of resident registration or the central land registry.

Portal Billing service automatically performs the accounting task for all applications to the user organizations on a quarterly basis and is connected directly to the federal SAP and printing facilities. Moreover, the constitutive technology – the "eGov Portal Services" – is the basis for the most frequently visited governmental citizen portals, such as "HELP.gv.at" (for citizens), "USP.gv.at" (for the economic) and "Gesundheit.gv.at" (Health services).
The standardized shared-ICT-service portal supports the attempt of the Austrian Government to make sustainable savings in ICT development and operation. A central aspect in reaching this goal is the interplay of high security standards on the one hand and a highly automated self-administration of the organizations and users of the concerned administration organizations on the other. Portal Austria received the EuroCloud Award in 2012 [3].

3.6.2 WORKFLOW MANAGEMENT – ELAK

ELAK represents the central federal filing and workflow management within and between central federal agencies (over all federal ministries). ELAK is deployed as an application service provider (ASP), but has restricted additional functionalities, such as a central administration and a shared infrastructure and security concept, which brings the application closer to a cloud application. A self-provisioning would be possible, but, due to legal restrictions, this functionality has not yet been rolled out.
ELAK is deployed on a shared infrastructure for all federal ministries and their subordinate agencies. The infrastructure exhibits a high elasticity and scalability, as it would be needed within a specific cloud solution. In contrast to pure cloud solutions, ELAK does not yet have dynamic accounting [3].

3. 6.3 OPEN DATA CATALOGUE - DATA.GV.AT

Since 2012, data.gv.at has been the central Austrian open data catalogue that allows Austrian public authorities to use self-administration via portal group protocol (PVP) and has been built on open source software. Data.gv.at came third at the EuroCloud Award in Austria in 2012 [3].

3.6.4 MAILBOX AS A SERVICE – MAAS

Mailbox as a Service (MaaS) includes the provision and operation of Microsoft Exchange 2010 mailboxes as a shared service for ICT workspaces. Customers acquire, use and administer their own mailboxes that are provided in a central, highly available and multi-tenant infrastructure. Secure client access is possible either using the Outlook client or Outlook Web App (OWA) via a hardware load balancer on the underlying HUB/CAS array. Data management is redundant in a data availability group in the central storage. Each active database has three passive copies that are distributed across two sites. A multi-stage anti-spam/anti-virus solution is also part of the platform.
The multi-tenant Exchange on premise installation is operated in a resource forest, from where there is a connection to the trust-account-forest of the customer, in which the user's access management takes place, to ensure that no additional login to the mailbox is required [3].

3.7 SPAIN

3.7.1 SARA APPLICATION SERVICES

In Spain, there are several services provided in a cloud model through the SARA network. Examples are the eInvoicing platform, the application registry, email, the civil servants payroll system, the eDelivery platform and the eSignature platform.
This service is a virtual face-to-face office that can be provided as a SaaS service or as an IaaS service, depending on the necessity of the user. It was born as a cloud service, as it didn't exist before. The provider of the service is the Ministry of Finance and Public Administration, and the user would be in any administrative face-to-face office, independent of the level of administration, whether central, regional or local.

Over the "Red SARA" network, an infrastructure for the exchange of electronic documents, called SIR, was developed as the interoperability infrastructure to exchange citizens' applications in a common format. This infrastructure is part of the national interoperability framework that is also part of the eGovernment legal framework.

Some public organizations used the SIR network as an IaaS service, so they could provide their employees in the face-to-face offices with the final software application to register citizens' applications. However, due to the fact that not all of them could afford the integration with the IaaS service, and because of lack of investment possibilities or technical difficulties, the Ministry of Finance and Public Administration provided a SaaS solution to public organizations with face-to-face offices, called ORVE. The idea of this cloud service is the digitization of citizen forms presented in hard copy in a face-to-face office in order to be included in the electronic back-office of the administrative unit. The citizens' applications are sent, following the interoperability standards defined in the national interoperability framework, via the SIR platform to the destination administrative unit that analyses the forms. Both solutions can be implemented in any country with an internal administrative network, as it has a high level of modularity and is based on open source platforms. Currently, there are 314 municipalities covering 3,149 face-to-face offices that already use some of these two cloud services. The estimated savings of this usage are of €997,329 [3].

3.8 SLOVENIA

The decentralized ICT in Slovenia provides services to the administrative units, economic sector and citizens from independent data centers located at ministries, agencies and similar. Standalone applications are also hosted independently and huge savings are expected after consolidation and their evolution into cloud services. However, most of the applications hosted by the Ministry of the Interior are cloud-ready, due to the standardized platforms and clear development strategy. Several international award-winning portals already exist, which will be used as the main entry points for end customer services within the hybrid cloud.

3.8.1 ONE STOP SHOP FOR BUSINESSES – E-VEM

The portal e-VEM - one stop shop has been operating since 1 July 2005. The basic purpose of the e-VEM project is to provide a suitable information support for the future entrepreneur and enable him/her to start business operations in the shortest time possible. The project covers two types of activities and relationships: state - legal persons (G2B) and state - state (G2G). The e-VEM portal was co-financed by the European Social Fund.

3.8.2 THE E-DEMOCRACY SYSTEM

The preparation and the final formation of regulation is a process, in which the ministries, the public, the government offices, the government and the national assembly are actively involved. The system allows coverage of all essential steps in the process of adopting a legal act, operating uniformly in all spheres of competence, which are involved in the process of preparing and adopting legislation. The portal e-Democracy was co-financed by the European Social Fund.

3.8.3 PIS - LEGAL INFORMATION SYSTEM

The PIS portal provides free access to legislation documents, a number of other public sector related documents, and documents released by the institutions of the European Union and the EU Council. This register of regulations of the Republic of Slovenia is linked to the collection of regulations of other state bodies and the official gazette of the Republic of Slovenia. From the technical perspective, this system is very important as it is the first system based on the NoSQL MongoDB database.

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