

# ***Cloud Computing***

## **Challenges and Opportunities**

### **EXECUTIVE SUMMARY**

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## INTRODUCTION

The objective of the report "Cloud computing. Challenges and Opportunities" is to analyze the current situation and the impact of cloud computing in Spain. Opportunities for growth and deployment strategies of this technological model have also been identified, focusing in particular in small and medium enterprises in Spain.

This report consists of five chapters and a series of annexes including bibliography, a glossary of terms and a list of graphs, tables and illustrations. The first chapter is devoted to the current status of cloud computing, the concept, advantages, models and status at worldwide, in Europe and in Spain in particular. The second chapter presents the results of the survey on the knowledge and use of cloud computing, motivation, barriers and future trends. This survey was carried out amongst 1700 Spanish SMEs (companies with 0 to 249 employees). The pioneering nature of this survey deserves mention, as the first survey on cloud computing focused on smaller Spanish enterprises. Moreover, it presents data broken down by micro-businesses (0 to 9 employees), small and medium enterprises (10 to 249 employees) and sector.

The third chapter offers the perspective of cloud computing experts from the sector of cloud service providers, large client business sector and the Public Administration. The analysis reflects the prospective opinion of experts regarding the future of cloud computing, as well as its strengths, barriers, impact and opportunities. The fourth chapter evaluates the impact of the technology from the macroeconomic, microeconomic, environmental and social point of view in the Public Administration. Finally, the fifth chapter contains a selection of best practices in the use of cloud services in different activities in both the public and private sector.

## 1. CONCEPTUAL FRAMEWORK

According to the NIST (*National Institute of Standards and Technology*), cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction.

The technology that makes the development of this scenario possible is virtualization. Virtualization decouples hardware and software making it possible to replicate the user environment without having to install and set up all the *software* that is needed to launch every application. Virtual machines allow easy workload distribution and create a new paradigm, cloud computing.

To get a quick understanding of the key elements of the concept of cloud computing, it is important to highlight the main characteristics that distinguish cloud computing from traditional IT systems:



- **Pay per use.** It allows usage-based billing.
- **Abstraction.** It makes it possible to isolate contracted computing resources offered by the provider from the computing infrastructure of the entity.
- **Dynamic scaling.** It allows the dynamic increase or reduction of the features offered based on the client's needs.
- **Multiple users.** A service or resource may be shared by all the users on the same technological platform, as tailored to their needs.
- **Self-service on demand.** The user has access to the computing resources on the cloud without having to contact the provider.
- **Unrestricted access.** Allows ubiquitous access to the contracted services at any time/place and from any device with Internet access.

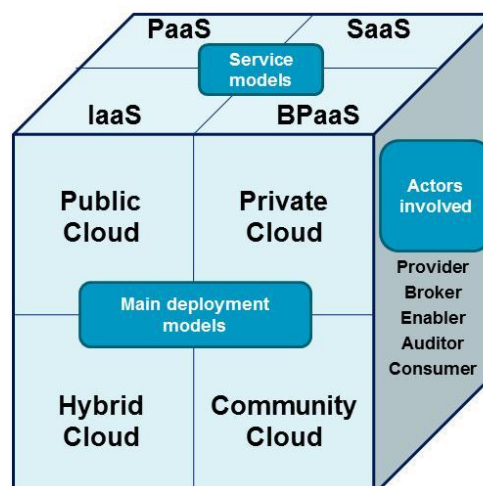
Cloud computing *solutions that* are currently available on the market can be classified according to three dimensions:

- Service Models: *Infrastructure as a Service (IaaS), Software as a Service (SaaS), Platform as a Service (PaaS)* and *Business Process as a Service (BPaaS)*.
- Deployment models (integration and exploitation models): *public* cloud, *private* cloud, *hybrid* cloud and *community* cloud.
- Actors involved in the business: enabler, provider, broker, consumer and auditor.

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#### Cloud computing solutions classification cube

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Source: ONTSI

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The deployment of cloud computing solutions and services provides several benefits to a wide range of groups, sectors and economic and social actors:



- **Benefits for businesses:** it avoids investment. Contracted solutions can be easily resized and the latest updates are always available. This has an impact in the form of reduced energy consumption.
- **Benefits for the economy:** it fosters the creation of new enterprises and jobs, reducing market entry barriers for new providers, consumers and brokers. Furthermore, it generates induced cross-cutting impact and it leads to cost savings.
- **Benefits for Public Institutions:** it promotes the development and maintenance of policies that require intensive technological support, it contributes to migrating costly services and it makes the widespread application of transverse services to the whole Administration feasible.
- **Benefits for citizens:** cloud computing improves access to personal services of communication and information management online. Furthermore, it allows pay per use and access on demand, optimizes access to content and allows administrative processing online. In the framework of open government, it permits access to large volumes of public information, improves health care services, enables access to shared "education clouds", improves the functions of social networks principally based on a technological cloud and allows access to applications.
- **Benefits for scientific research and innovation:** cloud computing speeds up the intensive processing of data and offers multi-entity collaboration platforms for the development of joint projects thus facilitating data harmonization and standardization.

At the same time, several key challenges have been identified that will determine the evolution and final deployment of cloud computing. These are: service availability, lack of technological standardization and integration, data security and privacy, supplier dependence, technological amortization, restrictions due to diverse geographical location, barriers to interoperability and legislation compliance.

In analyzing the current status of cloud computing, the fact that the European Commission has included several guidelines and specific recommendations in the Digital Agenda for Europe and the eGovernment Action Plan 2011-2015 in order for Member States to boost the development of the cloud computing sector is worth highlighting. In 2012, the announced "European Cloud Computing Strategy" will encourage public institutions to foster the sector and create a legal framework providing a safe environment for the cloud market, amongst other objectives. It is worth mentioning that the main providers of technological services operating in Spain have already adopted cloud products and cloud services that their international branches are already offering in other countries.



## 2. CLOUD COMPUTING IN SMALL AND MEDIUM ENTERPRISES IN SPAIN

Various studies about cloud computing indicate the small and medium enterprise as one of the main potential beneficiaries of cloud computing. Nevertheless, before this survey was conducted there was no representative data of the real use of this technology by Spanish SMEs.

ONTSI prepared this survey with the aim of shedding light on the level of knowledge and use of cloud computing in microenterprises and SMEs in Spain, as well as the obstacles and reasons for adopting this technology, perceptions about cloud computing and forecasts for the future. A population sample of 1,700 SMEs with websites was determined, classified according to size (0 to 9 employees and 10 to 249 employees) and activity sector.<sup>1</sup>

Main results are presented below:

- 45.2% of Spanish SMEs with websites have some knowledge of cloud computing: 20.5% acknowledge having a solid knowledge of cloud computing solutions and their applicability in the company and 24.7% have "heard of" this technology and can mention some examples but do not have a detailed knowledge of it. On the other hand, 54.9 % of Spanish SMEs have no knowledge at all of the technology.
- Three-quarters (77.5%) of the enterprises that knew of the existence of the cloud have never used cloud -based solutions.
- 21.7% of enterprises aware of the existence of the technology admit to using cloud-computing solutions at present. This represents 9.8% of the total number of SMEs taking part in the survey.
- The sectors with greater knowledge of cloud computing technology are ICT and industry, where respectively, 62.7% and 57.5% of SMEs with websites know the technology. As regards cloud computing use, the ICT sector stands out, with 37.7% of SMEs aware of the technology using it, as well as professional activities and services (legal, accounting, technical and scientific services, etc.) with 31.8%.
- Concerning deployment, the preferred implementation form is the private cloud, used by 6 out of 10 SMEs with websites using cloud computing technologies. Secondly, the public cloud comes up to 33.8% and in the third place, hybrid solutions, with 13.9%. Community cloud solutions are in the last place, barely attaining a 1.7% penetration rate.
- The most commonly used service model amongst cloud-using Spanish SMEs is Infrastructure as a Service (IaaS), with 76.1%. Amongst these solution types, the most in demand are storage services (68.5%) followed by *backup* services (22.4%). Just over half of the enterprises using cloud technologies acquire Software as a Service (SaaS), which represent the highest degree of abstraction and externalization among the cloud solution types. Least used are Platforms as a Service (PaaS) solutions currently accounting for 18.8%.

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<sup>1</sup> Eleven sectors were identified: industry, construction, vehicle sales and repair, wholesale trade, retail trade, hotels, campsites, travel agencies, transport and warehousing, computing, telecommunication and audiovisual services, real estate, administrative activities, professional activities and the finance sector.



- 47% of SME cloud users use these services in a cross-cutting way, instead of using them for specific areas or processes. 35% of enterprises have deployed cloud solutions in the sales and merchandising areas (for websites, e-commerce, client management solutions, etc.), 18% have used it for production and 12% for finance management.
- The three main reasons for adopting cloud computing amongst SMEs are the following: flexibility and scalability of resources (56% of user enterprises), the possibility of access from any device (49.1%), and the easy modernization of business and management processes (41.8%).
- The main benefits arising from the deployment of cloud solutions encountered among SMEs are time saved (71%) and cost savings (63%). Furthermore, approximately half of the cases (48%) consider that cloud solutions have resulted in a general improvement in productivity. Concepts such as the redesigning of internal business processes (30%), alterations in product and/or services offered (28%) and the redefinition of internal staff tasks (16%) are of lesser impact.
- Concerning cost savings due to cloud, 71% cloud-using companies point out savings in maintenance costs, 53% in investment costs and 32% in software licenses. Among other cost savings mentioned by enterprises are items such as non-IT staff not specialized attending to specific queries, or savings in space, electric power or hardware.
- The main concern voiced by Spanish SMEs when adopting cloud solutions is corporate data confidentiality and security (55%). This problem is the main factor preventing SMEs from relying on external managers for key business processes. Other significant reasons for doubt about the appropriateness of cloud to manage business processes is the loss of control over the processes (26%), acquired dependence on the service provider (21%) and problems relating to availability (18%) and the integrity (17%) of the contracted services.
- 62.7% of cloud-using enterprises are satisfied with the technology: 34.8% have found their expectations met as regards cloud computing and 27.9% have found them satisfied to a reasonable extent.
- Most of the cloud-using enterprises surveyed (63%) would recommend the technology without any reservations.
- The main reasons pointed out for not deploying cloud computing technology in SMEs- even where they are aware of its existence- are the following: they do not consider the technology necessary to develop their business (65%), they do not have a sound knowledge of these kind of technologies (22%) and they doubt whether this technology will serve the objective for which it was deployed in the company (14%).
- The two main factors that discourage enterprises from implementing cloud computing are knowledge and cost, both factors being equally important.
- The most recurrent concern among SMEs not using cloud is corporate data security and confidentiality (60.1%). Of secondary importance are service and data availability on the part of the provider (32.7%), loss of process control (27.4%) and acquired dependency on the provider (26.1%)



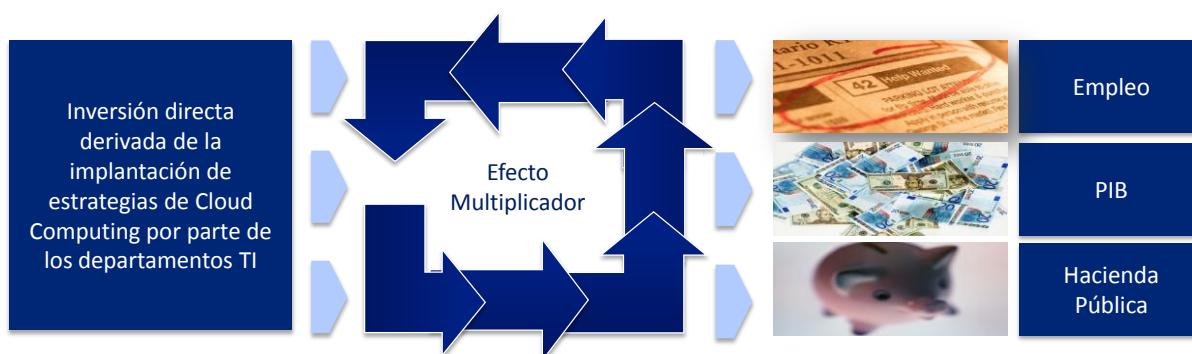


### 3. IMPACT EVALUATION

This section tackles all aspects related to the social, economic and environmental impact implied in the present and in the future by the progressive implementation of cloud technologies in Spain.

#### 3.1. Macroeconomic impact of cloud computing

The economic impact of cloud computing has been assessed with the help model developed by the consulting firm Deloitte on macro-economic aggregates (fundamentally GDP, employment and Treasury returns) linked to investment and the development of business strategies derived from the use of cloud computing. The methodology used is based on macroeconomic input and output tables.



The following have been included in the input model:

- According to the Spanish Multisectorial Trade Association for Electronics, Information and Communication Technologies, Telecommunications and Digital Contents Industries (AMETIC), comprising enterprises and professionals of the industry, the cloud computing business will exceed 1.8 billion euro in 2012.
- This amount will be dedicated to activities related to the features characterizing cloud computing. Turnover is attributed to productive sectors and its impact on the Spanish economy is described using the National Classification by Products and Activities (CPA) used in the National Statistics Institute's (INE) publications.
- Macro-economic aggregates linked to INEs publications:
  - o Gross Added Value (GAV)
  - o Gross Domestic Product (GDP)
  - o Personal consumption ratio classified by productive branch and per resident
  - o Inflation
  - o Input-output tables (Symmetric Table)
- Tax revenue collected by the Spanish Tax Agency for the period under study. Information is obtained from the publications of the Spanish Tax Agency.



Bearing in mind expenditure estimates, investment distribution <sup>2</sup> has been modelled according to the importance of each of production branch for 2012 turnover as indicated in the following table<sup>3</sup>.

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**Turnover distribution linked to cloud computing distributed between the different productive branches according to the model used for 2012**

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ID	Productive Branches	% Impact
58	IT activities	40,00%
32	Office machines and IT equipment	30,02%
52	Post and Telecommunications	15,28%
34	Electrical material manufacturing	3,05%
45	Restauration	2,03%
56	Real State activities	1,56%
43	Retail trade, repair of personal goods	1,15%
42	Wholesale trade brokers	0,50%
14	Other food industries	0,49%
65	Leisure, cultural and sports activities	0,42%
	-Other	5,48%

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*Source: Deloitte*

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As a direct result of the turnover breakdown between different productive branches in 2012, the impact that the investment will have on the main macroeconomic indicators may be calculated.

#### **Impact on Gross Domestic Product**

- Planned investment in the industry sector for 2012 will result in the generation of more than 2,730 million euro in Gross Added Value (GAV). This will generate more than 3,049 million euro in terms of Gross Domestic Product (GDP).
- For each euro invested, the impact in GDP terms would be of 1.63 euro.

#### **Impact on employment**

- As per the input-output method, the impact on employment stability will be very high and can amount to 65,000 jobs in one year.
- This implies that cloud computing will generate, in GDP terms, 46,700 euro/job retained. Compared to nominal GDP per capita, which amounted to € 22,500 in 2010, the figure is significantly higher. This means that the contribution of the cloud computing industry to the economy of our country can be highly beneficial.

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<sup>2</sup> Investment distribution based on the experience in IT projects, prepared by Deloitte.

<sup>3</sup> "% Impact" refers not only to direct expenditure in that productive branch but also induced effects and interrelationships between productive branches. These percentages show the future breakdown of the added value of the investment between the different productive areas.



## Impact on Public Treasury

- Based on the working hypotheses, Treasury returns in the first year will amount to 678 million euro in total. 54% of this amount corresponds to the collection of Personal Income Tax (IRPF), 29% to the collection of Value Added Tax (IVA) and 17% to Corporate Income Tax.

### 3.2. Microeconomic impact of cloud computing

The study on the microeconomic impact of cloud computing includes the comparative analysis of the economic and financial impact as well as the differentiating elements of five technological innovation projects in SMEs according to the traditional deployment model as against the new cloud paradigm.

Deloitte's Value Print tool has been used to achieve these objectives. This tool uses several hypotheses to ensure the correct definition of the problem in different areas such as:

- Characteristics of the SME.
- Characteristics of the project over a 5-year term (for both traditional and cloud paradigms)<sup>4</sup>.

After analyzing the business cases, comparative results are obtained between the traditional scenario and the scenario that would result from the use of cloud computing. Main financial data is compared (investment, benefits, returns, Weighted Average of Cost Capital (WACC), operating margin, etc.), return on investment, factors that have contributed to boosting benefits and the conclusions for each case.

The following business cases have been studied:

- The improvement of sales and invoicing through the implantation of CRM.
- The improvement of productivity per employee and time saved in template management through the implementation of an Enterprise Resource Planning system (ERP).
- The improvement in client satisfaction and associated cost savings through the automation of Customer Service and its integration in a web portal.
- The productivity increase in the management department in charge of drafting activity and status reports for the Board of Directors through the use of a Business Intelligence system.
- The reduction in storage cost and inventory management through the use of an IT solution for Inventory Management.

### 3.3. Social impact of cloud computing

Cloud computing has provided services and platforms that, in a short period of time, have become the most important levers for social change in the last decades. The following are worth highlighting:

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<sup>4</sup> Characteristics of the project and estimated expenses according to the consulting firm Deloitte.



- The use of social networks.
- Virtual storage of contents, ranging from e-mail to multimedia content such as videos, photos and information managers.
- Mobile telephony and cloud-based office automation allow the management of personal and professional information from any location.
- Access to digital content such as music or television.

### **3.4. Impact of cloud computing on Public Institutions**

In spite of the fact that experiences in the deployment of cloud computing models in Public Institutions are still in their early stages for an objective evaluation on costs savings and benefits obtained, other countries (such as the United States) are more mature and provide greater experience that make it possible to draw further conclusions.

It is difficult to generalize a conclusion or cost savings metrics for cloud computing in the public sector. Each project has to be assessed on an individual basis.

### **3.5. Environmental impact of cloud computing**

In general terms, the reduction of the environmental impact of cloud computing results from an improved efficiency in the infrastructure of providers and the reduction of user IT infrastructure needs. Cloud computing can contribute to reduce CO<sub>2</sub> emissions per user thanks to the following factors:

- It reduces excess in assigned infrastructure (dynamic provisioning).
- License for applications can be shared among multiple entities, thus reducing peak loads.
- Server infrastructure operates with a greater degree of utilization.
- Efficiency of large-scale, optimized data centers is improved by reducing the energy used for refrigeration and by working with servers at optimal utilization and optimum temperature.

Cloud computing is emerging as a feasible and scalable technology that can further reduce CO<sub>2</sub> emissions supporting the proliferation of new technologies for smart energy grids, intelligent buildings, logistics optimization and the dematerialization of some consumer goods. For these reasons, cloud computing could have a wider global impact in the reduction of CO<sub>2</sub> emissions and the optimization of energy consumption, obtaining further indirect benefits from the benefits described above.



## 4. BEST PRACTICES IN CLOUD COMPUTING

This study presents thirteen cases of best practices in the implementation of cloud computing solutions, both for private businesses and Public Institutions. Businesses considered range from research, development and manufacture, education, IT and telecommunication, media, e-commerce, audiovisual services, transport and scientific research. For each case, the motivations, technology and architecture used and main benefits obtained have been presented.

## 5. CONCLUSIONS, RECOMMENDATIONS AND PROSPECTS

A group of ICT and cloud computing experts coming from Public Institutions, cloud service providers and large companies were interviewed. An analysis of the experts opinions structured into conclusions, recommendations and prospects, is presented below.

### 5.1. Conclusions

The conclusions of the present study refer, not only to the characteristics, benefits and degree of use of cloud computing that have been extensively described in the report, but also to the added value mentioned by the experts interviewed.

During the interview, experts from provider companies, large businesses and Public Administration have outlined their perception about certain aspects that can be of great value in understanding the real situation of cloud computing in Spain. Their opinions are presented below:

#### Experts from provider companies

- There is a great lack of knowledge in the market about what cloud computing is and the advantages that it can offer, as the quantitative analysis of the report has demonstrated. In particular, 20.5% of microenterprises and SMEs in Spain acknowledge having a solid knowledge of cloud computing technology, while 54.9% admit having no knowledge at all.

Moreover, providers have detected a certain degree of rejection of the technology, mainly due to this lack of knowledge. Furthermore, information that reaches clients about cloud very often has to do with incidents in *public* clouds, contributing to generating mistrust in the technological model and psychological barriers.

- There is a significant lack of maturity in the sector and a service catalogue ill-adapted to the specific solutions concerning the activities carried out by companies.
- The offer is still badly structured in the domestic cloud market. There is a great deal of potential for the adoption of cloud by SMEs, but large providers have to become more oriented towards this market.
- To date, there is no common legal framework that can support these types of services, generating rejection among clients, as they do not have a clear vision of the implications in all aspects related to compliance with the legal framework, particularly in the case of the Personal Data Protection Law (LOPD).



- Clients are concerned by the loss of control and growing dependency on the provider. In this sense, providers have been clear and have alluded to the need of creating and adhering to standards that will facilitate migration from one cloud to another.
- The telecommunications network is the main success factor for cloud service providers, more than software and hardware. Telecommunications operators have the ability to be in a better position in the market, as they can guarantee connectivity and service performance. The development of SaaS services in particular depends greatly on fixed and mobile telecommunication networks.
- As is often the case with new paradigms, there is great resistance to change, due to the fact that the introduction of a standardized and organized environment is perceived as a loss of control or the possibility of losing one's job.
- Of particular importance in the current crisis (more than cost savings by itself) is the new cost model, through which enterprises can move away from supplies and infrastructure amortization, shifting from *capex* appraisal to *opex* analysis.
- The flexibility and ability that cloud offers can significantly reduce the time lapse between design and the launch of a product or service. Moreover, errors that arise can be quickly corrected without compromising the resources of the organization.
- The commercial concept of the cloud is being abused in the market. Many initiatives and solutions (virtualization, on-demand services, etc.) are being pushed under this concept, despite the fact that strictly speaking, these are not cloud solutions. This has contributed to generating confusion in the market.

### Experts from large client businesses

- The main barriers and disadvantages identified are closely linked to the results of the quantitative analysis, although, the most recurrent and crucial for clients are listed below:
  - The perception prevails of insufficient network speed and latency, likely to impact the business operations.
  - Privacy and legal requirement problems, although these are believed to be decreasing in importance thanks to the greater maturity of providers and their offers in this regard.
  - Sense of loss of control over the technology, but above all, over the corporate processes.
  - Inhibitors related to product quality and delivery, which underscore difficulties in management, integration and deployment.
  - Sense of growing dependency on the provider.
  - Interoperability and integration of contracted services that are used for internal operations.
- Large companies highlight the fact that cloud computing allows better cost-efficiency and computing power, storage and standardization in society, due to global demand. The clear disadvantage pointed out is the lack of control by the client due to the low level of customization.
- Large companies consider that systems with a higher possibility of cloud integration are systems with very variable demand, with low interrelationship



with other systems, less critical systems and environments requiring more infrastructure or hardware.

### Public Administration Experts

- Deploying a major project in a cloud model requires previous analysis to identify common services that are managed similarly by different entities. It also requires standardization work for management processes in order to adopt global cloud solutions.
- Managers in most Administrations studied acknowledge that effective and real maturity has been reached in Data Processing Center virtualization, infrastructure and hosting service outsourcing. This implies that the scenario is mature and appropriate for service migration towards a cloud model that would be mainly private.
- Although some discrepancy exists over the value that cloud computing would add to Public Administration, most civil service managers understand and can visualize the potential of this model as regards the economic and operational benefits that service centralization and consolidation among multiple public entities can entail, regardless of what model is deployed, whether cloud or traditional.
- Apart from all the advantages that cloud computing has to offer in terms of costs savings, flexibility, scalability, virtualization, avoiding duplication, economies of scale, etc., other benefits are mentioned that have to do with the development of teleworking, mobility or the possibilities to develop citizen-oriented public policies in terms of education, open government or health care.
- Its impact on the organization, adaptation and management of staff changes generates an additional cost that has to be taken into account when planning the migration process towards cloud computing.
- There are clear discrepancies of opinion concerning security and data protection in cloud models.
- Doubts arise on aspects related to the performance of the service offered, the maturity of the Spanish sector to offer services for technological assets that are critical and specialized and the "locked-in" effect caused by dependency on providers in business services of special importance.
- Domestic cloud computing providers are at a relatively mature stage in terms of reliability and quality of service and infrastructure on the national level. Merchandising and marketing efforts have been boosted, but the industry is perceived as being centered on the deployment of solutions, searching for projects and large accounts for return on investment.





## 5.2. Recommendations

Cloud computing *experts* from the Public Administration, provider companies and large client businesses have offered a series of recommendations concerning cloud computing. The following are worth highlighting:

### Recommendations for the private sector:

- The most important opportunities would be those offered to recently created companies with a great potential for growth, (*start-ups*). They can save on investment, since cloud technologies imply important savings and can offer greater flexibility and competitiveness.
- Sectors that would benefit the most from this technology are all sectors related to e-commerce, media, *call centres* and in general, any company based on project implementation. The bank and insurance sector are slightly reluctant regarding the use of cloud computing, above all, for central functions, but cloud format can be applied to many other functions (payroll management, *CRM*, etc.). Due to the constant restructuring in these business areas, these would be sectors of greatest potential.
- It is recommended to start with non-critical projects that offer the chance of getting acquainted with the technology.
- IT departments have to start with integration and migration initiatives as soon as possible, since otherwise the business areas will be the ones concerned with establishing these type of solutions in the organization.
- Migration is a complex process that has to be thoroughly analyzed for the deployment to be successful.
- Any deployment or migration of technology has to be presented as a new global project subject to business consulting, with needs subsequently linked to IT. Available resources will be analyzed and a development environment deployed. There will be a baseline analysis, a future status and an action plan. Moreover, staff and staff profile will have to change accordingly. More specifically, delineating clear objectives and identifying *quick wins* is important,<sup>5</sup> so as not to suffer disappointments.
- The provider sought will have to meet the same requirements as the company itself. It will be of utmost importance to avoid a blocking effect by providers offering Service Level Agreements (SLA) that imply penalties for non-compliance. The provider's offer will have to meet real needs and should preferably offer services in all cloud models.
- Concerning management, it is recommended to avoid loss of control over the project or service. Specifying service level and other agreements in order to have adequate control is especially important. IT department management will be of crucial importance and must work towards integration and interoperability amongst services.

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<sup>5</sup>*Quick wins* are obtained from the visible actions/solutions that recently appointed managers adopt in order to obtain approval from the persons responsible for his/her appointment.





## Recommendations for the Public Administration:

Recommendations concerning decision guidelines to be taken into account in a reflection process for cloud migration in Public Institutions:

1. Migration processes have to be progressive and carried out in controlled transition processes. At the outset, it is advisable to begin with an IT process or component that is not critical and that allows for the development of a pilot project.
2. Study the market to analyze existing solutions and evaluate the real capacity of providers to respond to the cloud technology demand.
3. Analyze the cost-efficiency of the efforts to be deployed, define the expected benefit boosters, the return on investment and the estimated improvement of efficiency.
4. Establish a competitive dialogue in accordance with the Consolidated Text of the Law on Public Sector Contracts, approved by Royal Legislative Decree 3/2001 of November 14<sup>6</sup>. Furthermore, the Law establishes that collaboration contracts between the public and the private sector may be awarded by this procedure.
5. Engage Managers of Public Institutions at the highest possible level in the decision-making process. Managers from legal departments may also contribute to the development of legal instruments that are adapted to cloud technology needs.
6. Once a decision is made and the cloud component is deployed, the impact on the organization and the management of change have to be dealt with. Staff assigned to the functioning of the system must be appropriately trained in management and monitoring of service level agreements and in the performance of service audits.
7. Evaluate the results and real benefits obtained in the process.

### 5.3. Prospects

In the same way as the conclusions and recommendations contained in the report are built upon expert opinion from provider companies, large client businesses and the Public Administration, the trends and prospects of cloud computing in Spain are based on the opinion expressed by experts during the interviews. Highlighted below are the following:

#### Experts from provider companies

- Observation of the American market demonstrates that cloud computing evolution is very promising. There are no longer any doubts that this will follow suit but what is hard is to ascertain when this will be a reality. There is a general perception that a hybrid model will end up deployed in the future, in the search for balance and the different benefits of public and private clouds.

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<sup>6</sup>Royal Legislative Decree 3/2001 of November 14 approving the consolidated text of the Law on Public Sector Contracts. 5th Section Competitive Dialogue.  
([http://www.boe.es/aeboe/consultas/bases\\_datos/doc.php?id=BOE-A-2011-17887](http://www.boe.es/aeboe/consultas/bases_datos/doc.php?id=BOE-A-2011-17887))



- The sector orientation of future cloud services offered will be increasingly important, along with the explosion of services related to new smart devices or aspects related to demand and savings forecasts.
- The systems that have a greater potential of integration or migration towards a cloud system are mainly development environments, non-critical management and administration applications, environments highly unpredictable as regards type and volume of workload. Even so, the most critical systems for the organizations will finally experience a leap in terms of performance requirements and needs that can only be satisfied using cloud models.
- Public and community clouds aim seek to optimize economies of scale, offering a lower level of customization. Their price will also be lower, facilitating access to companies with more restricted budgets. The perception prevails that they are less secure and this should not be the case if the company has clear security requirements that it must specify when contracting this type of cloud. Nonetheless, it will be more difficult for less customized clouds to meet these requirements.
- Concerning the situation for the IT department under this model, all experts agree that roles and profiles of IT staff must change from technical and development profiles to business consultancy profiles that, moreover, are acquainted with the technology. New staff profiles for the IT department will be in charge of analyzing and managing the services required by the business and the type of contract agreed with the provider. IT department must be viewed as a business facilitator. It has been mentioned cloud models could imply job cuts in the IT department, but the idea seems to prevail that this should not be the case. However, current members of the IT department will have to acquire new management and business skills in order to contribute greater value to the new model.

### Experts from large client businesses

- The future prospects mainly outlined by large businesses underscore the extensive background and strong growth of this technology, wherein whoever does not accept it will have a clear disadvantage in comparison with the rest. However, currently all businesses give evidence of doubts and fears in aspects such as data security and control.
- In the case of the transformation that the IT department has to suffer, the general idea of large companies coincides exactly with that of the supplier experts. Initially there must be a change in the perception of the IT department. Staff profiles must also change from technical and development to more business-oriented profiles.

### Experts from the Public Administration

The technological transition towards the world of cloud technology in Public Institutions will in any case be progressive and begin with the migration of general systems of low specialization such as office applications and e-mail.

In June 2011, in a working group for the deployment of shared infrastructures in the Central State Administration, several conclusions were reached concerning the consolidation process of support services and infrastructures and the strategy guidelines to be followed in the future:



- It was proposed to define a master plan for the development and rationalization of ICTs in the Public Administration, applying the premises of consolidation and centralization of shared services.
- This development is marked by an impact on the management and organization of the model. Competencies on these services must be taken on by one unit and collaboration and service models between public agencies have to be organized (agreements, pay per use, etc.).
- The scope of this technological development must be global along the lines of a *community* cloud model for all Spanish Public Institutions, integrating regional and local administrations.
- There are three types of service that must be given priority for standardization:
  - Infrastructure consolidation, Data Processing Centres, storage environments and systems.
  - The consolidation of common technological platforms such as e-mail, portals, content managers, databases, etc.
  - The consolidation of information systems that use "horizontal services" of any type of Administration such as human resources, payrolls, records, training, electronic administration or economic and financial management, among others.
- Cloud solutions will have a wider effect and benefit in smaller Administrations. This service model can be an opportunity for modernization and adaptation of organizations in the context of new technologies, especially in Local Entities. The possibility that larger administration offices offer service and infrastructure to smaller ones would contribute to an important global reduction of costs and would result in a better use of IT resources.
- It is estimated that cloud computing will generate a strong concentration of the ICT sector in Spain. Few companies that have the technical capacity, bargaining power, economies of scale and investment capacity to deploy and provide an effective portfolio of cloud services that can meet the requirements of Public Administrations. Clustering and cooperation among business networks in the sector must be promoted to guarantee their subsistence and future feasibility, ensuring that they can compete in a highly competitive market nationwide and internationally. Administration offices will have to take this phenomenon into account when developing concentration processes and analyzing the alternatives to deploy a framework of cloud contracting that will be fair and inclusive of SMEs of the national ICT sector.
- Telecommunication companies are called on to play a very significant role in national network management both from the point of view of infrastructure and communication. The control of communication networks is a key factor to be competitive in this sector. It is estimated that telecommunication companies will begin to provide cloud services in the near future, both to companies and individual consumers. ADSL products that include cloud solutions such as virtual desktop, e-mail, databases, etc. are beginning to appear on the market and will have an impact on competition with respect to traditional software and hardware providers.
- All experts interviewed unanimously agree that during the next few years, cloud computing must be promoted as ultimate leverage for the modernization of Spanish SMEs and their inclusion in the information society.



- E-invoice, e-commerce platforms, web portal services and operation infrastructure are the cloud solutions perceived as more interesting with greater potential, according to the experts interviewed.
- Cloud computing will end up deployed in public Spanish institutions in a time frame not to exceed four years, albeit always more conservative than in the private sector. In general, the Administration is obliged to be more conservative due to the critical character of its systems and the risks entailed.
- However, the role played by providers and the business and media intensity of the market will effectively impose this model, reducing sector timelines for adoption and adaptation. In any case, the future of information technologies in the public sector will have a mixed character wherein proprietary information systems, traditional *hosting* and cloud solutions of any type, both public and private, will coexist.