

The Usage of IT&C Tools in the Public Administration Decision Processes. Case Study Bucharest, Romania

Shuleski Darko

The Bucharest University for Economic Studies, Romania
darko.shuleski@man.ase.ro

Birsan Alexandru

The Bucharest University for Economic Studies, Romania
alex_brsn2007@yahoo.com

Liviu-Catalin Pricop

The Bucharest University for Economic Studies, Romania
catalinpricop86@gmail.com

Crina Veronica Cristea

The Bucharest University for Economic Studies, Romania
crina.cristea@gmail.com

Abstract. When we think about public administration, we usually think about the group of public institutions that are developed and function within a society and which aim at managing public activities and businesses. Some specialist such as Paul Marinescu consider, this may be the only form of both social and economic organization of a country, which is capable of dealing with modern world challenges. Despite this so called mutation, the basics of the public administration is somehow similar with those of the enterprises, with little differences mostly related to the working procedures. Unlike enterprises, public institutions, as parts of the public administration, are characterized by a greater resistance in terms of change management, which affect their alignment with the technological updates and upgrades. Nonetheless, among the world there are examples of public institutions, the most relevant being those of Estonia, that have adapted to the technological breakthrough which use different online tools when it comes to collecting taxes, voting or public communication. The aim of our paper is identifying the main characteristics of the public administration in Romania/Bucharest, with focusing on the way that IT&C tools such as, business Intelligence, cloud computing or collective network can improve the existing way of working. Currently in Romania the IT&C solutions used in public administration are insufficiently developed or outdated. In this research we will use the qualitative methodology, to improve the public sector services in Bucharest, Romania. Most public institutions lack the implementation of advanced management methods and techniques and use inconsistent applications, developed in various programming environments, which have a low efficiency. In this research we are trying to improve the way of taking decision in public sector at the highest level based on Business Intelligences solutions. Also, there is a lack of an intranet system for each administration to enable interconnection of all organizational links. Only a fully integrated system developed for each public sector will help focus on obtaining efficiency and managerial performance. This aims to create appropriate organizational framework for the development, implementation and operation of IT&C solutions that contribute on operating focused on economy, efficiency and effectiveness.

Keywords: business intelligence, cloud computing, virtual intelligent network, improving public services

1 Introduction

Business Intelligence (BI) comprises the strategies and technologies for the data analysis of business information (Dedić 2016) and can be used by enterprises to support a wide range of business decisions, from operational to strategic.

The trend is to implement business Intelligence effectively in both the private and public sectors. While in private companies, BI is mainly used to improve the competitive advantage, by means of market analysis, basket analysis and attrition assessment, in the public sector, most of the applications are meant to prevent fraud or crime, reduce inefficiency and measure performances.

In Italy they, law nr. 150/2009 was issued and the Italian administration was forced to adopt a Business Intelligence system to measure its efficiency and internal production capabilities. The system relies on the measurability of the achieved results, comparing them to the expected output, in order to impose a “management by objectives” approach to public administration managers. The main aim of the system is to reduce inefficiency. Each department of the administration is awarded a score, based on their performances. Lower-than-expected efficiency may result in increased auditing and eventual penalization. Good or excellent performances may instead be rewarded (Il bilancio dell’esercito e il controllo interno di gestione 2011). The British government believes that : “Cloud computing has brought about a step change in the economics and sustainability of Information and Communication Technology (ICT) enabled service provision. Government is committed to the adoption of cloud computing and delivering computing resources to users as needed (an on-demand delivery model). By exploiting innovations in cloud computing we will transform the public sector ICT estate into one that is agile, cost-effective and environmentally sustainable.” (HM Government 2011) In Romania, the IT&C solutions used in public administration are insufficiently developed or outdated and they need improvement. Most of the Romanian public institutions lack the implementation of an advanced management system by using inconsistent applications. An intranet system for each administration is needed in order to interconnect all of the organizational links. Only a fully integrated system developed for each public sector will help focus on obtaining efficiency and managerial performance. In this paper we trying to create a model for automatization of decision making process approach in public transportation sector in Bucharest. Automatization with combination of IT&C technologies Business Intelligence, Cloud Computing, Virtual Networks.

1.1 Business Intelligence

Business intelligence is a technology-driven process that helps analysing data and presents the results as information to help end users make better business decisions. Through a variety of tools, applications and methodologies B.I. makes organizations able to collect data from internal systems and external sources and by analysing it, creating reports and dashboards turn it into valuable information to improve and optimize the decisions and the performance of both the managers as well as operational workers. A data warehouse is a federated repository for all the data that an enterprise's various business systems collect. The repository may be physical or logical. The term data warehouse was coined by William H. Inmon, who is known as the Father of Data Warehousing. Inmon described a data warehouse as being a subject-oriented, integrated, time-variant and non-volatile collection of data that supports management's decision-making process. (Rouse 2015) The queryable source of data in the enterprise. The data warehouse is nothing more than the union of all the constituent data marts. A data warehouse is fed from the data staging area. The data warehouse manager is responsible both for the data warehouse and the data staging area. Specifically, the data warehouse is the query able presentation resource for an enterprise's data and this presentation resource must not be organized around an entity-relation model because, if you use entity-relation modelling, you will lose understand ability and performance. Also, the data warehouse is frequently updated on a controlled load basis as data is corrected, snapshots are accumulated, and statuses and labels are changed. Finally, the data warehouse is precisely the union of its constituent data marts. The Data Warehouse Life Cycle Toolkit (Ralph Kimball) Data mart provides the primary access to the data stored in the data warehouse or

operational data store. It is a subset of data sourced from the data warehouse or operational data store specifically focused on a business function or set of related business functions. (Regers 2010) The data mart mostly holds only one subject area and concentrates on integrating information from that subject area or set of source systems. Taking a look at both Inmon and Kimball we can see two major points of view, one stating it is best to start with data marts and merge them together into a data warehouse (closer to Kimball's idea) and one that states it is best to start with a data warehouse (closer to Inmon point of view) "You can catch all the minnows in the ocean and stack them together and they still do not make a whale," (William 1998). "... The data warehouse is nothing more than the union of all the data marts ..." (Kimball 1996) Having big data means data sets vary widely and are mostly unstructured, complex, and in volumes that cannot be managed with traditional relational database methods. To address these limitations, some companies have introduced multiple data warehouses to help solve more high value business problems, be more efficient and be more competitive, realizing greater value from diverse and optimized data sets.

1.2 Cloud Computing Technology

Cloud computing has emerged as the natural evolution and integration of advances in several fields including utility computing, distributed computing, grid computing, web services, and service oriented architecture (Weiss 2007). The value and originality of cloud computing comes from packaging and offering resources in an economical, scalable and flexible manner that is affordable and attractive to IT customers and technology investors.

The cloud services as promoted by the vision of "everything as a service" (Robinson 2008) are: Infrastructure as a service (IaaS): Hardware resources (such as storage) and computing power (CPU and memory) are offered as services to customers. This enables businesses to rent these resources rather than spending money to buy dedicated servers and networking equipment. IaaS providers, e.g., Amazon EC2, offer virtual machines to customers where they can deploy and run their programs. Typically several virtual machines run on the same physical machine to address the problem of underutilization of physical resources. Statistics show that 80% of computing power and 65% of storage capacity is not efficiently utilized, where a single company privately owns dedicated machines (Carr 2008).

Database as a service (DaaS): A more specialized type of storage is offering database capability as a service. Examples of service providers are Amazon SimpleDB, Google BigTable3, Force.com database platform and Microsoft SSDS4.

Software as a service (SaaS): In this model, software applications are offered as services on the Internet rather than as software packages to be purchased by individual customers. One of the pioneering providers in this category is Salesforce.com offering its CRM application as a service. Other examples include Google web-based office applications (word processors, spreadsheets, etc.), Microsoft online CRM and SharePoint, or Adobe Photoshop and Adobe Premiere on the Web.

The trend is to implement the cloud- computing technology into the public sector. Usually public administrations are organized in silos: monolithic architecture models that make it difficult to re-use services for the development of new applications, while these services could be connected and offer access to information open. The European Commission is piloting the potential of a Cloud of public services for the development and the delivery of more flexible public services by combining building blocks and allowing service sharing between public and private providers. Ultimately the citizens should benefit from more personalized public services, provided also by third-party actors using public information. In turn, public administrations can experience savings and increased flexibility in services design and provision (Commission 2015).

A workshop on 'Cloud computing uptake in the public sector' in May 2014 illustrated how many cloud computing challenges are very similar, while only the applications vary. Knowledge is being shared between areas – with the experience of big science helping big cities deal with their own cloud

challenges – and this is beginning to have spill-over benefits. The exploratory workshop proved to be a valuable platform for such cross-fertilisation.

The EU research programme for 2014-2020, Horizon 2020 – in particular topic ICT8 of the 2014-2015 work programme (entitled ‘Boosting public-sector productivity and innovation through cloud computing service’) – offers opportunities for further practical cooperation.

Cloud-for-Europe (C4E) is a key piece in the European Cloud Computing Strategy. The public sector initiative will investigate the cloud procurement requirements of public organizations using pre-commercial procurement across Europe. It is a double partnership, on the one hand between public sector organizations, and on the other with industry.

1.3 Data analysis

According to Paul Marinescu, public institutions are made up of all the organized structures, developed within the society in order to manage the activities and public affairs. They are the only form of social-economic organization of the state capable of meeting the challenges of the modern world.

The main functions of public institutions within the democratic state are:

- Elaboration and adoption of normative acts;
- Implementation of laws;
- Supervising the enforcement of decisions taken at political level. (Marinescu 2003)

Public institutions have as their purpose the provision of public services. Unlike services provided by commercial companies, public services are distinguished by a number of defining features, such as:

- They have the ultimate purpose of meeting a social need;
- Produce effects through administrative management decision;
- From a legal point of view, they are governed by rules of public law;
- Public services include services such as water, electricity, gas or telecommunications. (Marinescu 2003)

Unlike clusters and virtual organizations respectively, public institutions are characterized by a specific organizational structure and their own goals and goals. Thus, their activity and organizational structure are defined by norms and regulations, regulated by the legislation in force, as opposed to clusters whose activity is defined independently. Moreover, if the fundamental objective of a cluster is to generate profit, being defined over a time horizon and quantified according to a predetermined benchmark, the objectives of public institutions depart from the SMART character, as defined by the literature in management, being defined as "serving the public interest". (Marinescu 2003) The public interest is defined as "that interest involving the guaranteeing and respect by the public institutions and authorities of the rights, liberties and legitimate interests of the citizens, recognized by the Constitution, the internal legislation and the international treaties to which Romania is a party, as well as the fulfillment of the attributions service, respecting the principles of efficiency, effectiveness and cost-effectiveness of the resource. (Drept Online 2004) Taking into consideration the specificity of public institutions, the implementation of collaborative platforms should take into account the following fundamental characteristics: (Urs 2015) The community - the public institutions represent the interface of the central and local administrations in the relationship with stakeholders (represented by citizens). Thus, the community to which it is addressed becomes the main actor, around which the infrastructure needed to implement an IT solution can be built.

- Interactivity - an interactive communication is about transforming both participants into both broadcasters and recipients, based on a successive exchange of messages and feedback. Therefore, collaborative platforms must ensure transparency of the communication process,

both by sending feedback as a form of response to citizens' requests, and by taking into account the feedback messages sent by them.

- Involvement - the result of focusing on the community and adopting a form of interactive communication is concretized by actions aimed at involving public institutions in solving daily problems and, implicitly, in serving the public interest.

The development of collaborative platforms at the level of public institutions is based on the structure of e-Government. This creates two alternatives, based on which collaborative platforms can be developed. If the perspective of communicating with citizens and the local community is strictly addressed, the IT solution can be grounded on the infrastructure provided by social networks. Otherwise, an IT solution that encompasses the work of public institutions, so that the information flow follows the working procedures, it is necessary to develop a platform according to their needs. The e-Estonia project aims to turn Estonia into one of the most advanced information societies in the world. The components of the project are targeted at the society as a whole, acting at the level of citizens, education, healthcare, infrastructure, government, financial services, business and utilities. (estonia 2017) The e-School component was introduced in 2002 and aims to improve communication between electors, teachers and parents in the learning process. Thus, 85% of Estonian schools and 95% of pupils are included in the project. (estonia 2017) The implementation of the Government's eHealth component resulted in a significant increase in transparency and understanding of government decision-making by citizens, as well as a reduction in the duration of a cabinet meeting from 4 hours to 90 minutes (estonia 2017). Also, the court's information system allows records of complaints at any time, saving and storing relevant information for a case, and hearings can be conducted by accessing the documents, without having to be present in the courtroom. (estonia 2017) The online voting system allows voters to participate in the electoral process in any country using a computer connected to the Internet. Thus, during the period of time, they access the system on the basis of their identity card and express their choice. One particular feature of the system is that the Electoral Commission records only the voting option, but not the identity of the person who voted. In the 2015 parliamentary elections, 30.5% of votes were cast through the platform, with voters currently in 116 countries. (estonia 2017). The implementation of the e-Estonia project has increased tax collection rates, enabled the digitization of registration procedures for a company or a real estate and increased the efficiency of the health care system.

2 Methodology

Decision analysis is a approach by decision making that allow managers to make a better decisions and to solve the problem. Our research is based on data analysis from Bucharest public sector and Estonian IT&C approach in public sector, also various books and scientific articles from IT&C domain.

3 Decision making under condition of uncertainty in Bucharest public transportation

3.1 Bucharest Public Transportation

Bucharest has the largest transport network in Romania, and one of the largest in Europe. The transport network is made up of two systems that operate independently of each other: a metro network METROREX and a surface transport network RATB. Bucharest's metro system consists of four lines (M1, M2, M3 and M4), 44 Bombardier trains and 33 IVA trains. In total, the network is 69.25 km long and has 51 stations with 1.5 km (0.9 mi) average distance between stops. It is one of the fastest ways to get around the city. (Metrorex 2017) RATB's bus fleet is made up of 1100 vehicles (in 2017) and 20 Trolleybuses supplement buses. RATB also operates a complex system of 26 tram lines and one converted light rail line. (Club 201)

Bucharest has one international airport “Henri Coandă International Airport”, located north of the Bucharest metropolitan area, in the town of Otopeni, Ilfov, and one private flights airport “ Aurel Vlaicu International Airport”, situated only 8 km north of the Bucharest city center. The transportation system in Bucharest, because of the lack of a good infrastructure causes a lot of problems to its inhabitants. The most noticeable urban transport problems are:

- The lack of Parking Space and Traffic Congestion: Congestion is one of the top issues when it comes to transportation in metropolitan areas. The continuous spread of motorized transport and increased number of private cars determined an even larger demand for transport infrastructure. Nonetheless, infrastructure is not able to meet the need generated by traffic growth. Congestion is also related to parking troubles because looking for parking and not being able to find a space creates additional delays and hinders local traffic circulation;
- The transition between the place of residence and place of work is taking a lot more time. This trend is linked to housing prices; the most affordable houses are located away from central areas;
- Inadequate Public Transportation: Public transport systems don’t meet demand and create inconvenience for users during peak hours;
- Environmental Impact and Energy Consumption: The quality of life and health of urban residents is seriously affected by the pollution including noise generated by the rotation. Another form of pollution is energy consumption by urban transport;
- Accidents and Safety: Increased traffic generates an increased number of accidents and fatalities. Repeated delays are also linked to accidents and with the continuous increase in traffic, people feel unsecure in using the streets.

3.2 Fuzzy sets implementing in Public Transportation RATB Bucharest (DMM)

The analysis of the fuzzy method takes into account the transportation in the public sector in Romania by time schedule, weather, season and type of day. (working, weekend, holiday)

Figure 1: Multiple-criteria decision-making case study-Bucharest Transportation

Criteria	MAXIM	MAXIM	MAXIM	MAXIM
K =	5.8	4.70	4.3	5.2
Bus line(i)\Criteria (j)	Time	Weather	season	Daily time (Normal/Weekend/Holidays)
1 (282)	(traffic hight 3	(hot)1	(summer)1	3
2 (335)	(traffic med) 2	(snow)3	(autum)3	1
3 (331)	(Low traffic) 1	(rain)2	(winter)2	2
TOTAL	6	6	6	6

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First each line of transportation as shown in Figure 1 has been given a value from 1 to 3 taking traffic into account low (1) high (3) on each criteria column, thus each criteria is based on a maximum value as most important. The value K for the vector of membership coefficients has been given to each criteria from 4 to 6 depending on the importance. After the sums of values for each column have been set we proceeded on calculating the relative consequence of decision making for each criteria. Taking into account the most favorable result lead us to the next matrix for finding out the transportation routes that needed to be supplemented based on 4 types of techniques.

Figure 2: Results – optimal variant with using 4 techniques (Wald's, Hurwicz's, Maximax and Laplace's criterion)

	Supplementing Routes according to the 4 techniques			
	PESSIMIST	OPTIMIST	HURWIVZ Criterion	LAPLACE
1	282	282 / 335	282	335
2	335	282/335	335	282
3	331	331	331	331

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Wald's criterion

The Wald's criterion is an approach which the pessimistic manager will prefer to apply (Radu 2005). In the framework of the observed criteria the decision maker prefers the highest value of bad conditions. However, according to Wald's criterion, the farmer should select the maximum of the row minima. In the presented research the alternative 1 (282) of the transportation routes Figure 2.

Hurwicz's criterion

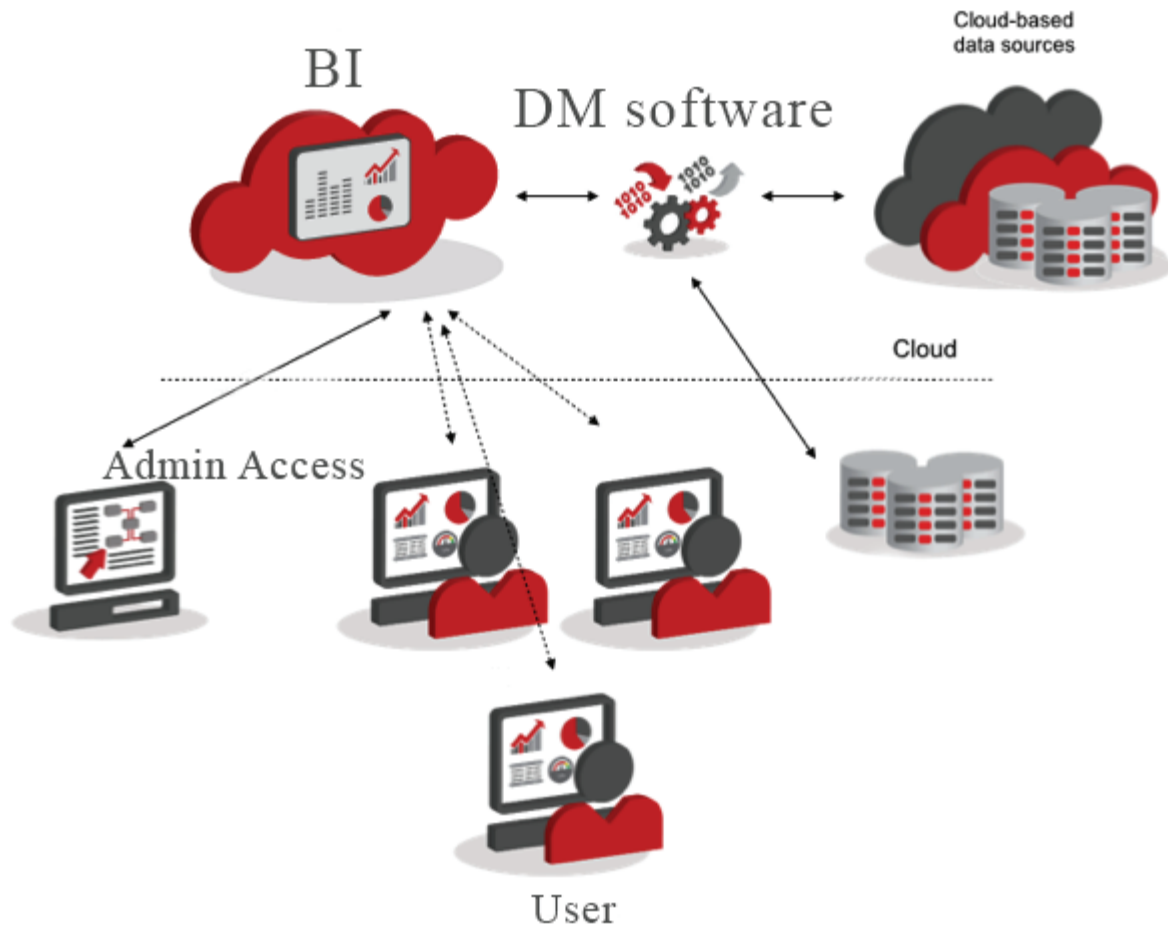
According to the Hurwicz's criterion, the manager has a calculated attitude - between pessimistic and optimistic attitude. Each result has been weighted according to optimistic coefficient ($a = 0.7$). As shown in Figure 2 the highest and the lowest values of each business alternative has been multiplied by optimistic coefficient ($a = 0.7$) and pessimistic coefficient ($1-a = 0.3$). The highest calculated average value is selected, as seen in our table, by alternative 1 (282) of the transportation routes.

C criterion According to Maximax criterion, the manager chooses the best among the conditions determined for each route alternative. The decision maker is optimistic. The Maximax criterion showed that both alternative 1 (282) and alternative 2 (335) were equally as important.

Laplace's criterion

Laplace's rule is neither optimistic nor pessimistic (Radu 2005). The decision-maker assumes that all future conditions have the same probability of existence and creates a measure of average rewards where the manager claims the alternative to the best combined average. Based on Laplace criterion we selected alternative 2 (335) of the transportation routes as being the most important.

Figure 3: Infrastructure of decision making software



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The software as shown in the figure 3 above is unifying the Business Intelligence solutions with the capabilities of the cloud based data sources to provide, in a single platform, an easy way to enhance the decision making process, being able to use it from anywhere.

By using such software the users can take decisions in a shorter period of time, as example the fuzzy method can be done in a few clicks rather than calculating manually in a few hours, and can have a better vision by prioritizing, ranking and choosing the best option for their business and business strategy from among the alternatives.

4 Remarks

As proven by the e-Estonia project, the implementation and usage of IT&C solutions have a great influence in the activity of the public administration, in general, and of the government institutions, in particular. Looking on a deeper level, solutions such as Cloud Computing, Business Intelligence or Data Analysis tools might not replace the human component of the decision chain, but will, most likely, provide a strong support in the decision process, as a whole. As the decision maker will have the possibility of relying on specialized software whenever a action plan would need to be set up and, thus, a set of decisions to be adopted, he will experience a gain in efficiency, by acknowledging the probable impact of each alternative, as well as in saved time, by transferring some decision steps to the

software itself. The main role of the using the up mentioned solutions is the optimization of the process. The Fuzzy methodology provides an objective, yet accurate way of analysing the decisional alternatives, based on predetermined variables. As the method takes into consideration the importance of the variables, it has effects on optimizing the resource requirements and, eventually, on the decision making process. As the IT&C solutions rely mostly on Fuzzy like methods, the overall effect of using them will be equivalent with a cost optimization, by excluding the unnecessary or redundant resources. In conclusion, we strongly believe that the usage of the IT&C tools will efficientize the decision processes within the public administration, by optimizing the costs and required resources, as well as eliminating some time consuming steps.

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