IMPACT OF CLOUD COMPUTING TECHNOLOGY IMPLEMENTATION IN PUBLIC SECTOR

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ABSTRACT
Nowadays the information technology area is changing, technological rush is brewing and the impact is felt all across organization in public and private sector. The importance of cloud computing is playing important role in the IT strategies and sustainability of organizations. If we want to improve efficiency and business processes, furthermore to reduce emissions of IT operation, we must improve them with implementing cloud computing technologies. A cloud computing service is the fastest way to make a revolution in IT, with low costs, agility, flexibility and scalability. In this paper we will discuss about the factor influencing cloud computing implementation impact in Romanian public transportation sector use a combination of already existing methods, such as fishbone diagrams (Ishikawa diagram). In this research we proposed to use a qualitative study by using a multiple case study. Finding it also explores the cost and security benefits of cloud computing implementation in public and private sector. We will evaluate the opportunities and challenges of the new way of delivering computing resources and services, using 3 aspects (management, IT and security).

KEYWORDS: *Cloud Computing, Public Services, Improving, Challenges.*

JEL CLASSIFICATION: *O32, M15, M20*

1. INTRODUCTION

Nowadays we are witnessing about faster development of Information Technology and Communication. According (Consulting, 2015) in 1960's the first concept of cloud was born. It was suggested as an "Intergalactic computer network", a system through which people around the world could be interconnected and able to access programs and data from anywhere Professor Ramnath Chellappa first used the term "Cloud Computing" in 1997. Its trend to using cloud computing services for real-time applications and improves the connection between passenger and vehicles, vehicles and vehicles. Cloud computing services is best solution for increase operational efficiency and productivity, at the same time lowering the costs and maximizing the investments.
According (Alex A.) To allow a team to identify, explore, and graphically display, in increasing detail, all of the possible causes related to a problem or condition to discover its root cause(s). The diagram facilities the identification of key process variables when frequency or other types of data are not available. Because of its appearance, the cause and effect diagram is also called the fishbone chart. Another common term used is the Ishikawa chart, after Kaoru Ishikawa, who

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popularized, the use of the chart in Japan. Its most frequent use is to list the cause of particular problems. The lines coming off the core horizontal line are the main causes and the lines coming off those are sub causes. From all of the factors on the fishbone, the five or six believed to be most important are the factors to measure and whose variability should be reduced. The research questions: What are the costs of cloud computing for public organizations, are there any benefits? Are there any security risks? In this research we will find the answer of this research question by testing some hypotheses, to improve the public services in Romania.

2. CLOUD COMPUTING

The idea of cloud computing was introduced by scientist John McCarthy publicly in 1961: *"If computers of the kind I have advocated become the computers of the future, then computing may someday be organized as a public utility just as the telephone system is a public utility. ... The computer utility could become the basis of a new and important industry."*
According National Institute of Standards and Technology, Cloud computing is a model for enabling ubiquitous, convenient, on-demand network, access to a shared pool of configurable computing resources e.g., networks, server, storage, application, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction.
According (Thomas, 2013) Cloud computing is a specialized form of distributed computing that introduces utilization models for remotely provisioning scalable and measured resources.
As shown in (Erik, 2014) you don't need to go out and buy a computer, or write any code or set up a network. All you care about is that the service offered is available and reliable. As more users join the game, the cloud is able to quickly grow or shrink to meet the change in demand-elasticity in techie terms. There are several positive side effects that come along with this. Business or departments within businesses can focus on their core competencies as opposed to worry about how some technology works. Smaller companies can get access to technologies and services in the cloud that were only available to the biggest firm s a mere five years ago. And the fact that almost all cloud computing services are pay as you go (PAYG) makes it very easy and economical to adopt this model.

2.1. Cloud computing essential characteristics

As demonstrated (Peter, 2011) Cloud model is composed of five essential characteristics, three service models, and four deployment models.

Essential Characteristics:
On-demand self-self-service. A costumer can unilaterally provision computing capabilities, such as server time and network storage, as needed automatically without requiring human interaction with each service provider.

Broad network access. Capabilities are available over the network and accessed through standard mechanisms that promote use by heterogeneous thin or thick client platforms (e.g., mobile, phones, tablets, laptops, and workstations).

Resource pooling. The provider's computing resources are pooled to serve multiple consumers using a multi-tenant model, with different physical and virtual resources dynamically assigned and reassigned according to customer demand. There is a sense of location independence in that the customer generally has no control of knowledge over the exact location of the provided resources but may be able to specify location at higher level of abstraction (e.g., country, state, or datacenter). Examples of resources include storage, processing, memory, and network bandwidth.

Rapid elasticity. Capabilities can be elastically provisioned and released, in some cases automatically, the capabilities available for provisioning often appear to be unlimited and can be appropriated in any quantity at any time.

Measured service. Cloud Systems automatically control and optimize resource use by leveraging a metering capability at some level of abstraction appropriate to the type of service (e.g., storage, processing, bandwidth, and active user accounts). Resource usage can be monitored, controlled, and reported providing transparency for both the provider and consumer of the utilized service.
(Peter, 2011) Defined three Service Models:

Software as a Service (SaaS). The capability provided to the consumer is to use the provider's applications running on a cloud infrastructure. The applications are accessible from various client devices through either a thin client interface, such as a web browser (e.g., web-based email), or a program interface. The consumer does not manage or control the underlying cloud infrastructure including network, servers, operation systems, storage, or even individual application capabilities, with the possible of limited user-specific application configuration settings.

Platform as a Service (PaaS). The capability provided to the consumer is to deploy onto the cloud infrastructure consumer-created or acquired applications created using programming language, libraries, services, and tools supported by the provider. The consumer does not manage or control the underlying cloud infrastructure including network, servers, operating systems, or storage, but has control over the deployed applications and possibility configuration settings for the application-hosting environment.

Infrastructure as a Service (IaaS). The capability provided to the consumer is to provision, processing, storage, networks, and other arbitrary software, which can include operating systems and applications. The consumer does not manage or control the underlying cloud infrastructure but has over operating systems, storage, and deployed applications; and possibly limited control of selected networking components (e.g., host firewalls).
According (Peter, 2011)

Deployment Models:
Private Cloud. The cloud infrastructure is provisioned for exclusive use by a single organization comprising multiple consumers (e.g., business units). It may be owned, managed, and operated by the organization, a third party, or some combination of them, and it may exist on or off premises.

Community cloud. The cloud infrastructure is provisioned for exclusive use by a specific community of consumers from organizations that have shared concerns (e.g., mission, security requirements, policy, and compliance considerations). It may be owned, managed, and operated by one or more of the organizations in the community, a third party, or some combination of the, and it may exist on or off premises.

Public cloud. The cloud infrastructure is provisioned for open use by the general public. It may be owned, managed, and operated by a business, academic, or government organization, or some combination of them. It exists on the premises of the cloud provider.

Hybrid cloud. The cloud infrastructure is a composition of two or more distinct cloud infrastructures (private, community, or public) that remain unique entities, but are bound together by standardized or proprietary technology that enables data and application portability (e.g., cloud busting for load balancing between clouds).

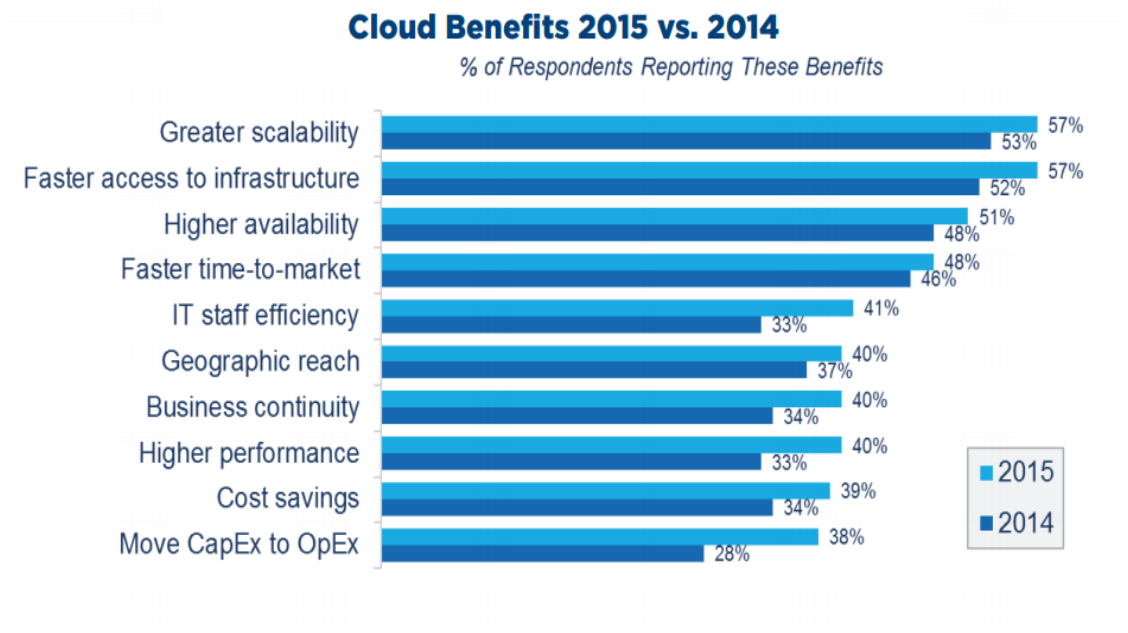

Figure 1. Cloud Computing benefits
Source: adapted (RightScale, 2015)

As shown in **Figure 1. Cloud Computing benefits,** cloud computing benefits enables the users to have a transparent view, service levels and services which can be expected from cloud providers.

2.2 Methodology and data analysis

As shown in (Michael, 2015) In 2015, 63% of businesses utilized a private cloud services, with 88% using public cloud services, according to the study. Similarly, 82 percent of businesses us a hybrid cloud setup to run their operations. Cloud usage is expected to become even more widespread in 2016, with slant estimating that 36% of all data will be stored in the cloud by the end of the next year. The federal government reported saving 5.5 Billion dollars per year by switching to cloud-based-services. Saving was also prevalent for private companies, with 64 percent reporting reduced waste and energy consumption due to their cloud usage, according to the study. Improved security, services stainability, data efficiency and lower operating costs also factored into private businesses reasons for increased cloud usage.

According (Consulting, 2015) consumers too are benefitting from the cloud without even knowing it. A whopping 95% of Americans are using services in the cloud, however only 29% actually reported using the cloud; 14% have pretend to know what the cloud is in a job interview; 17% have done so during a firs date; and 10% are honest and say they have never heard of the cloud.

As shown in (Louis, 2015) report the global SaaS market is projected to grow from $49B in 2015 to $67B, attaining a compound annual growth rate (CARG) of 8.14%. Global spending on Infrastructure-as-a-Services is expected to reach $16.5B in 2015, an increase of 32% form 2014.

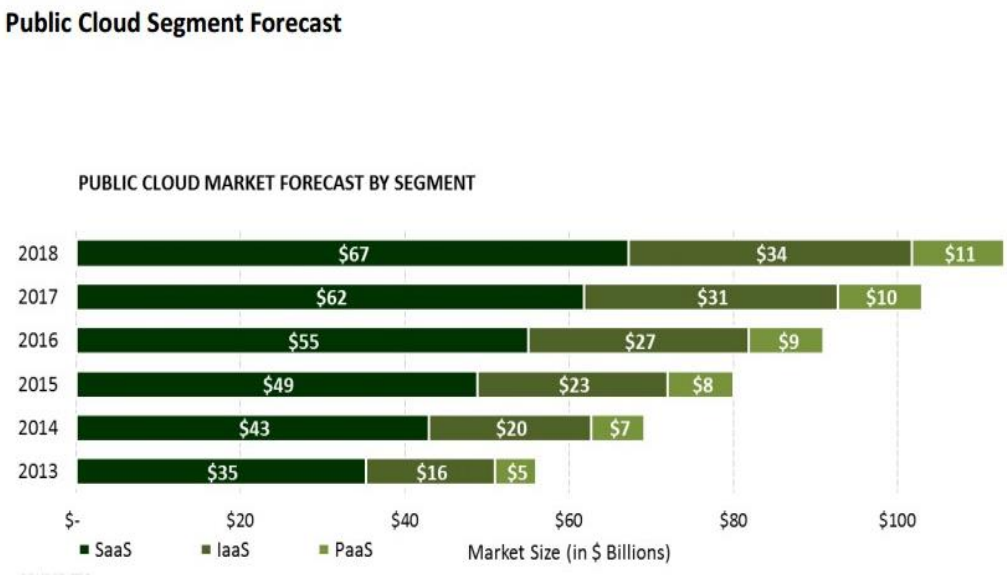

Figure 2. IaaS vs SaaS vs PaaS (PUBLIC CLOUD MARKET FORECAST BY SEGMENT)
Source: adapted (Louis, 2015)

As shown in **Figure 2. IaaS vs SaaS vs PaaS (PUBLIC CLOUD MARKET FORECAST BY SEGMENT)**, the global Software as a Services (SaaS) market is he leader of cloud services and is projected to grow from $55B in 2016 to $67B in 2018, attaining a compound annual growth rate of 8.4%. Global infrastructure-as-a-services (IaaS), spending globally is projected to grow from $27B in 2016 to $34B in 2018, attending compound annual growth rate of 10.27% in the forecast period. According (Juan, 2015) Cloud Computing represents the top enterprise IT spending in 2015, even beyond other hot growing technologies like Mobile and IoT. IaaS in 3 years will represent: 35% of cloud use cases (compared with a 65% of SaaS and Paas).
As shown in (Fernando, Cloud Computing Concerns in the Public Sector, 2011) several issues may arise when public sector organizations consider transitioning to cloud computing.

- ✓ Control: Managers naturally want to determine how and where elements of the ICT system are deployed and used. Cloud Computing raises questions of ownership and accountability within ICT groups, across the organization, and extending to service providers and other vendors;
- ✓ Security: Organizations must keep systems safe from intrusions, and they need to safeguard information, privacy, and, in the case of research institutions and universities, intellectual property.
- ✓ Reliability: An ICT group must be able to trust in the reliability and resilience of its clouds implementation, especially when it supports mission- critical applications.
- ✓ Quality: CIOs are concerned that consistency and quality should not be compromised and that service-level agreements (SLAs) can be maintained.
- ✓ Ownership: When ICT is arranged in a new way, there are questions about who should manage which resources and who should pay for services that are shared. Data governance becomes an issue in cloud deployments when data is stored in locations outside institutional and territorial boundaries.
- ✓ Interoperability: A traditional reliance on separate system infrastructures makes cloud technology an unfamiliar option in the public sphere.
- ✓ Portability: Adopting a cloud approach should not lock the organization into applications, equipment, or services from a narrow spectrum of vendors and providers.
- ✓ Standards: Because cloud technology is relatively new, industry standards and best practices are still being developed.

- ✓ Vendors: Competing platform and proprietary approaches complicate the cloud marketplace. In addition, there is a perception among some CIOs that cloud oriented vendors still do not fully understand the needs of public sector organizations.
- ✓ Governance: ITC group must decide what new organizational approaches are needed, including the need to focus more on intelligent services and supporting interactions among business group.
- ✓ Culture: Public sector organizations may resist approaches that make it appear that they are giving up or privatizing their resources. Cloud-related innovations may also stir institutional opposition among those who resist change or fear that well-established procedures could be compromised.
- ✓ Compliance: Organizations must be sure they can comply with all relevant government regulations. Examples include regulations pertaining to privacy, such as the U.S Health Insurance Portability and Accountability Act (HIPAA) and the European Data Privacy Directive; accountability laws, such the U.S Sarbanes-Oxey Act; and legislation concerned with security, such us the U.S. Federal Information Security Management Act (FISMA).
- ✓ Risk Assessment of risk needs to include anticipating a course of action if a cloud service provider fails to deliver services or goes out of business.

(Vincent K. Omachonu, 2005)The cause–and-effect (CE) diagram was developed by Dr. Kaoru Ishikawa of University of Tokyo in the summer of 1943, while he was explaining to some engineers at the Kawasaki Steel Works how various factors can be stored out and related. For this reason, this diagram, stems from the fact a completed diagram resembles the skeleton of a fish. The primary purpose of the Cause and effect diagram is to show the relationship between given effect and all identified causes of that effect. There are typically several major causes for any given effect. Therefore, a CE diagram assists the team in gathering and organizing the possible causes, reaching a common understanding of the problem, exposing gaps in existing knowledge, ranking the most probable studying each cause. Dr. (Ishikawa, 1982) invented the fishbone diagram, also now as Ishikawa diagram. The Ishikawa diagram is an analysis tool that provides a systematic way of looking at the causes and effects that create or contribute to those effects. As shown in **Figure 3 Fishbone (Ishikawa diagram cause-effect)**, we have an example with fishbone diagram, using a method for identifying cause and effect in implementation of cloud computing technology.

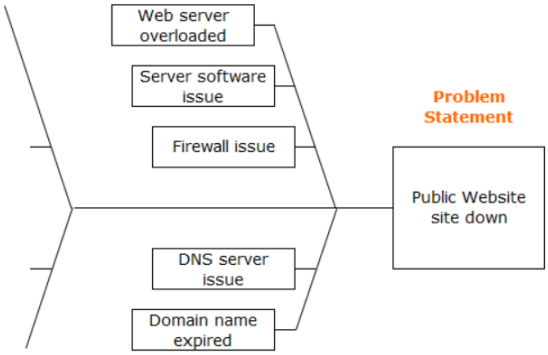

Figure 3. Fishbone (Ishikawa diagram cause-effect)
Source: authors

In our research we found case studies who's implement the cloud computing technologies in public sector. Our first example of first case studies is the Regional Government in Spain. The Regional Government of Castilla-La Mancha, Spain which employs 72 000 administrators, educators and

health care workers, mostly dispersed in small towns and rural areas, developed cloud strategy for e-government application (for pensions, taxes, drivers licenses, online learning and virtual classrooms) and they reduce physical data centers form 48 to 2, and have savings about 400 000 E. The IT department of New Mexico created private cloud (based an Cisco UCS platform) for state agency's needing which support internal and citizen-facing allocations. With this kind of operation on virtual platforms, state saves a lot of money, energy and space. Another example is MDI – health care administration leader, serving 31 US states, which cloud infrastructure supports SaaS business that give clients web-based access to analytical tools. With the new server and storage, company can manage all the resources as a single redundant. "We're able to sprint while other companies are still walking" – Billy Steeghs (senior vice president of IT). Cisco Network Academy, global educational program for teaching students about building, design, troubleshoot and secure mobile networks which is collaborating with institutions and communities. Cisco Academy uses cloud-based curricula and instructional tools for some of its online courses and they employs Cisco WebEx teleconferencing technology to deliver training opportunities and engage classroom teachers in more then 165 countries. Chinese University of Hong Kong realize that the 14.300 students has need for more power in order to purchase their own network hardware, servers and computers, so ICT group of CUHK created private cloud platform based on Cisco Data Center Business Advantage Architecture. This cloud allowed centralizing and virtualizing of all the center and network data resources. With this, the budget is much easier to manage with (ICT monthly charge the cost to departments) and operational efficiency is increased.

H1: Cloud Computing is applicable in public sector.

Conform (Russell, 2009) Some public sector organizations have made early moves into cloud computing. For example, in Washington, D.C., all 38,000 city government employees have unlimited access to Google documents and services such as Gmail. The U.S. General Services Administration recently announced moving the government-wide portal usa.gov to the cloud and issued an RFI for cloud infrastructure services. In Japan, the Ministry of Internal Affairs and Communications has announced plans to shift all government agencies into a private cloud environment by 2015. We are witness of many cloud computing technology implementations in public and private sectors, and many examples mentioned in this research has confirmed this hypothesis.

H2: Cloud computing implementation will have a positive effect.

Table 1. Private vs Public Computing costs (Total cost of ownership of private vs public cloud over 5 year period)

The Total Cost of Ownership of Your Private Cloud Over a 5 Year Period			**The Total Cost Of Ownership Using A Hosted Cloud Over a 5 Year Period**		
DESCRIPTION	***QUANTITY***	***AMOUNT***	***DESCRIPTION***	***QUANTITY***	***AMOUNT***
Physical Servers & Vmware Licensing	5	**$103,000**	GB of Memory (N+2 Redundant)	395	**$426,600**
Storage Area Networks (SAN)	1	**$28,890**	GB of SAN Storage Space	1000	**$36,000**
Network Switches	2	**$50,958**	Network Switching	0	**0**
Server Cabinet & PDUs	4	**$8,000**	SSAE-16 SOC II Computing Environment Audits	0	**0**
Power and Cooling Costs	3744	**$240,000**	Tier III+ Data Center	0	**0**
Number of Systems FTEs to manage the environment	2	**$750,000**	24x7x365 Onsite Support	0	**0**
		$1,180,848			**$462,600**

Source: authors

As we can see from our analysis shown in **Table 1. Private vs Public Computing costs**, using private cloud, we have costs that are with 60% higher, comparing with the public cloud costs. This analysis are for period of 5 years for identical performance of computing.

H3: Security have a positive effect on cloud computing implementation. Analyzing data from our research we are confirming this hypothesis with literature review and case studies. According (Fernando, Cloud Computing Concerns in the Public Sector, 2011) Keeping data secure and personal information private is critical for any ICT implementation today, but particular for those that serve large numbers of citizens. As ITC systems are extended and merged, there is growing fear that sensitive data that is collected and held by public entities will be vulnerable to criminal hackers or other types of unauthorized disclosure. This threat is magnified when a piece of crucial identity information such as a social security number, can be linked to other information about that individual residing on the network, such us financial or health record.

A security breech is inconvenient for individual users, but it can be a catastrophe for an organization whose reputation, credibility, and legal standing is at stake. Public sector organization are especially vulnerable because their operation are tied so closely to the public's trust. When the relationship between organization and citizen is damaged, it is very difficult to repair. And lawsuits arising from assaults on privacy not only taint public perception, but can also deplete public funds.

Citizens are understandably worried about security, performance, privacy with cloud computing applications. They are concerned whether confidential information stored by public agency are secured. Many of them don't understand cloud computing, so they are conceded that the metaphor of soft and ever-moving cloud will not protect their information.

3. CONCLUSIONS

As we noted in our research, cloud computing technologies will be the next evolution in the history of computing. Cloud computing is offering flexibility, low cost, we don't need to purchase IT infrastructure If we want to test some applications, we can rent from cloud computer services providers. Cloud services offers huge opportunities to the IT industry. We are trying to improve the Romanian public sector services with implementing cloud computing technology, like a best solution for computing using some of existing methods like Ishikawa diagram (fishbone cause-effect), to identifying the possible issues in implementing cloud computing technology in public sectors and services for general interests. As conclusion of our research, the public cloud is much rentable comparing with private cloud. This article is only a beginning of our research, and we well prove a better understanding of cloud computing and identify the right directions in this new area. Cloud computing is the best solution for the current times due, at least in flexibility, cost efficiency and security.

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