ASPECTS CONCERNING DECISION OF CHOICE OPTIMIZATION OF CLOUD COMPUTING SERVICE AMONG YOUTH

Delia, Teselios[1]
Mihaela, Savu[2]

Abstract: *Decision making is an important and frequent activity, which involves choosing a variant of several possible depending on certain criteria of analysis. When it comes to choosing cloud storage service, things get more complicated, those who intend to use such a service having access to a multitude of offers. This paper uses the Martin - Deutch algorithm to determine the optimal solution and prioritization of alternatives in three cloud computing services: Dropbox, Google Drive and Microsoft One Drive, to support young people who are usually most attracted to using this type of services, to achieve the best choice.*

Keywords: *cloud computing, optimization, line moment, column moment*

JEL Classification: C61

1. Introduction

The term "cloud computing" is defined by the National Institute of Standards and Technology (NIST) as follows [3]:

"Cloud computing is a convenient model for enabling ubiquitous, 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."

Using a simplified definition we can say that the term "Cloud Computing" refers to an innovative technology, constantly developing, which allows storing and accessing data and software via the Internet.

Therefore, users will minimize the costs for IT infrastructure, will benefit from synchronization and data accessing wherever they are, on multiple devices, the only condition being the existence of an Internet connection.

In fact, the term "cloud computing" derives from a common symbolic graphical representation of the Internet, cloud-shaped ("the cloud"), used when the Internet technical details can be ignored (Fig.1) [2].

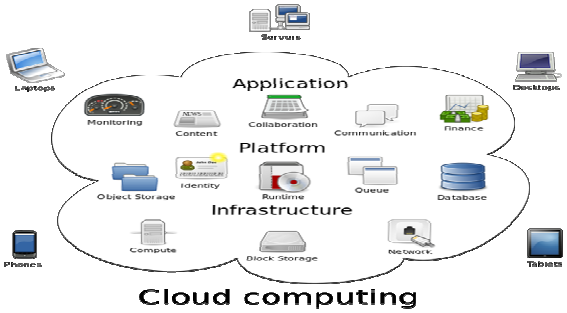

Fig.1. Conceptual diagram of Cloud Computing
Source: https://ro.wikipedia.org/wiki/Cloud_computing

2. Aspects concerning cloud computing

The emergence of cloud computing has revolutionized the IT industry, users having the possibility of hiring, on request, the necessary hardware and software resources, based

[1] PhD Lecturer, "Constantin Brancoveanu" University of Pitesti, Romania, delia_teselios@yahoo.com
[2] PhD Associate Professor, "Constantin Brancoveanu" University of Pitesti, Romania

on a "pay only what you use" principle. As a result, more and more companies use cloud computing services, from a desire of:

- optimizing resources (servers, networks, etc.);
- decreasing the costs in IT infrastructure;
- the possibility of accessing applications from any Internet-connected device (laptop, smartphone, etc.);
- working to increase speed and storage capacity.

According to data provided by Eurostat [5], in 2014, in Romania, only 5% of companies used cloud computing services, given that the average use of this service in the EU-28 was 19%, especially for email and storing files electronically. In 2015, the number of companies from Romania who used cloud computing services increased to 8% [6].

The first place is owned in 2015 by Finland by 53%, increase compared to 2014 being of 2%.

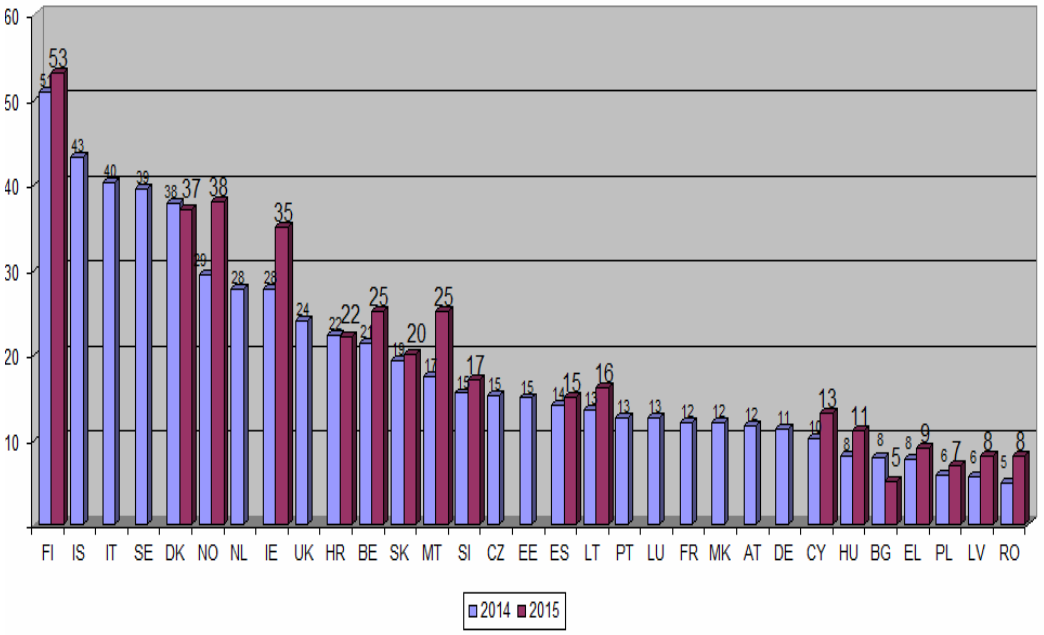

Fig.2 The use of cloud computing services, 2014 - 2015 (% of companies)
Source: Created by authors based on data available at
http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=isoc_cicce_use&lang=en

Observation 1: Values plotted in (Fig.2) are part of the latest update on cloud computing service conducted by Eurostat in 10/17/2016. It should be noted that at that time not all countries had reported the values of using this service.

On the first place in the EU-28 in the use of cloud computing services were companies in the IT sector (45%), followed by the professional, scientific and technical ones (27%) (Fig. 3).

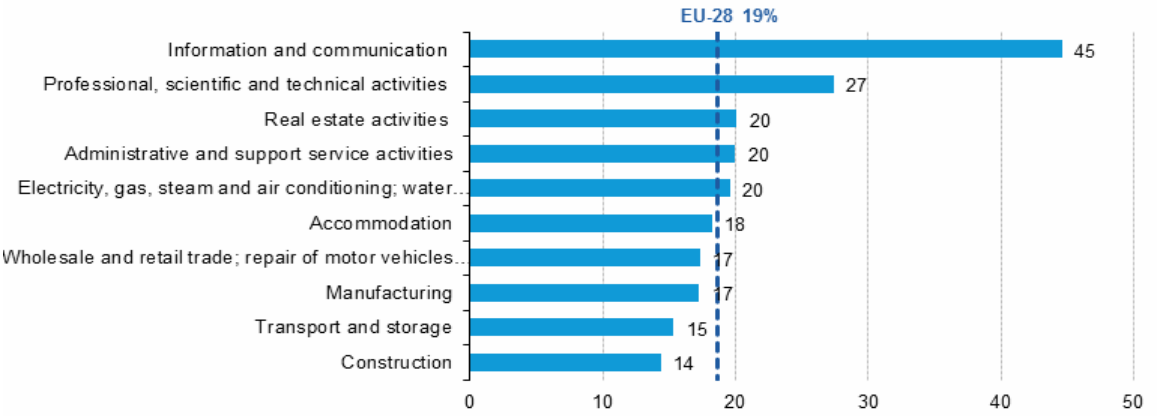

Fig.3 The use of cloud computing services according to economic activity, EU-28, 2014 (% of companies)

Source: http://ec.europa.eu/eurostat/statistics-explained/index.php/Cloud_computing_-_statistics_on_the_use_by_enterprises

The main reasons why the companies are cautious about the use of cloud computing are related to data security, 57% of large companies and 38% of medium and small companies having this opinion (Fig. 4).

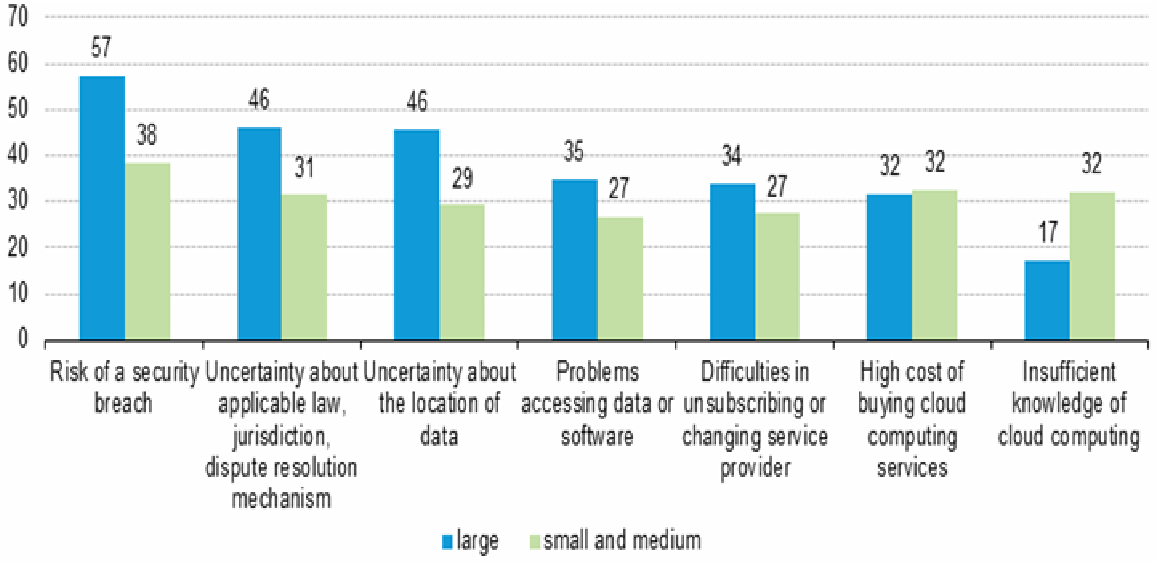

Fig.4 Factors limiting the use of cloud computing by enterprises, EU-28, 2014 (% of companies)

Source: http://ec.europa.eu/eurostat/statistics-explained/index.php/Cloud_computing_-_statistics_on_the_use_by_enterprises

The statistical data provided by Eurostat [18] shows that 21% of Europe's population in 2014 used storage services via the Internet. It should be noted that 35% of them were young people aged between 16 and 24 years. Cloud computing services have been used in European states as follows:

- Denmark:42% of the population;
- UK: 38% of the population;
- Luxembourg, Spain: 35% of the population;
- Lithuania, Poland, Romania: 8% of the population.

These data on our country should not surprise us, since in the year 2014, 39% of Romania's population did not use the Internet. However, of those who use cloud computing services in our country, the structure depending on their age is:

- 20% are aged between 16 and 24 years;
- 8% are aged between 25 and 54 years;
- 2% are aged between 55 and 74 years.

In the publication of the National Institute of Standards and Technology in 2011 "The NIST Definition of Cloud computing" [3], cloud computing services are classified, depending on the implementation models in:

- Private Cloud (or internal cloud), where the IT infrastructure is used by a single company comprising more consumers (eg. Departments). Infrastructure management can return to the company, to a third party or to a combination of both. Private Cloud can improve resource allocation within the company and minimizes security fears many companies have. It may physically exist within the organization or outside it.
- Community Cloud, where infrastructure is shared by several organizations of a certain group with common concerns (eg. The mission, security requirements). Owning and managing its IT infrastructure may return to one or more community organizations, to a third party, or a combination of both. It may physically exist within the organization or outside it. In other words, the community cloud can be regarded as a public cloud but with the security and privacy levels of a private cloud.
- Public Cloud, where the IT infrastructure is owned and operated by a service provider (eg. Commercial, academic or governmental organizations) and is available to the general public via the Internet on the basis of "pay only what you use" principle.
- Hybrid cloud, where the IT infrastructure totals 2 or more cloud infrastructure like those described above and are considered as a whole.

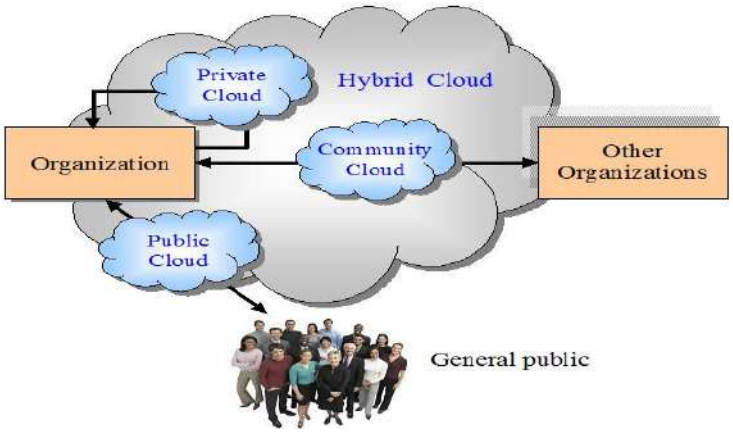

Fig. 5. Classification of cloud computing services depending on the implementation models

Source: http://www.jmir.org/2011/3/e67/

Another classification of cloud computing services is performed according to service models [3] [4]:

- Infrastructure as a Service -IaaS
- Software as a Service
- Platform as a Service

The characteristics of these service models are presented in graphical form in (Fig. 6).

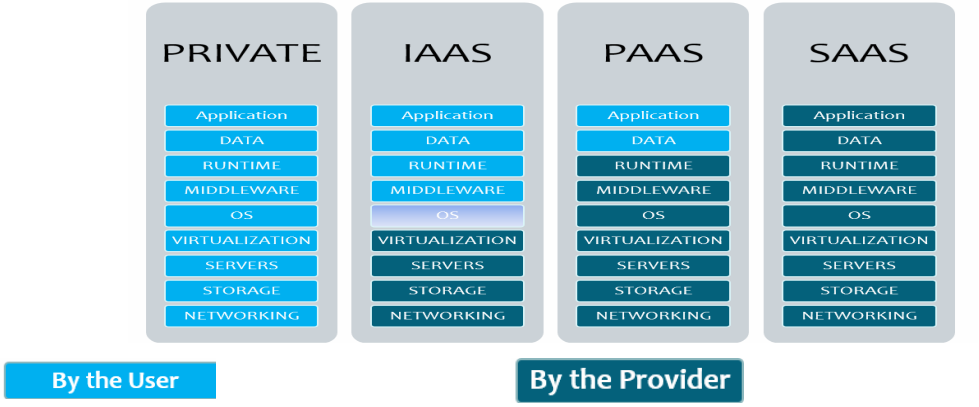

Fig.6. Classification of cloud computing services depending on service models
Source: http://www.seeei.org/EL2013/Program/025.htm

3. Optimizing decision in conditions of certainty

Companies like Microsoft, Amazon, IBM, Google, occupying the top places in a ranking of providers of cloud computing, offer a wide range of cloud services for both individual users and companies, regardless of their size. But this diversity of services offered challenge those who intend to use such a service and must make a choice here.

Starting from this aspect, we propose to determine the optimal solution and prioritize alternatives in three cloud computing services that offer storage space for data, services of data synchronization and client software. It is about Dropbox, Microsoft OneDrive and Google Drive, all supporting operating systems Windows, Mac, Android and iOS.

We consider four criteria of evaluation, represented by fundamental characteristics of these services, all equally important for the user in determining the optimal variant (Table 1).

Table 1. Characteristics of cloud computing services

	Cloud service	**Free storage capacity**	**Tariff plan for 1TB/month/ user**	**File size restrictions**	**Free space bonus**
Assesment criteria / Variants		**C_1**	**C_2**	**C_3**	**C_4**
V_1	Microsoft OneDrive	5GB	7.22 €	10 GB	da
V_2	Google Drive	15GB	9.03 €	10 GB	nu
V_3	Dropbox	2GB	9.99 €	20 GB	da
		Criteria of maximum	Criteria of minimum	Criteria of maximum	Criteria of maximum

Source: [7]- [12]

To optimize decision it is used the algorithm developed by S.B.Deutch and J.J.Martin, which involves the following steps:

Step1: It is determined the matrix noted $R = (r_{ij})_{i=\overline{1,3},\ j=\overline{1,4}}$ whose elements are calculated as follows:

$$r_{ij}=\frac{a_{ij}-a_j^{\min}}{a_j^{\max}-a_j^{\min}},\ \text{for a criteria of maximum} \quad (1)$$

$$r_{ij}=\frac{a_{ij}-a_j^{\max}}{a_j^{\min}-a_j^{\max}},\ \text{for a criteria of minimum} \quad (2)$$

where $A=\left(a_{ij}\right)_{i=\overline{1,3},\ j=\overline{1,4}}$ is the matrix of characteristics measurements from (Tabelul 1).

Observation 2: We granted value 1 for cloud service that offers free bonus space and value 0 for cloud service that does not offer free bonus space.

Using relations (1) and (2) obtain values:

$$r_{11}=0.23,\ r_{21}=1,\ r_{31}=0 \quad (3)$$

$$r_{12}=1,\ r_{22}=0.34,\ r_{32}=0 \quad (4)$$

$$r_{13}=0,\ r_{23}=0,\ r_{33}=1 \quad (5)$$

$$r_{14}=1,\ r_{24}=0,\ r_{34}=1 \quad (6)$$

$$\Rightarrow R=\begin{matrix}v_1\\v_2\\v_3\end{matrix}\begin{pmatrix}0.23 & 1 & 0 & 1\\ 1 & 0.34 & 0 & 0\\ 0 & 0 & 1 & 1\end{pmatrix} \quad (7)$$

Step 2: There are calculated the line moments noted M_i^l (for each line) and the lines of matrix R are ranked in ascending order of line moments values.

$$M_i^l=\frac{\sum_{j=1}^{4} j\cdot r_{ij}}{\sum_{j=1}^{4} r_{ij}},\ \text{for } i=\overline{1,3} \quad (8)$$

Thus, we obtain the following values:

$$M_1^l=2.79,\ M_2^l=1.25,\ M_3^l=3.5 \quad (9)$$

$\Rightarrow$ The matrix obtained after rearranging lines depending on the values of line moments is:

$$R_1^l=\begin{matrix}v_2\\v_1\\v_3\end{matrix}\begin{pmatrix}1 & 0.34 & 0 & 0\\ 0.23 & 1 & 0 & 1\\ 0 & 0 & 1 & 1\end{pmatrix} \quad (10)$$

Step 3: There are calculated the column moments noted M_j^c (for each column) and R_1^l matrix columns are ranked in ascending order of column moments values.

$$M_j^c = \frac{\sum_{i=1}^{3} i \cdot r_{ij}}{\sum_{i=1}^{4} r_{ij}}, \text{ pentru } j = \overline{1,4} \text{ for} \quad (11)$$

The column moments obtained with relation (11) are:

$$M_1^c = 1.18,\ M_2^c = 1.74,\ M_3^c = 3,\ M_4^c = 2.5 \quad (12)$$

Therefore, columns 3 and 4 are reversed and we get the matrix:

$$R_1^c = \begin{matrix} v_2 \\ v_1 \\ v_3 \end{matrix} \begin{pmatrix} 1 & 0.34 & 0 & 0 \\ 0.23 & 1 & 1 & 0 \\ 0 & 0 & 1 & 1 \end{pmatrix} \quad (13)$$

Step 2 of the algorithm is resumed and we get the values:

$$M_1^l = 1.25,\ M_2^l = 2.34,\ M_3^l = 3.5 \quad (14)$$

Because $M_1^l > M_2^l > M_3^l$, there is no longer needed sorting the lines in case of variants.

Step 3 of the algorithm is resumed and we get the values:

$$M_1^c = 1.18,\ M_2^c = 1.74,\ M_3^c = 2.5,\ M_4^c = 3 \quad (15)$$

Because $M_1^c > M_2^c > M_3^c$, there is no longer needed sorting the columns.

Therefore, the determining variants order is: V_2, V_1, V_3.

4. Conclusion

The result obtained means that the best option is to choose Google Drive cloud service, this surpassing the other two alternatives: Microsoft OneDrive and Dropbox. This also represents, in fact, ranking decisional variants depending on the number of variants outclassed.

We believe that the future of these services belongs to young people as inside the population structure using cloud computing services they hold the first place in terms of weight. The coming years will show an increase in the proportion of young people who will use these services both at European level and in our country, because it is desired that by 2020 the percentage of Romanians who have never used the internet to be reduced to 30%.

In terms of using cloud computing services by companies, it is forecasted a growth of the private sector, but not only of this one, because the increased number of users will reduce the costs of these services.

Bibliography:

1. Greavu-Serban, V., 2015, Cloud Computing. Caracteristici si modele, Editura ASE, Bucureşti
2. https://ro.wikipedia.org/wiki/Cloud_computing
3. http://nvlpubs.nist.gov/nistpubs/Legacy/SP/nistspecialpublication800-145.pdf
4. https://dzone.com/articles/introduction-cloud-computing
5. http://ec.europa.eu/eurostat/statistics-explained/index.php/Cloud_computing_-_statistics_on_the_use_by_enterprises
6. http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=isoc_cicce_use&lang=en
7. http://www.go4it.ro/internet/stocare-online-care-sunt-cele-mai-bune-si-mai-ieftine-servicii-9893361/
8. https://www.google.com/settings/storage

9. https://onedrive.live.com/about/en-gb/plans
10. https://support.office.com/en-gb/article/OneDrive-help-for-Windows-8-1-acff449b-f6d2-435d-9658-cbc0cff88cca?ui=en-US&rs=en-GB&ad=GB
11. https://www.dropbox.com/business?_tk=uo_resources&_camp=uo_resources&_kw=quota&_ad=hc_article&_net=general
12. https://www.dropbox.com/en/help/5
13. http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2012:0529:FIN:RO:PDF
14. http://www.digitalcitizen.ro/intrebari-simple-este-skydrive-si-facilitati-ofera-utilizatorilor
15. http://www.seeei.org/EL2013/Program/025.htm
16. http://www.jmir.org/2011/3/e67/
17. http://ec.europa.eu/eurostat/documents/2995521/6343581/4-16122014-BP-EN.pdf/b4f07b2a-5aee-4b91-b017-65bcb6d95daa