

Drivers and Barriers of the Cloud Computing in SMEs: the Position of the European Union

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Received: August, 2016.

Accepted: March, 2017.

Published: October, 2017.

Title

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Abstract

Cloud computing is one of the technologies that organizations, and especially users, know the least about. It is a new Internet-based technology used to store information on servers, and is provided as an on-demand service to clients. Cost savings and simplification of the technological infrastructure are two of the most decisive factors in its increasing use. However, the lack of standardization, the need for new professionals and the emergence of distrust are some of the barriers to its adoption. The purpose of this paper is, firstly, to present the current situation of this technology from the perspective of businesses by reviewing the existing literature. Secondly, we analyze the situation of this technology from a two-part viewpoint: the European Union, and in particular, the situation in SMEs. Finally, the strategic positions of the European Commission will be reviewed with respect to the consequences of the adoption of the cloud paradigm.

Keywords

Cloud computing, Economic model, Europe, Governance.

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This change in paradigm enables the software to be used without having to install licenses

1. Introduction

Cloud computing represents a change in the business paradigm, since it is no longer necessary to have servers, hardware and software in the company's offices, as processes are carried out over the Internet. All of this is on demand, and occurs in a dynamic and scalable manner, to the extent that the needs for resources can increase or decrease according to business needs.

The features offered by cloud computing would not be possible without virtualization technology. Through it, clients share a combination of servers, hard drives, communication devices, data devices and memory devices (Cervone, 2010). According to Hwang (2008), "cloud computing has brought about new possibilities in building and deploying computational infrastructures and complex services, thanks to virtualization."

These services are maintained and controlled, but users only pay for what they use of these aforementioned computing resources, and not in terms of the amount or duration of use. The cloud appears as a single access point for the needs of all users, where the only requirement is access to the Internet.

These two ideas are partnered with the cloud concept and have led to a very interesting field of research for information systems in organizations, as they represent an opportunity for small and medium-sized businesses to grow without investing excessive amounts of resources in IT resources and for new business ideas to emerge, based on services using this technology. The question to investigate is whether the change this has meant in the computer resource usage model is having a parallel repercussion in the European Union, and in particular, in Spain. The intent is therefore to establish the conceptual bases of cloud computing from a business perspective or business model, reviewing its primary technical characteristics. From there, the objective is to find out the European Union's position with regard to this paradigm, the most recent studies and, in particular, those decisions that are most closely related to Spain and SMEs.

The first section of this article establishes the theoretical framework for cloud computing. This includes a review of different definitions, its scope and vision in Europe. Later, in a separate subsection, it does this for Spain and finishes by establishing the barriers and drivers of the cloud, based on a bibliographic review. The methodology is then discussed in a separate section, followed by another that analyzes the main cloud initiatives in the European Union and their application in Spain. Finally, it ends with a conclusions section and another part with interesting recommendations that are the product of the previous sections.

2. Theoretical framework

2.1. Concept of cloud computing

Cloud computing is defined as computing services from anywhere, using any mobile device with an Internet connection, provided through a type of parallel distributed system on virtual computers that are interconnected and can be dynamically procured, and it is presented as one or more computing resources unified on the basis of service level agreements or SLAs that are established between the service provider and the user (Misra & Mondal, 2011).

One unanimous definition of cloud computing is provided by the U.S. National Institute of Standards and Technology (NIST). The cloud is a model that permits ubiquitous access in a convenient and configurable manner, at the request of the network. Computer resources (for example, networks, servers, storage, applications and services) can be quickly procured at the

The cloud permits ubiquitous access in a configurable manner, at the request of the network

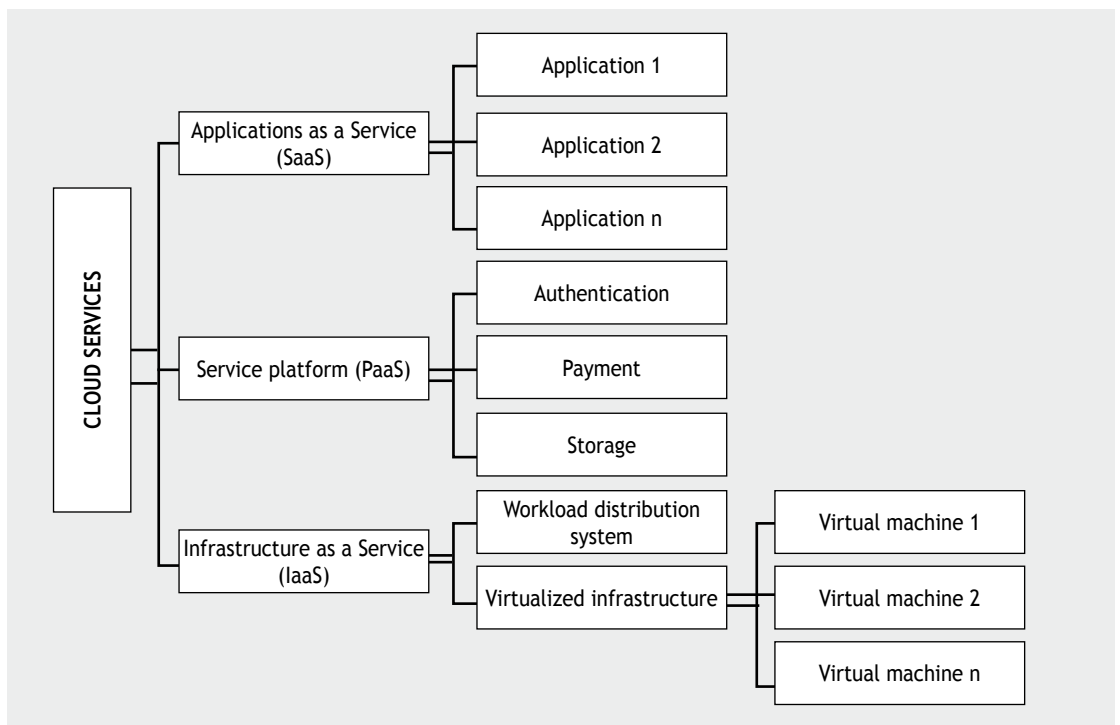
client’s request, and with minimal effort in terms of management or service in contact with the supplier (Mell & Grance, 2011; Sabi, Uzoka, Langmia & Njeh, 2016).

Cloud computing lets companies opt among deployment models for software solutions, platforms or computer infrastructure in the cloud. These three deployment models are outsourced as network services by the cloud provider (Mell & Grance, 2011) (see Table 1). The first is known as IaaS (Infrastructure as a Service). IaaS consists of the outsourcing of IT resource infrastructures for the computing, storage and management of data. This model offers resources in the form of products that are offered as the remote delivery of an IT infrastructure that is accessible via the Internet (Sultan, 2011).

The cloud can be deployed as PaaS (Platform as a Service), where they are provided according to the traditional model. The services offered in this modality are usually network equipment, databases and management systems, specialized in keeping everything running, such as operating systems, databases, middleware, web servers and other software resources.

The latest deployment modality is SaaS (Software as a Service), in which the applications are executed with web browsers and from servers over the Internet and are used by accessing the Internet. There is no need for an installation or software maintenance. This service frees clients from the complexities of software and hardware (Sultan, 2011). These services are subscription-based or pay per use and are helping reduce implementation times, even for large systems, and expand ICT (information and communication technologies) capacities for companies in a flexible manner (King & Ganti, 2010).

Table 1
Cloud computing architecture



Source: author’s own work.

In 2019, the most commonly found and adopted service model will be SaaS

The forecasts indicate that by 2019 the most commonly used and adopted service model for cloud workloads in public and private environments will be SaaS (59%), up from a current level of 45% (2014); 30% of all cloud workloads will be IaaS, down from 42% in 2014; and 11% of all cloud workloads will be PaaS, declining from the 13% they represented in 2014.

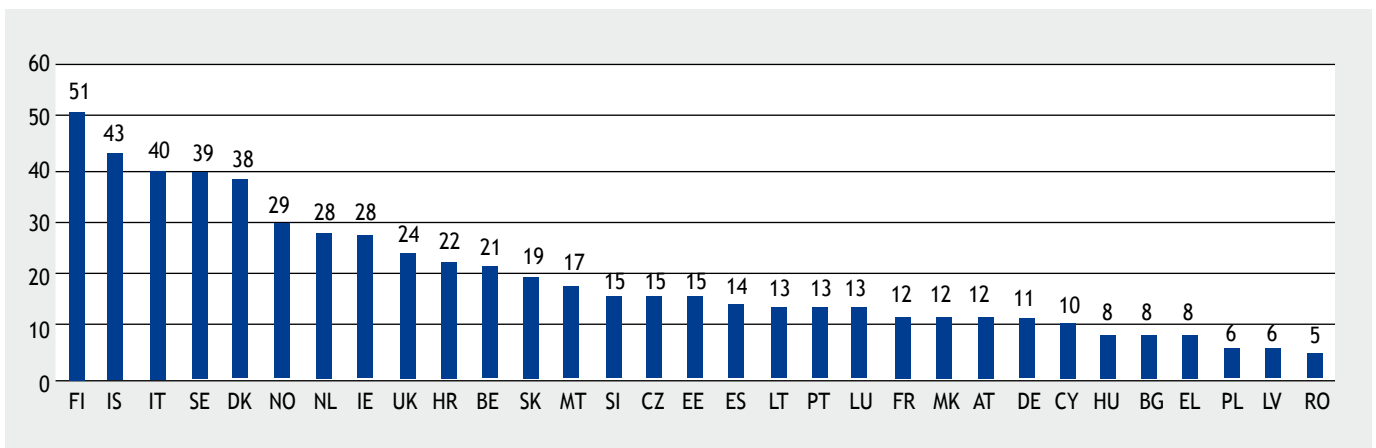
It is estimated that in 2019 the cloud traffic figures by region (Cisco, 2015) will be led by North America, which will have the greatest cloud traffic volume (3.6 ZB¹ per year), followed by the Asia-Pacific region (2.3 ZB annually) and Western Europe (1.5 ZB per year). North America will also generate most of the data center traffic in 2019 (4.5 ZB annually), followed by the Asia-Pacific region (2.3 ZB per year) and Western Europe (1.8 ZB per year).

2.2. The cloud in the European Union

In 2014, the European Union conducted a survey, the results of which showed that 19% of the companies in the European Union use cloud computing, particularly for email systems and file storage in an electronic format. 46% of these companies use advanced cloud services conditioned by the use of financial and accounting software applications (ERP), customer relationship management (CRM) applications or energy savings reasons.

In spite of the fact that the proportion of companies with Internet access is very nearly 100% in most of the member States, only one in five (19%) use cloud computing services. Significant differences are observed in all countries (see Table 2).

Table 2
Use of cloud services in 2014 (percentage of companies)



Source: Eurostat.

In Finland, Iceland, Italy, Sweden and Denmark, more than 30% of companies use cloud computing. On the other hand, less than 10% do so in Hungary, Bulgaria, Greece, Poland, Latvia and Romania. With regard to the use of the cloud, around 66% use a cloud-based solution for their email. Instead of creating a server infrastructure for their email system, which would increase investment and maintenance costs, companies have opted for a cloud

¹ A zettabyte is a unit of information storage that is the equivalent of 10^{21} bytes; it is abbreviated as ZB. The prefix, adopted in 1991, comes from the Latin word *septem*, which means seven (like *hepta-*), since it equals 1000^7 (Wikipedia, 2017).

19% of companies in the European Union used it for e-mail and storage

solution based on per user operating costs. Like these cloud services, many others can meet a wide range of ICT needs in companies. More than half (53%) use the cloud to store files in an electronic format (see Table 3).

Table 3
Use of cloud services in companies (2014)

	Cloud use	Email	File storage	Database hosting	Office software	Financial and accounting software	CRM application software	Computing power for the software
	Percent of companies	Percent of companies that use cloud computing						
EU-28	19	66	53	39	34	31	21	17
BE	21	52	62	45	31	33	26	23
BG	8	74	50	53	58	50	24	16
CZ	15	79	41	34	38	35	18	20
DK	38	63	70	55	42	49	34	34
DE	11	46	56	33	21	25	18	20
EE	15	58	41	18	41	47	17	7
EI	28	57	74	37	36	25	23	17
EL	8	67	50	36	31	32	25	26
ES	14	61	69	54	28	21	24	25
FR	12	62	61	49	32	26	23	14
HR	22	85	49	46	52	50	13	26
IT	40	86	32	28	41	33	14	8
CY	10	68	70	26	39	23	29	16
LV	6	58	58	55	42	47	19	26
LT	13	70	50	47	34	45	33	38
LU	13	46	61	41	32	19	18	14
HU	8	64	46	33	43	35	25	20
MT	17	60	57	44	31	17	19	19
NL	28	55	63	64	40	52	37	18
AT	12	51	54	31	33	23	23	16
PL	6	69	54	41	31	27	22	19
PT	13	78	49	31	36	31	18	30
RO	5	76	36	37	37	33	0	19
IS	15	67	44	39	35	33	20	29
SK	19	84	34	31	46	54	13	22
FI	51	66	54	38	39	39	29	13
SE	39	55	65	43	32	37	26	25
UK	24	51	71	44	29	25	24	22
IS	43	69	74	73	45	62	25	26
NO	29	63	66	54	41	41	33	31
MK	12	74	48	47	57	63	27	31

Source: Eurostat.

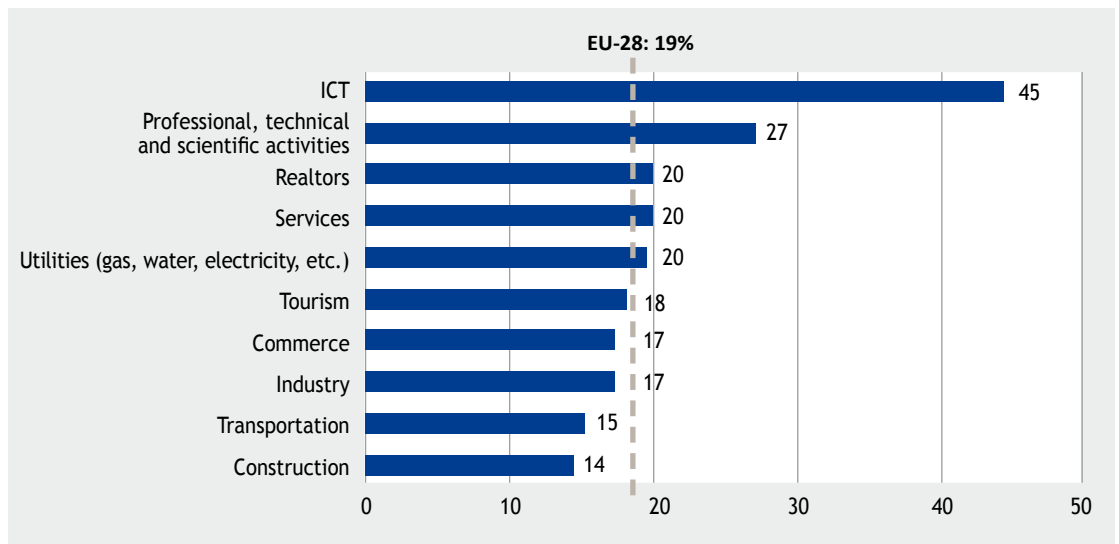
Most companies that use the cloud (45%) belong to the ICT sector

Nearly 39% use it to house their database, while 34% use office software from the cloud (for example, word processors, spread sheets, etc.). The most important thing is that companies access the most advanced management software in client mode; for example, ERP 31% and CRM 21%.

In addition, as can be seen in Table 3, 17% use the cloud computing platforms due to their high performance and computing power in order to run their own business software applications.

As shown in Table 4, the majority of companies that use cloud computing services (45%) belong to the ICT sector, while in almost all the remaining economic sectors, the percentage varied from 14% to 20% (Giannakouris & Smihily, 2014).

Table 4
Cloud use by activity sector in the EU-28 in 2014 (percent of companies)



Source: Eurostat.

2.3. Cloud computing in Spain: the cloud

In the case of Spain, the data provided by the National Institute of Statistics report on the percent of companies that purchased some cloud computing service over the Internet (see Table 5). It should be noted that file storage, email services and database services are the most commonly used services, exceeding 54% in all cases. Trailing the list and with a very small incidence are customer management software (CRM), financial software or computing capacities for running the company's own software.

Previous studies have confirmed that SMEs are unaware of the advantages of adopting cloud solutions (ONTSI, 2012), which means that only 9.8% of SMEs have implemented cloud solutions. These alarming data can be justified by the recent innovation that cloud technology represents, but they highlight the need for training and awareness campaigns regarding their adoption in the business world, in other words, stimulating the demand for services.

The cloud concept is in its earliest adoption phase

Table 5
Spanish companies that have contracted cloud services

Company total	Percentage
22. Cloud computing: percent of companies that purchased a cloud computing service used over the Internet (3)	15.0
22.1. Cloud computing: percent of companies that purchased one of the following cloud computing services used over the Internet (6): email	61.4
22.2. Cloud computing: percent of companies that purchased one of the following cloud computing services used over the Internet (6): office software	27.7
22.3. Cloud computing: percent of companies that purchased one of the following cloud computing services used over the Internet (6): company database server	54.7
22.4. Cloud computing: percent of companies that purchased one of the following cloud computing services used over the Internet (6): file storage	69.0
22.5. Cloud computing: percent of companies that purchased one of the following cloud computing services used over the Internet (6): financial or accounting software applications	20.7
22.6. Cloud computing: percent of companies that purchased one of the following cloud computing services used over the Internet (6): software applications to process customer information	23.1
22.7. Cloud computing: percent of companies that purchased one of the following cloud computing services used over the Internet (6): computing capacity to run the company's own software	25.1

Source: INE, 2014.

However, this process cannot be carried out without the required stimulus from the ICT sector, which must bring itself up-to-date and offer solutions accessible to the SMEs. We are therefore faced with another need: to stimulate the offer.

2.4. Factors facilitating and inhibiting the adoption of cloud computing in SMEs

This change in paradigm means being able to use the new software services and ICT infrastructure on the go, without having to pay for the use of software licenses or purchase hardware that must be installed in the offices. This drastically reduces the cost of implementing applications (Durkee, 2010) and provides a set of advantages for companies: outsourcing, cost savings, improved quality and access to a specialized support (Leimeister, Böhm, Riedl & Krcmar, 2010).

It may seem to many traditional software providers who until now have been selling packs (for example, ERP, CRM, office software, productivity software, etc.) that they would be on the losing end, as they are no longer selling licenses or packages, but they have discovered how to evolve and nowadays they apply rates for using these same applications that use cloud computing, offering new complementary services, such as cloud-based back-up copies or storage, all with a high degree of adaptation in terms of the offer.

Among the drivers most often found in the literature on cloud computing is the market-oriented architecture, which unlike the resource management architecture centralized in the traditional system, is regulated by the offer and demand for cloud resources, and is therefore based on the market balance and on its flexibility (Buyya, Yeo, Venugopal, Broberg & Brandic, 2009), which simplifies the technology infrastructure. Another of the drivers of cloud computing that is most often cited is the scalability of the cloud model (Benlian, Koufaris &

Three out of ten SMEs that use the cloud are held back by the risk of a security breach

Hess, 2011; Saya, Pee & Kankanhalli, 2010), which offers the option of increasing or decreasing ICT resources on demand through the use of virtualization.

The ubiquitous access to cloud-based services is also highly valued (Benlian, Hess & Buxmann, 2009; Saya et al., 2010). The high degree of availability of the cloud services is an important advantage (Benlian et al., 2011), along with the high quality of service and performance (Steinfeld, Markus & Wigand, 2011). Finally, payment per use and its pricing model is another driver (Armbrust, Fox, Griffith, Joseph, Katz, Konwinski, Lee, Patterson, Rabkin, Stoica & Zaharia, 2010; Saya et al., 2010) that permits important cost savings.

This model offers great possibilities for organizations in terms of investment, scale economies, offshoring, access to information from any location, etc. (Palos & Correia, 2016).

The cloud business model also has disadvantages that could prevent users from adopting cloud services. The strongest barrier to this technological innovation is data security, which refers to their protection against unauthorized access, dissemination, modification or destruction while being stored, processed or transferred within a cloud computing system as the result of loss or theft of the data (Benlian et al., 2011; Hay, Nance & Bishop, 2011; Saya et al., 2010). The lack of reliability (Koehler, Anandasivam, Dan & Weinhardt, 2010; Marston, Li, Bandyopadhyay, Zhang & Ghalsasi, 2011) and a deficit of standardization (Clemons & Chen, 2011; Padilla & Pinzón, 2016) are other notable barriers. These barriers highlight the need for new professionals who are specialized in the use of cloud technology, since IT knowledge and the skills of professionals in the ICT sector constitute a crucial factor to bear in mind and as a result, their ongoing training represents an important challenge (Khajeh-Hosseini, Greenwood, Smith & Sommerville, 2012; Hutchinson, Ward & Castilon, 2009).

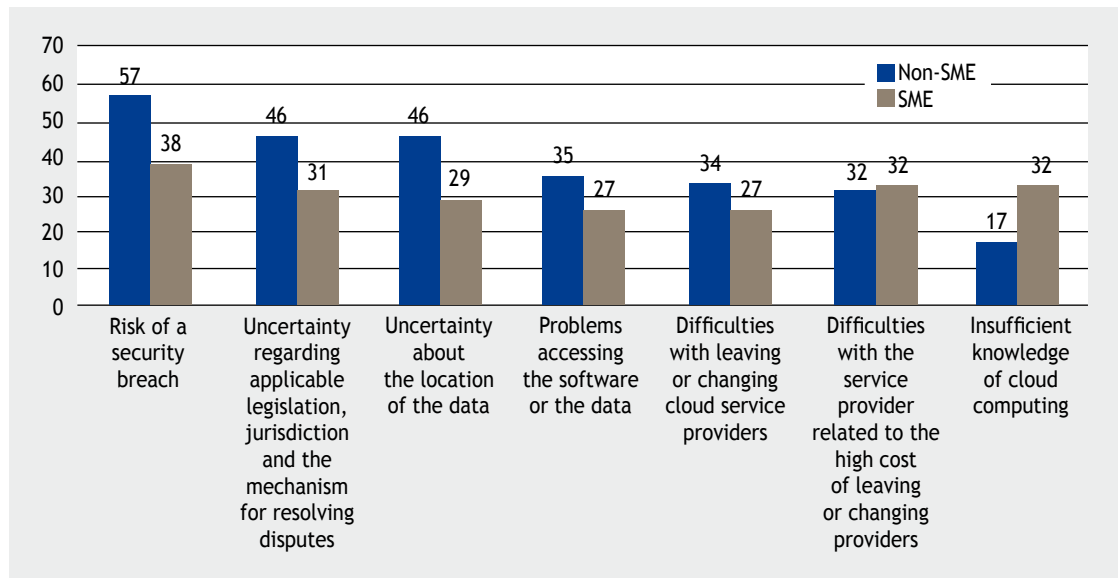
The cloud as a technology or new business model represents progress, but it must be adopted according to a modular scheme that offers great facility for reconfiguration, in which resources or services can be accumulated in a flexible manner, in order to meet changing market demands. However, particularly in Spain and in a general sense in the rest of the world the concept is still in its earliest adoption stage, affecting in disparate ways the two key sectors of the business world: big business and SMEs.

As can be seen in Table 6, more than three out of every ten SMEs that use the cloud (38%) find that the risk of a security breach is the main factor limiting the use of these cloud services. A similar proportion of SMEs (32%) do not use the cloud due to a lack of knowledge and point to this as the main barrier in adopting cloud technologies. Other relevant factors are related to good service by the providers (27%) or problems associated with access to the data (27%).

The cloud is important for companies because they outsource the service to specialized providers in the cloud who are able to offer scale economies (Leimeister et al., 2010) and who take over the maintenance and updating, saving customers time and resources in infrastructure management (Benlian et al., 2011). This cost reduction, along with the scalability of the cloud, permits a very efficient use of resources (Steinfeld et al., 2011). Organizations that adopt this technology improve their processes, since they have better access to ICTs. However, as seen in Table 4, the statistics on use show that less than half of European companies use the cloud. This limited use is directly related, in quite a pronounced manner in the case of SMEs, to the second barrier found: the insufficient knowledge of cloud computing.

The Cloud is an external service from specialized providers who are able to offer scale economies

Table 6
Barriers encountered by companies that use cloud services, classified by size, in the EU-28 in 2014 (percent of companies that use the cloud)



Source: Eurostat.

For the European Commission and the rest of its institutions, the industrial power is made up by SMEs. They form significant segments of the industry in the European Union and are responsible for most of the employment actions in this territory (Etro, 2009). They therefore require specific political attention. While their strength lies in the flexibility with which they can adjust to changes in market conditions, their small size makes them less able to bear the high initial costs of investments in ICT. For this reason, as we will see below, stimulus programs designed for SMEs have been launched and funded.

As we can see below, the importance of cloud technologies in SMEs is crucial to the European economy. The adoption of cloud technology by organizations can mean substantial improvements in the efficiency throughout the economy, and especially in SMEs. The cloud could be especially important for SMEs in the economies with the greatest difficulties or in remote or rural regions, as it would make it possible to take advantage of those markets in the more thriving regions (European Commission, 2012).

There are studies indicating that cloud technology is developed easier in developing countries or emerging nations (Kshetri, 2010) and specifically, in European countries such as Romania or Greece, where cloud technology is a very important tool in the advancement of their SMEs (Marešová & Hálek, 2014).

Some studies conducted prior to the final deployment of the cloud estimated that in Europe one of the consequences of the adoption of the cloud would be the creation of around a few hundred thousand new SMEs throughout the European Union. The effect of the cloud will be that the creation of SMEs will be sustained over time, almost as a permanent effect, with a more profound effect in the countries in which the spread of SMEs is particularly strong or in

The importance of the cloud for SMEs is crucial for the European economy

which the adoption of ICTs has been generally quick. In absolute terms, it is estimated that Italy has experienced the greatest impact in terms of new businesses (81,000), followed by Spain (55,000), France (48,000), Germany (39,000), the United Kingdom (35,000) and Poland (32,000).

Part of the positive effects of cloud computing are going to be related to the speed with which the new technology is adopted. Research suggests that authorities must promote as much as possible a quick adoption of cloud computing with tax incentives or subsidies in the most dynamic sectors of the economy. Likewise, foreign companies can be attracted through the introduction of favorable regulations in terms of data processing that promote the movement of data between their country and Europe. On the other hand, in a context like the European, the smallest countries would be able to obtain the greatest benefits from these policies, at least in the initial phase, because they would easily attract foreign investments from the largest countries (Etro, 2009).

3. Methodology

This research project was conducted according to a methodology based on the review of the existing literature on the adoption of cloud computing in SMEs. It relied on the use of secondary data sources of an external nature (technical reports, research articles and books), web sources from the European Commission and the Spanish government's Ministry of Industry and SCOPUS databases, the Web of Science and Science Direct to consult articles and scientific books.

This research thus uses an exploratory methodology, since the objective of the study is to examine a research problem that has received little or no study and about which questions remain. Such research is also exploratory when the literature review reveals that the ideas have been vaguely related or when we want to investigate a topic from a new perspective or expand the existing ones (Hernández, Fernández & Baptista, 2007).

4. Analysis of cloud initiatives in the European Union

It was in the Granada Declaration (2010) that the European Union recognized cloud computing as a strategic sector with great market potential. In 2010, as the result of this declaration, the European Digital Agenda was approved, in which cloud technologies were highlighted as one of the strategic pillars of the future (Joyanes, 2012).

In 2011, different consultations were begun with experts. These consultations made it possible to involve the main users, to coordinate a standard that provided support for the interoperability and portability of data, but above all they permitted gathering information to develop a European strategy on cloud computing.

In 2012, the European Institution stated that this technology represented an important opportunity for the Public Administration and that a guide needed to be followed for the oversight of cloud contracts in a homogeneous manner throughout the European Union. This guide made it possible to inform the different Administrations about the security criteria when contracting services.

Within the European Commission's Digital Agenda, a set of initiatives was enacted to increase the use of ICTs by SMEs. Specifically, the strategy was based on the initiative "Unleashing the potential of cloud computing in Europe," which defines the cloud as an opportunity to

In 2012, the European Union stated that this technology represented an opportunity for the Administration

improve business competitiveness through the adoption of its different technological solutions.

4.1. The European Union's cloud computing strategies

The initiative "Unleashing the potential of cloud computing in Europe," discussed for 18 months with different experts, intends to accelerate and increase the use of cloud computing throughout the economy, promoting European companies and the productivity of the Public Administration.

The acceleration of the adoption of cloud services experienced in Europe in 2012-2013, particularly in services such as web-based email and the social networks, is still limited in terms of the evolution forecast by the European Union. This is due to the fact that, unlike the Internet, cloud computing is in an early stage of development. This permits its legal framework to be developed and to ensure that companies and users are capable of benefiting from the supply and demand of cloud services.

There are three cornerstones of the strategy:

- **Strategy 1. Promotion of interoperability and building consumer confidence in cloud services.** The intent is to generate the essential rules for seamless communication and data portability, that help prevent customers from having problems in changing providers when they wish, and promote competition. The Commission is working with the European Union Agency for Network and Information Security (ENISA) and other corresponding entities to aid in the development of voluntary certification systems throughout the European Union for the cloud (including data protection).

Their application began with the creation of a group of experts on certification in the framework of the Cloud Selective Industry Group (C-SIG), which gathers representatives of various cloud providers and other industry participants. Its conclusions are presented to the governing board of the European Cloud Partnership (ECP). ENISA has already drafted a report on the certification and auditing of the cloud from a security perspective. It has also contributed to the creation of a directory of cloud computing security standards, in collaboration with the European Telecommunications Standards Institute (ETSI).

- **Strategy 2. Generating a set of secure terms and fair contracting conditions.** The intent is to promote fair and transparent practices in the provision of cloud contracts. This is necessary not only for consumers and small companies, but also for Service Level Agreements (SLAs) between large companies and the public authorities. A series of standard agreement templates have been drafted based on eleven attributes. Work has also been done on a code of conduct for cloud computing providers that will support the uniform application of data protection standards. The Commission will also review the contract clauses applicable to the transfer of personal data to third countries and has already interacted with the national data protection authorities to approve the binding corporate standards for cloud providers.
- **Strategy 3. The establishment of a European Cloud Partnership to promote innovation and growth in the public sector.** The initiative brings together industry experts and public sector users to work on the common requirements for contracting cloud services. The intent is to establish a common ground for contracting requirements that can represent greater efficiency and reduced costs for national budgets, intensifying at the same time interoperability. A high level administrative board that represents countries in the

Authorities must promote quick adoption of the cloud technology through incentives

European Union and cloud service providers advise the European Commission in order to, among other purposes, minimize the risk of a loss of confidence in the cloud by companies and users. This loss of confidence would fragment the cloud market in separate national market segments, which would represent a step backwards for the common market, with the subsequent detriment of not obtaining the critical mass of customers needed for the development of the cloud in Europe, and therefore its own European industry.

This strategy has culminated in a list of recommended certifications, called CCSL, the compliance with which is voluntary. As an extension of the CCSL, Certification System Metaframework (CCSM) has been created to facilitate the use of the existing certification systems during the procurement of cloud services.

As a whole, the initiative proposes measures to gain 2.5 million new job positions in Europe, as well as an annual increase in the GDP in the European Union equal to €160 million (around 1%) between 2014 and 2020.

The resolution on the unleashing of the potential of cloud computing (European Parliament, 2013) recognizes the economic potential of cloud computing to increase the global competitiveness of Europe and it can become a powerful instrument for growth and employment.

Clearly, cloud computing is based on the expectation that it will become an element of development that transforms all sectors of the economy. In addition, it is indicated that it is important for the European Union to develop its enabling technologies and the underlying infrastructures and competences, in particular in benefit of SMEs, as one of the key factors in order to be able to take advantage of the opportunities afforded by cloud computing and compete on a worldwide level in the data economy (European Commission, 2013).

The importance given to this matter makes room for it in the European Digital Agenda of the Horizon 2020 Project, where its repercussion on the European economy is stressed. A specific program has been created for this purpose, for the development of cloud computing ("European Cloud Computing Strategy," 2012). The program objective covers a time frame of up to 2020. It is articulated in a set of actions that make it possible to generate 2.5 million new European jobs and contribute an annual growth figure of €160 million (1%) to the GDP by 2020. While the figures do not match those included in the document "Unleashing the potential of the cloud, 2012," it does indicate the importance given to it by the Commission.

The SMART 2013/0043 study on the adoption of cloud technology in Europe provides some quantitative estimates of the impact of cloud computing on the economy of the European Union for 2020. The study focuses on the potential economic impact that the adoption of cloud computing solutions by the public and private sector could have on the economy of the European Union as a whole. The study found that between 2015 and 2020, cloud computing may contribute a cumulative total of €449 billion to the joint GDP of the 28 member countries, including their public sectors, of which €103 billion would be the net growth in 2020, which represents a 0.71% share of the European Union's total GDP, or more than three times the amount it represented in 2013.

Between 2015 and 2020, approximately 303,000 new companies will be created, particularly SMEs, thanks to the availability and adoption of cloud computing. Furthermore, of the 1.6 million job positions expected to be created between 2008 and 2020, almost 1 million jobs will be created during the 2015-2020 period. The total market value of the cloud in the

Assistance in the development of voluntary certification systems throughout the European Union for cloud technologies

European Union in 2013 was estimated to be €9.5 billion, less than 3% of the total ICT budget for the public and private sectors in the European Union. This value is expected to increase to €17.2 billion in 2015 and €44.8 billion in 2020, i.e., accounting for almost five times the size of the market in 2013 and more than 10% of the ICT budget anticipated for 2020.

The study found that the cloud replaces ICT service and system-related expenses. For example, the adoption of SaaS (Software as a service) eliminates the need to purchase software and servers. As a matter of fact, every €1 spent on SaaS replaces €2.30 of expenses that an organization would spend to achieve the same result through a traditional solution. The results of this study back the Commission's strategy to create a single digital market, as announced in May 2015.

Measures are currently still being implemented from the "Unleashing the potential of cloud computing" initiative, following the recommendations of the Eurostat Report (2014) and the European Union Conference on Cloud Security (ENISA, 2015).

4.2. Spanish strategy on cloud computing

The Spanish Digital Agenda is aligned with the strategy of the European Union and establishes the objectives, lines of work and measures to promote the development of the Information Society. The Ministry of Industry formed a Group of High Level Experts for the Digital Agenda, the first meeting of which was held in 2012, with the aim of proposing and guiding measures to develop the government's strategy in Telecommunications and the Information Society (Joyanes, 2012).

Some of these measures benefit from financing with funds from the FEDER operational programs, which are intended to give a major boost to the availability and use of telecommunications and information technologies, implementing services and deploying infrastructures for networks and broadband Internet access in the areas of greatest need for citizens and SMEs. It would also create digital contents, supporting projects in SMEs aimed at incorporating technological solutions and the adoption of ICT services and applications that can serve as a level for greater electronic business development and for the ultimate integration of Spanish companies in the Information Society. This would contribute to increased productivity in their economic activity and their competitiveness (Red.es, 2015).

In this sense, the Intelligent Growth Operational Program 2014-2020 (hereafter, IntGOP) specifies the strategy and objectives for intervention by the central state administration (CSA), co-financed with the FEDER fund, to contribute to the improvement and the recovery of the competitiveness of the Spanish economy, by promoting a more intelligent growth model based on research, innovation and ICTs, with special attention to the needs and potential of SMEs.

For this reason, the IntGOP concentrates its actions on three thematic objectives of the eleven set out in Article 9 of Regulation (EU) No. 1303/2013. The Spanish Digital Agenda is essentially framed within thematic objective 2, enhancing access to, and the use and quality of ICT.

Within this thematic objective and the scope of the digital economy are actions supporting the implementation of R&D projects in the ICT sector, which will contribute to developing an effective industrial policy in the ICT sector in Spain, promoting both the economy and the digital society. This line will address the finance needs of the ICT sector, especially for innovative projects that are closer to the market for the development of ICT products and services, having identified cloud computing, big data, smart city, cyber security and the Internet of the future as the main ICT industries of the future (Red.es, 2015).

A program to promote the offer of cloud solutions in underprivileged areas

For this reason, within the IntGOP framework, a series of initiatives were programmed to promote the development of the ICT offer, through support for companies as they develop products and services in technologies and industries of the future, and in particular in the areas of smart cities, smart destinations, the Internet of things, big data and cloud computing.

The priority lines of action for the Digital Agenda are an aid program to town councils and associations aimed at promoting the existence of smart cities, an e-commerce mentoring program for SMEs (2011-15), the program promoting the offer of cloud solutions in the Castille-La Mancha, Extremadura and Andalusia regions (2015) and the current program of assistance in the program promoting the demand for cloud computing solutions for SMEs.

The latter two programs have provided the biggest push for the Spanish strategy promoting the adoption of cloud technologies. On the one hand, the program supporting the offer of cloud computing solutions for small and medium-sized businesses offered SMEs and freelance workers who worked in the ICT sector assistance for migration or the development of new solutions in SaaS mode. This financial assistance provided an amount of between €12,500 and €60,000 per beneficiary, corresponding to a percentage of between 50% and 80% of the subsidizable budget requested. The program was endowed with €25 million.

The second program, which took effect in May 2016, offers SMEs in any sector assistance for the adoption of cloud solutions, which can be selected from a catalog divided into categories, made available to them through Red.es, a public business organization attached to the Ministry of Industry, Energy and Tourism (MINETUR), which offers an extensive set of programs so that Spanish society reaps the full benefits of the possibilities offered by ICTs.

The program is endowed with a total budget of €40 million and co-finances between 50% and 80% of the adoption cost of the assistance during a period of approximately nine months. The aid will cover an amount of between €625 and €15,000 per beneficiary. Red.es defines beneficiaries as SMEs or freelance workers with fewer than 250 employees, a business volume of less than €50 million and tax residence in Spain, which have begun activity prior to the publication of the subsidy rules.

The catalog classifying the offer is divided into the following ten categories: user stations, economic management, business management, customer relations, point of sale management, presence on the Internet, e-commerce, infrastructure as service, development platform as a service and virtual switchboard.

The company providers whose cloud solutions make up the catalog were selected through a public approval process and a general call to tender. This program therefore boosts demand, but at the same time selects and promotes specialization in the offer by providers and constitutes an important leverage point to consolidate the adoption of cloud solutions in Spain.

5. Conclusions

The sectors with the greatest knowledge about cloud computing technology are the ICT sector and industry, with 62.7% and 57.5% (ONTSI, 2012), and with 37.7% of the SMEs in the ICT sector being aware of the technology and making use of it, as well as the professional activities and services sector (legal, accounting, technical, scientific, etc.), with 31.8%, among those who are the quickest to adopt cloud technology in Spain. These figures do not agree with other European studies, which after the ICT sector also mention professional activities, but

Europe must exploit its great strength in the area of legal security, protection and transparency

immediately speaking, it is the tourism sector that has the greatest levels of dependence, which is in agreement with other studies on cloud computing in the hospitality sector (Palos & Aguayo, 2016). It may thus be of concern that the Spanish tourism sector is not in line with the competitiveness that this innovation produces.

Companies, in particular SMEs, have low levels of knowledge and training in the functionalities and advantages of the cloud. Moreover, in some cases, they use these technologies and are formally unaware that they are doing so. Therefore, communication and training are revealed to be two aspects that may provide to be key, especially in SMEs, and efforts towards dissemination and education are needed by providers and institutions in Europe.

The economic expectations that the European Commission had placed on the cloud industry do not match the published data. One of the reasons is because the Administrations themselves are not adopting this technology. We therefore coincide with previous studies that indicate that the Public Administrations are possibly not aware of the real importance of cloud computing and even though efforts are acknowledged to convince companies to adopt ICTs, there is still a great deal of work to be done in the development of infrastructures and the dissemination and support for the incorporation of these technologies (Maqueira-Marín & Bruque-Cámara, 2012).

The lack of standardization of application program and technology platform interfaces means that interoperability among platforms is poor. Companies are not capable of easily transferring data from one cloud provider to another. In this sense, the European strategy is creating an important regulatory body of certifications, whose translation into the reality of each Member State will play an important role.

It is thus important to prevent consumers from encountering lock-in data providers, i.e., the difficulty or impossibility to change providers. This perception of lack of control could discourage companies from starting to adopt cloud computing (Armbrust et al., 2010).

The uncertainty of the service availability and its reliability, especially the concern about the time during which the system would be inactive in light of an unexpected interruption could dissuade companies from adopting cloud computing, since it increases project costs and business risks. All these data herald large public and private investments in these technologies and at the same time also make a strong reconversion of the ICT sector necessary, which is used to developing applications or providing services according to models that are now absolutely obsolete in their deployment or business model.

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