

## ROMANIAN ENTERPRISES' WILLINGNESS TO ADOPT THE CLOUD COMPUTING SERVICES FOR HOSTING THEIR DATABASES

**BABUCEA ANA-GABRIELA**

PROFESSOR, PHD, „CONSTANTIN BRANCUSI” UNIVERSITY OF TÂRGU JIU

e-mail: [gabibabucea@gmail.com](mailto:gabibabucea@gmail.com)

**RĂBONȚU CECILIA-IRINA**

PROFESSOR, PHD, „CONSTANTIN BRANCUSI” UNIVERSITY OF TÂRGU JIU

e-mail: [cecilia.rabontu@gmail.com](mailto:cecilia.rabontu@gmail.com)

### **Abstract**

*The digital economy requires the digital transformation of businesses as a mandatory requirement for the development of any company and a guarantor of their business success. The digital transformation regards the digitalization of all aspects of the business and the utilization of digital solutions for all its processes. From this perspective, cloud-computing services are the base of digital transformation. Cloud-based infrastructure ensures flexible access to data, and if it is demand, to the computing resources, supporting in this way the new business models. Data hosting in cloud allows the development of applications and databases much more advanced than those of local data-centers, especially since lately, large data and information have proved quite complicate to locally store, with very high costs. Therefore, more and more companies are considering adopting cloud solutions for storing their databases. The study based on the EUROSTAT statistical data, aims to create an image of the Romanian enterprise's typologies that buy/use hosting for their databases as a cloud computing service.*

**JEL classification:** L86

### **1. Introduction**

The "digital economy" is an economy based on information technology and telecommunications, characterized, in addition to expanding the use of the Internet, through a new form of connectivity between economic organizations and between individuals, producing a variety of new interdependencies. All of this has generated new business models, that is, a new "digital economy", which refers to their dynamics, rather than to their efficiency, to customers and innovative activities and products, rather than to the pursuit of increased productivity. It is a fact; this means a digital transformation of the organizations that involves transforming business processes based on analyzing and understanding the needs of customers/consumers so that goods and services meet their specific requirements in terms of increased profitability for the company. However, to achieve such an objective, the priority is to adopt the current digital technology that allows the satisfaction of the customers and at the same time the increase of productivity and the revenues of the company. The way digital transformation generate economic efficiency and improve enterprise productivity is a top subject in the last years' literature on the topic [1], [2], [3].

Even if the cloud-computing, concept defined by Mell and Grance [4] as „a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) which can be rapidly provisioned and released with minimal management effort or service provider interaction” presents a lot of caveats in using it. Some of them are like data security and privacy, jurisdictional issue, compliance requirements or vendor reliability [5], [6], [7], but if the enterprise is ready for that, the benefits are major [8].

The speed with which new Internet-oriented digital technology is developing involves the digital transformation of human resources, too. Employees and customers, together, must adapt their digital skills necessary for interaction with digital technology. The practical way of

redesigning business for the digital economy differs significantly depending on the type of organization, and the size of the business. Small and medium-sized economic organizations seem to be benefiting from the active adoption and use of digital technology, being either "native digital" or easy to convert into a business model based on digital technology. Many organizations still use older technologies not easily replaced. Others, may not or have not yet decided to invest in replacing these legacy technologies. Many others do not have a management that is aware of the danger or cannot find the digital and IT staff with the skills to coordinate such a process.

There is a large class of economic organizations includes businesses of all sizes, generically called "traditional businesses", which are reluctant to use the Internet and digital technologies and have already entered the path of extinction by ignoring the transition to the digital area. Large companies with their own data centers felt some resistance because of considerable amounts invested. However, are in the situation of adopting these technologies that in fact have the role of facilitating business processes, of them makes it simpler, faster. At the same time, the reluctance in the face of digital transformation also arises due to growing concern for ensuring the cybersecurity of data, protecting them against illegal access to their information systems with the purpose of money theft, as intellectual property, private information, or simply to disrupt control systems.

In addition, through the extensive automation of processes, the expansion of chat boxes and artificial intelligence, the person who fails to transfer their skills to the new jobs is affected.

In this context, the cloud computing (CC) or cloud processing is a "model of organization of IT services, which means that processing services (hardware and software) are delivered on request to customers through computer networks, in a self-service manner, regardless of the location of the device used". Usually, when it comes to cloud computing, we consider two components of cloud infrastructure and software applications. The CC infrastructure consists of the hardware resources that are necessary to support the cloud services provided and generally include servers, storage, and network. The second CC component refers to the computing power and software applications needed to run enterprise applications provided through the Internet by third parties. Therefore, this technology can help organizations efficient use modern technologies especially for computer virtualization and Internet connectivity. Thus, organizations can have processing hardware resources and even software applications in the cloud. Depending on how "the IT services of modern organizations are developed, delivered, updated, maintained and paid for", cloud processing is available through three different types of services [9]:

- *Infrastructure as a Service (IaaS)* which is a cloud service model that allows client organizations to create their own hardware infrastructure with the ability to configure their equipment by specifying, for example, the number of processors and their features, RAM and storage space, as well, how to network.

- *Platform as a Service (PaaS)*, where organizations can use the infrastructure and programming environments hosted by the service provider to build their own applications, with programmers being offered specific sets of APIs. On the other hand, Cloud computing platforms allow enterprises to expand their IT infrastructure whenever required, involving minimal costs, and thus reducing investments in complex IT departments and hardware. The advantage of PaaS is that the application developers have all the necessary tools available from the service provider, being able to focus on integrating their own applications. Using the service requires "migrating" databases and applications to the cloud, but this process is becoming easier.

- *Software as a Service (SaaS)*, the most accessed cloud service model because it allows customers to use, for free or at a cost, a number of software applications for running the organization's current activities, constituting a low-cost (subscription-based) alternative for servers it. All these facilities offered by IaaS type services involve virtualization of computing resources. Managing and maintaining applications, updating them and generating backups is the attribute of the SaaS service provider. Users access the respective applications through a web browser, the data, and applications being stored on the providers' servers.

There is another kind of service, *Database-as-a-Service* (DBaaS) [10], which permits organizations to host their own databases in Cloud Computing, offering access for storage, retrieve, and update and delete the data via the internet following [11].

Given the obvious tendency of rapidly increasing the volume of data stored in databases because of the integration of enterprise applications and processes digitalization, a series of requirements are imposed implicitly on data management systems designed to ensure their proper functioning, respectively:

- Maintaining an adequate response speed, at the request of the users who can access the data not only from the classic terminals (desktop computer), but also from many other mobile devices (PDAs, tablets, mobile phones);
- Adapting the available storage space whenever the database is updated by adding new data;
- Ensuring the security of the stored data available to the different categories of users
- Integration and shared use of data with suppliers and customers, the combination in a centralized database all the information of interest to the company ensuring the increase of the functional efficiency of their computer-based systems.

Traditionally, enterprises have data stored on their own servers, which makes the computer-based systems no longer meet the requirements of good functioning. Under these conditions, the adoption of Cloud is a notable solution because of its adaptability, being optimal for ever-larger amounts of data, by the possibility of extending the capacity of the work system or by its already enlarged size, respectively their scalability. In addition, in situations that require updating, repairing, restructuring, etc., the Cloud system can function normally throughout the intervention. The migration of databases and Web applications to the Cloud is an obvious trend of business and public administration, too, being the viable option that offers in addition to the technical advantages and financial advantages. The payment of the Cloud services is invoiced according to the length of time of use, by the size, the allocated space, respectively by the data transmission band [12].

Businesses can purchase many cloud-computing services like hosting of the enterprise's database, accounting software applications, CRM software, computing power. In addition, the cloud solutions "eliminate costs related to buying servers, software licenses, hosting, maintenance, highly specialized technical staff, all sorts of upgrades, annual subscriptions, etc." [13].

According to Eurostat, collected statistical data in the eBusiness domain are in the context of the follow up of the Digital Single Market process. There are some highlights statistics regarding the use of cloud computing by the European Union enterprises at the level of the year 2018: 26 % of the EU enterprises used CC, mostly only for hosting their e-mail systems and storing files, 55 % of those used high CC services (financial or accounting software applications, CRM software, computing power). 68% of cloud European enterprises used such as services for storing files, 48% to host their enterprise databases, while 53% reported using it for office software. Also, in 2018, many more firms used public cloud servers (18 %) than private cloud servers (11 %), i.e. infrastructure for their exclusive use, Compared with the year 2014, the use of cloud computing increased particularly in large enterprises (+21 percentage points)" [14]. However, there is a significantly differences across EU member-states. For example, with at least 40 % of enterprises that are used cloud-computing services, are highlighted Finland, Sweden, Denmark, Netherlands, Ireland, United Kingdom, and Belgium. Bulgaria and Romania are the countries with the lowest performance, less than 10% of enterprises used cloud services.

In the 2019 "Digital Economy and Society Index", the most recent report of European Commission that monitors Europe's general digital performance and measures the evolution of EU member states regarding digital competitiveness, Romania was placed well below the average at the level of European Union on eBusiness indicators.

The table below presents the Romania's country profile, based on the evolution of main Eurostat indicators in the topic:

Table no. 1 Romania's profile - Country ranking table on a thematic group of indicators regarding eBusiness

Indicator (including breakdown and unit)	Romania value				EU28 value	Romania rank among EU28 countries
	2015	2016	2017	2018	2018	2018
<b>Enterprises paying to advertise on the internet</b> - All enterprises (in % of enterprises)	-	12	-	15	26	28
<b>Cloud computing services (medium-high sophistication)</b> - All enterprises (in % of enterprises)	6	5	6	7	18	25
<b>Enterprises with High levels of Digital Intensity</b> - SMEs (10-249 persons employed) (in % of enterprises)	11	8	11	11	17	25
<b>Enterprises having a website with some sophisticated functionalities</b> - SMEs (10-249 persons employed) (in % of enterprises)	42	40	43	42	57	23

Source: Selected data from European Commission, Digital Scoreboard, <https://digital-agenda-data.eu/charts/country-ranking-table-on-a-thematic-group-of-indicators#chart={%22indicator-group%22:%22ebusiness%22,%22ref-area%22:%22RO%22,%22time-period%22:%222018%22}>

It can be remark a slight improvement in the indicator "Cloud computing services (medium-high sophistication) - All enterprises (in % of enterprises)", from 6% in 2017 to 7% in 2018, even if it remains well below the EU average of 18%. The indicator measures the "enterprises purchasing at least one of the following cloud computing services: hosting of the enterprise's database, accounting software applications, CRM software, computing power".

## 2. The use of Cloud Computing Services by the Romanian enterprises for hosting their databases

In order to describe the actual stage of the use of Cloud Computing Services by the Romanian enterprises for hosting their databases in the EU context, were considered the recent Eurostat data regarding digital economy and society with the main indicator of ITC usage in enterprises, included in the E-Business category: "Buy hosting for their databases as a CC service"

The indicator "Buy hosting for their databases as a CC service" (in % of enterprises / % of enterprises which bought hosting for their databases as a CC service) is drawn from the subject of "E-business processes and organizational aspects", monitored by size class, by NACE categories, or by region (until 2010) [15].

Highlighting the importance of leveraging cloud computing in Europe, the European Commission noted, "If this technology is adopted by businesses, and other organizations, especially for SMEs, significant increases in efficiency can be expected throughout the economy". Moreover, "the CC can be especially important for small businesses in troubled economies or from remote and rural areas, as it would allow them to enter more dynamic markets" [16].

Statistical data show for Romania an evident increase tendency in the share of companies that have bought cloud hosting services for their enterprise' databases in the period 2014-2018, regardless of size class. Especially the large enterprises, with more than 250 employed, tripled the percentage (from 4% in the year 2014 to 12% in the year 2018).

A similar increase had registered medium enterprises, but at a lower level, from 2% in the year 2014 to 6% in the year 2018, and only a double and a half level for the small enterprises, from 2% in the year 2014 to 5% in the year 2018 (See Table no.2).

Table no. 2 Romanian enterprises which buy hosting for their databases as a CC service, by size class - (% of enterprises)

	Small enterprises (10-49 persons employed)	Medium enterprises (50-249 persons employed)	Large enterprises (250 persons employed or more)
2014	2	2	4
2015	3	4	6
2016	3	5	8
2017	3	5	11
2018	5	6	12

Source: Eurostat database, Cloud computing services [isoc\_cicce\_use], last update 13.05.2019, extracted on 16.10.2019

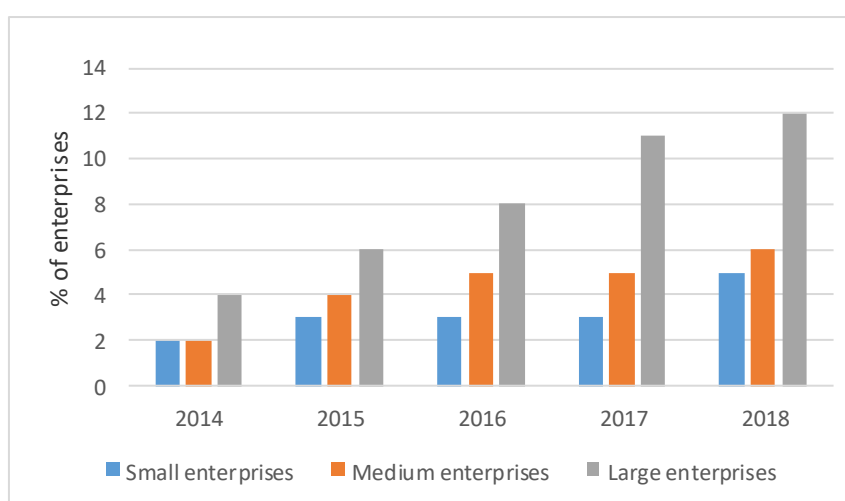


Figure no. 1 Percentages of Romanian enterprises that bought hosting for their databases as a CC service, by size class, thru the period 2014-2018

However, compared with the evolution at the level of the European Union (28 countries), Romania remains far away for all types of enterprises.

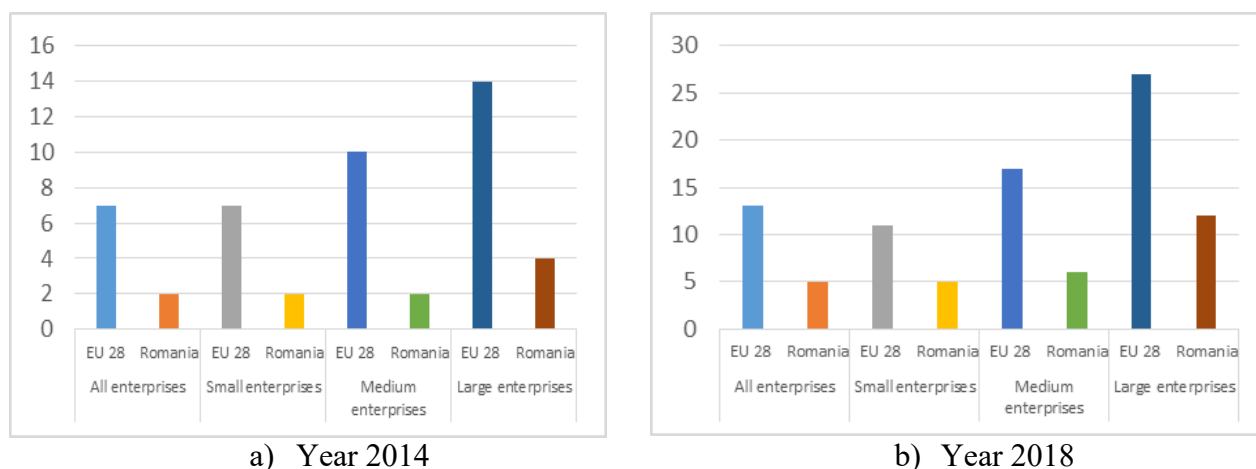


Figure no. 2 Percentage of enterprises which bought hosting for their databases as a CC service, by size class in European Union (28 countries) and Romania

Romanian companies are still shy about ITC's use. Buying the CC as services for hosting enterprise databases is only one of the first stages in the process of digital business transformation. All types of enterprises must adopte such behavior, especially small or medium enterprises, no only the large companies. The adoption and use of CC technologies must be encouraged such that the business and public administration can interrelate with each other.

By occupying the last positions in the European rankings regarding the digital economy, at a large distance from the first positions for almost all monitoring indicators, Romania's gaps with the European Union member states are major. The low level of digital skills and user confidence continues to be a hindrance to the development of Romania's digital economy, given that the digital economy is not an exclusive feature of the European space, but a global phenomenon [17].

In the digital economy, the use of digital technologies, access to platforms or buying cloud-computing services is the only way to adapt the businesses, improving their performances, products, or services for their clients simultaneous with increasing business efficiency.

A simple compared analysis of data regarding European Union member states shows that the percentages of the Romanian enterprises that buy CC services for hosting their databases (as a CC service) are encouraging if considered only the enterprises that buy CC services. The situation becomes worrying if considered the percentages of enterprises that buy CC services for hosting their databases (as a CC service) at the level of all Romanian enterprises which buy or not buy CC services, indifferent to their size, small, medium or large (See Figure no.3 and Figure no.4)

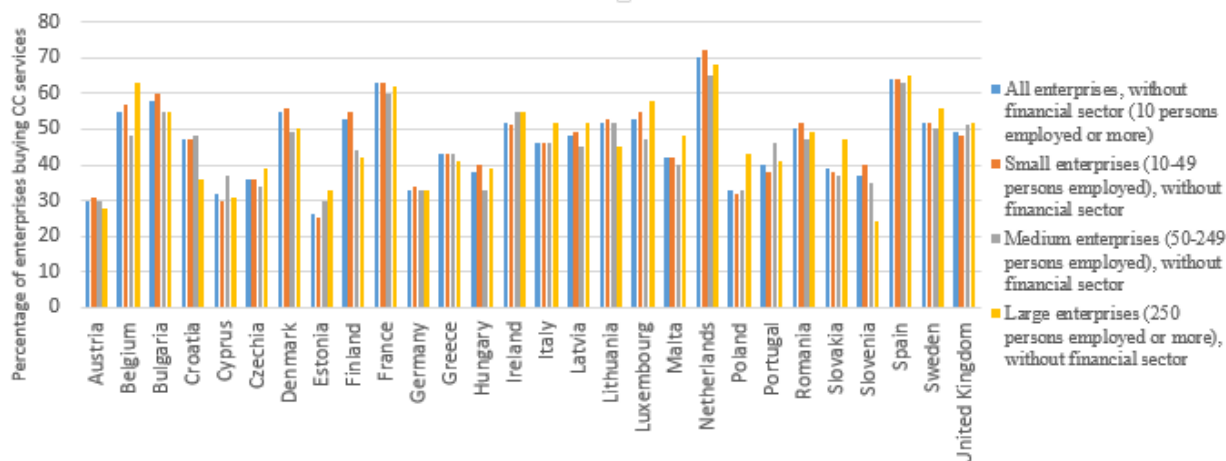


Figure no. 3 Buy hosting for the enterprise's database (as a CC service) – percentage of enterprises buying CC services, year 2018

Source: Based on data from EUROSTAT Database - Cloud computing services [isoc\_cicce\_use] extracted on 25.11.2019

Compared with the other European Union states, by considering the percentages of enterprises buying hosting for their databases, the figures allow remarking that, in 2018, Romania performs under the EU average for all types of enterprises (small, medium or large), more near to the minimum values among EU countries, as Poland, Bulgaria or Greece. (See Figure no. 3)

At the same time, by considering only the enterprises that buying CC services, Romania performs above the EU average for all types of enterprises (small, medium or large) regarding the percentages of enterprises buying hosting for their databases, more near to the medium values among EU countries, with higher values for small enterprises. (See Figure no. 4)

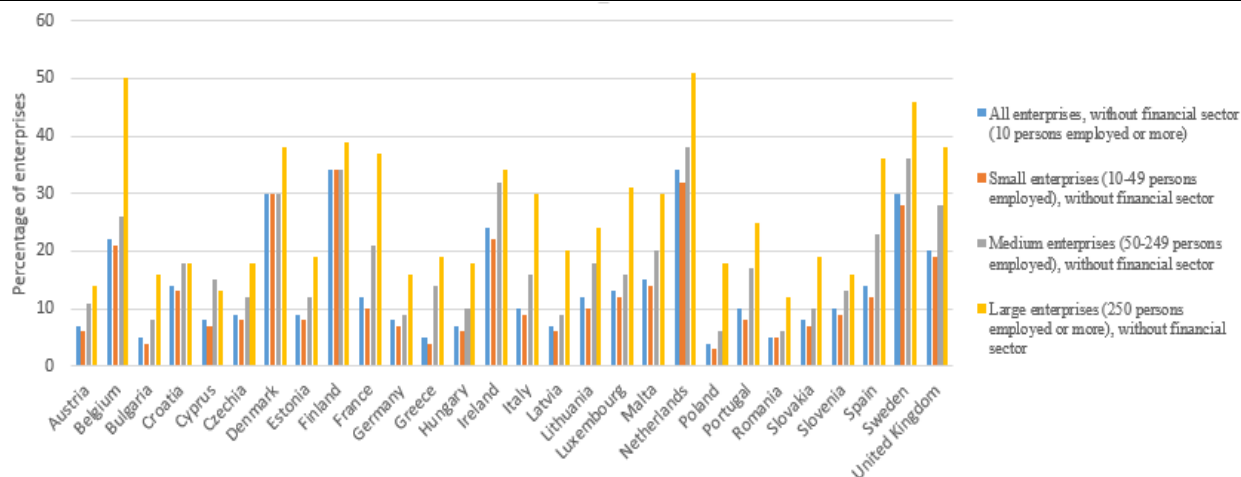


Figure no. 4 Buy hosting for the enterprise's database (as a CC service) – percentage of enterprises, year 2018

Source: Based on data from EUROSTAT Database - Cloud computing services [isoc\_cicce\_use] extracted on 25.11.2019

Table no. 3 Enterprises that buy hosting for their databases as a CC service, by size class - (% of enterprises/% of enterprises buying CC services)

Country/Region	% of enterprises				% of enterprises buying CC services			
	All enterprises (10 persons employed or more)	Small enterprises (10-49 persons employed)	Medium enterprises (50-249 persons employed)	Large enterprises (250 persons employed or more)	All enterprises (10 persons employed or more)	Small enterprises (10-49 persons employed)	Medium enterprises (50-249 persons employed)	Large enterprises (250 persons employed or more)
Austria	7	6	11	14	30	31	30	28
Belgium	22	21	26	50	55	57	48	63
Bulgaria	5	4	8	16	58	60	55	55
Croatia	14	13	18	18	47	47	48	36
Cyprus	8	7	15	13	32	30	37	31
Czechia	9	8	12	18	36	36	34	39
Denmark	30	30	30	38	55	56	49	50
Estonia	9	8	12	19	26	25	30	33
Finland	34	34	34	39	53	55	44	42
France	12	10	21	37	63	63	60	62
Germany	8	7	9	16	33	34	33	33
Greece	5	4	14	19	43	43	43	41
Hungary	7	6	10	18	38	40	33	39
Ireland	24	22	32	34	52	51	55	55
Italy	10	9	16	30	46	46	46	52
Latvia	7	6	9	20	48	49	45	52
Lithuania	12	10	18	24	52	53	52	45
Luxembourg	13	12	16	31	53	55	47	58
Malta	15	14	20	30	42	42	40	48
Netherlands	34	32	38	51	70	72	65	68
Poland	4	3	6	18	33	32	33	43
Portugal	10	8	17	25	40	38	46	41
Romania	5	5	6	12	50	52	47	49
Slovakia	8	7	10	19	39	38	37	47
Slovenia	10	9	13	16	37	40	35	24
Spain	14	12	23	36	64	64	63	65
Sweden	30	28	36	46	52	52	50	56
United Kingdom	20	19	28	38	49	48	51	52
European Union (28)	13	11	17	27	48	48	47	49

Source: Based on data from EUROSTAT Database - Cloud computing services [isoc\_cicce\_use] extracted on 25.11.2019



### 3. Conclusions

Usually, database hosting needs an enormous memory, high processing power, and dedicated hardware resources. Larger enterprises were the size class of companies that realized that can mitigate their costs by using cloud resources for database hosting, even if the cloud computing seems to be better suited for small businesses. The advantage offered by the cloud being the lower costs, because they no longer need their own large-capacity servers, and by using the cloud, can target ever-larger markets, in the last years, in the European Union as in Romania. However, the small share of companies that have chosen to opt for a cloud solution for hosting large databases shows that in Romania, most of them, regardless of the size class, remain reserved in this regard.

Even there are many advantages of using a cloud database (as-a-service), there are some alarming questions in front of the all types enterprises' management in the entire world, not in Romania only. Some of them are:

- Can the enterprise pay at each time in the future for hosting the database in the cloud and how will the payment modify during the time?
- The security is a sensitive problem for each company, so is it safe for companies to be totally based on the provider regarding the control over the servers, over the software or over the security of the cloud database?
- Is it safe for companies to leave totally their hosted database dependent on the service provider?
- There is all the time the high speed needed to transferring and processing data?, or
- How easy can be the switching database to another provider of DBaaS?

Nevertheless, with all of these concerns, the globalization, the digital era, or the single digital European market are good reasons for companies to adopt the cloud computing services and move their databases to the cloud for having faster, clear, and cheap information.

The aim for an effective way to host and process its data, make an organization to choose in each time the cost saving. Therefore, the cloud service seems to be this proper way. It is a fact that hosting databases in the cloud now presents advantages and disadvantages together. However, the adoption of the cloud database especially by the large companies in all Europe, and in Romania, too, proves that the benefits are greater than their worries. The cloud database services can offer different benefits to all categories companies, so each organization may choose the best cloud computing service that is adequate to its necessities.

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