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The use of Cloud Computing services by Portuguese's Small and Medium Enterprises (SMEs)

A study which aims to understand to what extent are Portuguese's SMEs managers using and managing Cloud Computing services

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ABSTRACT

Title: The use of Cloud Computing services by Portuguese's Small and Medium Enterprises
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The objective of this dissertation is to understand to what extent are the Portuguese SMEs using and managing Cloud Computing services. This work strives to understand if the managers of the Portuguese SMEs are knowledgeable to embrace this technology, and identify which areas of the Portuguese SMEs' value chain is Cloud Computing being currently applied and which areas are expected to be explored in the future.

In order to address the main objective of this dissertation, an on-line questionnaire is made to several Portuguese SMEs from different economic sectors. This questionnaire has been made by taking into account the knowledge of the Literature Review and the expertise and experience of a pool of experts on the field of Cloud Computing.

With the objective of interpreting the data from the on-line questionnaire, a statistical analysis is performed. This data is analyzed trough descriptive statistics, as well as cross-tabulations between variables, according to the research objectives of this work

The results of this work highlights that only around 40% of the Portuguese SMEs are using Cloud Computing services consciously, meaning that there are companies using this technology without even being aware of it. According to this study, 73% of the Portuguese SMEs are using Cloud Computing applications without realizing, which consequently means that only 27% of the SMEs do not actually use any kind of Cloud Computing applications. Moreover, the majority of the companies which use this technology are able to identify Cloud Computing most important features as its characteristics, advantages and potential risks. Finally, regarding the Service and Deployment models used by these companies, these are mainly focused on the IaaS and Private Cloud solutions.

Nevertheless, most of these companies' managers still do not see Cloud Computing services as a core technology to use on their primary activities nor use the most appropriate management procedures for the management of this technology (as for example SLAs or KPIs). Consequently, this dissertation's results show that there is still a long way to go regarding the utilization of Cloud Computing by the Portuguese SMEs.

Keywords: Cloud Computing; Cloud Computing applications; SMEs; Small and Medium Enterprises; Portuguese Small and Medium Enterprises; Cloud Computing features

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I. INTRODUCTION

According to Abdulaziz Aljabre [Aljabre, 2012], nowadays, with the all the economic downturn and financial crisis it is crucial for every company to have reliable, trustful and at the same time reasonable priced technology in order to survive in such a competitive market environment.

Before personal computers appeared in 1980, computing was very centralized and completely dependent on mainframes [Jena and Mahanti, 2011]. In the 1960s and 1970s most computers were totally dependent on a connection to a mainframe which consequently required the users to literally carry their disks from one mainframe computer to another [Barnatt, 2010]. In the 1990s, with the general adoption of the internet and the Personal Computers (PC), computing started to be more decentralized and users started to be able to store, transfer and download information in an easier and friendlier way [Jena and Mahanti, 2011].

However, after 2000 the status quo of the IT industry started changing once again for a more centralized storage [Böhm et al, 2009]. Nicholas Carr [Carr, 2009] argues is it possible to draw a parallelism between electricity and computing in the sense that computing as electricity is started to become a public utility. Therefore, well known corporations as Google, Amazon, Microsoft, IBM, Apple and others have created giant servers, commonly called "Sever Farms" [Accenture, 2009] which taking advantages of economies of scale can sell computing services in a pay-per-use basis [Sosisnsky, 2010]. It is in this context that Cloud Computing emerged [Jena and Mahanti, 2011].

Cloud computing has been a much debated topic in the IT sector today [Vaquero et al, 2009]. According to Haag and Cumming [Haag and Cumming ,2010] "cloud computing is a technology model in which any and all resources-application software, processing power, data storage, backup facilities, development tools… literally everything (in the computing context) - are delivered as a set of services via the Internet".

Although more and more companies (large and small) are adopting and embracing Cloud Computing as a strategic pillar of their business [Sultan, 2011], Staten [Staten, 2008] states that for large business to transfer all their information system to the cloud can be time consuming and costly. In this sense Cloud Computing services could be critical and very important in the future especially for SME's that want to stay competitive and innovative [Neves et al, 2011] since it allows these companies to decrease considerably their IT costs [Aljabre, 2012] and provide customize and lower cost services [Etro, 2009]. Additionally, Cloud Computing could fosters innovation and improve business competitiveness levels in way SME's

"alone" could not achieve [Tumer, 2010], for example trough the use of collaborative applications [Barnatt, 2010].

Therefore, today's Cloud customers are in the large majority companies mainly concentrated in industries like Ecommerce, Technology and Telecommunications [Heric et al, 2011]. However, it is expected that in 2015 approximately 65% of the growth in the cloud will be due to companies with currently almost no use of cloud computing services [Heric et al, 2011].

1.1 Topics Addressed

According to IDC [IDC, 2009], it is forecasted a considerably increase of Cloud services consumption from 17 billion $ (US) in 2009 to 44 billion $ (US) in 2013. Bearing this fact in mind and the importance referred above Cloud Computing could have for SMEs, this dissertation problem statement aims to understand to what extent are Portuguese's SMEs using and managing Cloud Computing services.

According to Christopher Barnatt [Barnatt, 2010] the Cloud provides important advantages for the companies, but it is relevant to understand to what extent the managers of Portuguese SMEs are aware of those potentialities. Furthermore, as any other technology Cloud Computing can have some drawbacks and potential risks [Briscoe and Marinos, 2009], and although their advantages clearly prevail over its negative aspects [Aljabre, 2012], this work strives to understand if the managers of the Portuguese SMEs are knowledgeable to embrace this technology.

This way, this work verifies if these managers are capable to deal with Cloud's potential risks and if they know the best management models /business processes which allow their companies and employees to take the best of Cloud Computing services. Additionally, this work strives also to identify which areas of the Portuguese SMEs' value chain is Cloud Computing being currently applied and which areas are expected to be explored in the future.

Therefore, in order to address the problem statement just described, the following Research Questions are proposed:

1. Are the managers of the Portuguese SMEs aware of Cloud Computing main characteristics, advantages and potential risks?
2. How are the managers of the Portuguese SMEs managing Cloud Computing?
3. How are the Portuguese SMEs using Cloud Computing services regarding Service Models, Deployment Models and its application on the value chain?

Cloud Computing is, as referred above, a much debated topic so this work strives to contribute to a better understanding of this paradigm and how the Portuguese SMEs are addressing this technology. Thus, the Research Questions are answered trough an on-line questionnaire made to a number of Portuguese SMEs managers from different sectors. This questionnaire is supported by the academic literature and by a pool of experts with experience and knowledge on the field of Cloud Computing. This pool is composed by experts from IT consultant companies (Accenture and Logica), by experts from a Portuguese Cloud Computing services provider (Portugal Telecom) and by an expert from EuroCloud Portugal (part of the EuroCloud[1] group which is an independent non-profit organisation with the main objective of creating awareness and helping European countries to approach Cloud Computing).

1.2 Structure for this work

In order to achieve the objective of this dissertation four main chapters are developed after the *Introduction* chapter. There is the *Literature Review* which focuses on the fundamental theory applied throughout this work. There are three main topics explored: the evolution of the concept Cloud Computing, the Cloud Computing Services and its Deployment models, and finally the Advantages and potential Risks of this technology, especially for Small and Medium enterprises. Moreover, a brief overview of the reality of the Portuguese SMEs regarding Cloud Computing is presented, based on the knowledge and experience of the experts. In addition it is also addressed the Value Chain from Michael Porter [Porter, 1998] and the Cobit Maturity Attribute table [ISACA, 2007] since are these models adaption, along with the knowledge from the Literature and the experts, that allows to address the dissertation Research Questions purposed.

Then, there is a chapter called *Research Methodology and Model, Research Hypothesis and Data Collection* where it is discussed the methodology and the model used. In addition it is also approached the Research Hypothesis and how the necessary data has been collected and analyzed. After, there is the *Results and Discussion* chapter where the analysis of the results is presented and some intermediary conclusions are made. Finally, this dissertation last chapter is the *Conclusion*, in which the final conclusions and principal findings of this study are presented as well as its main limitations and possibilities for future research.

[1] http://www.eurocloud.org/

II. LITERATURE REVIEW

2.1 Chapter introduction

In this chapter are covered all the theoretical aspects and concepts regarding the Cloud Computing paradigm. First, it is illustrated the evolution of the concept of this technology through the years and it is presented an overview of the most important players of Cloud Computing. Then, it is explained the concept of Software as a Service (SaaS), its market value and its most important and well known applications. Similar approach has been taken to the Platform as a Service (PaaS), a description of the concept, its market value and its most important applications and providers. Moreover, the Infrastructure as a Service (IaaS) concept is also discussed as well as its market value and its main vendors.

Then, the Deployment models are addressed and the concepts of Public Cloud, Private Cloud, Hybrid Cloud and Community Cloud are explored. In addition, the main advantages and potential risks of Cloud Computing are illustrated in this chapter plus a brief overview of the use of Cloud Computing by Portuguese SMEs. Finally, the model of Porter Value chain [Porter, 1998] and the Cobit Attribute Maturity table [ISACA, 2007] are explained.

2.2 Cloud Computing

This chapter will focus on the concept of Cloud Computing and how it is approached by the different authors. Moreover, the main characteristics of Cloud Computing are presented as well as its evolution concerning the worldwide IT spending from 2009 to 2013. In addition, this chapter also provides a brief overview about Cloud Computing main players.

2.2.1 Cloud Computing Concept

Barrie Sosisky [Sosinsky, 2010] argues that the concept of Cloud Computing is a dream since the beginning of the computing industry. Nonetheless, the term of Cloud Computing is believed to be first time mentioned in 2007 [Lohr, 2007; Böhm et al, 2009; Sosinsky, 2010]. The first initiatives and researches were started by two of the largest companies in the world (Google and IBM) in cooperation with six American Universities: Carnegie Mellon, Massachusetts Institute of Technology, Stanford University, The University of California, Berkeley, the University of Maryland and the University of Washington [Lohr, 2007]

Since then the concept of Cloud Computing has been one of the most debated topics not only in the IT sector but also on the Academic Literature related with technology and management [Vaquero et al, 2009]. However, there is not a single definition of Cloud Computing and it is still an unclear topic for many individuals and organizations [Böhm et al, 2009].

In order to define the concept of Cloud Computing some authors focus on the services provided by this technology, stating that Cloud Computing is a combination of different services provided through the internet [Haag and Cumming, 2010]. Being the most relevant services quoted associated with applications software [Godse and Mulik, 2009]; applications development and deploy [Boniface et al, 2010]; processing power [Bhardwaj et al, 2010] and data storage and back-up services [Bhardwaj et al, 2010]. Others authors prefer to focus more on Cloud Computing main characteristics and services models [Youseff et al, 2008] or in its several advantages in order to define this technology [Neves et al, 2011]. Additionally, some authors focus more on the Cloud Computing Business model, the pay-per-use or pay-as-you-go model [Choubey et al, 2011].

As a result, Luis M. Vaquero [Vaquero et al, 2009] understood that was important to reach a more comprehensive and clear definition of Cloud Computing. Consequently, Vaquero gathered the definitions of Cloud Computing proposed by some of the authors above mentioned and other experts in this field in order to reach a common definition. According to Vaquero [Vaquero et al, 2009], “Cloud Computing is a large pool of easily usable and accessible virtualized resources through the internet (such as hardware, development platforms and/or services). These resources can be dynamically re- configured to adjust to a variable load (scale), allowing also for an optimum resource utilization. This pool of resources is typically exploited by a pay- per-use model in which guarantees are offered by the Infrastructure Provider by means of customized SLAs”.

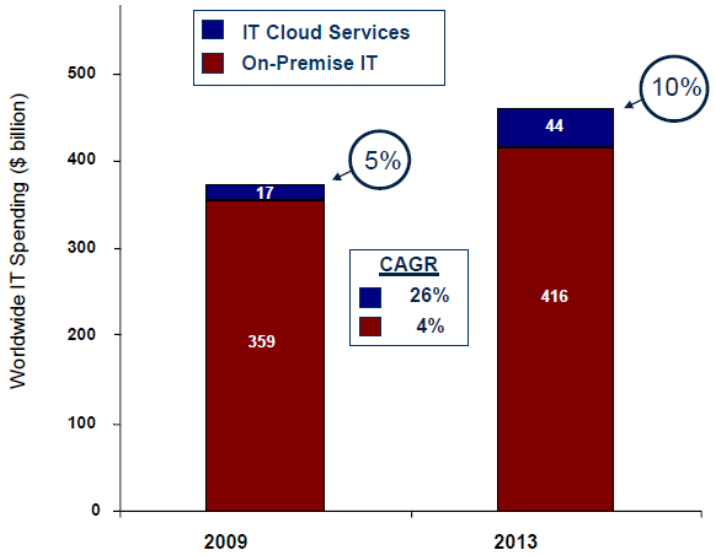
Before Cloud Computing the majority of the companies used the internet only has a source of information and has a tool to exchange emails and documents [Barnatt, 2010]. These companies had their own data centre, from which the employees access company applications and where it was stored enterprise information [Barnatt, 2010]. Conversely, with Cloud Computing the computing power started more and more to be seen as a public utility, like the telephone or electric system for example [Carr, 2009]. The majority of the company applications and information are no longer installed and stored on their computing devices or

in their own data centre, this data and software applications are accessed now from the cloud [Carr, 2009].

As a result of that change, companies begin to take advantages of Cloud Computing main characteristics, which are according to the U.S NIST (National Institute of Standards and Technology) [NIST, 2011] the following: on- demand self-service; Broad network access; Resource pooling; Rapid elasticity and Measured Service. The on-demand service permits the customer to easily and fast acquire Cloud Computing services without having to deal directly with the provider, which means it can be done by a simple "click" with the mouse [NIST, 2011]. The broad network access is related with the independent device characteristic of the Cloud - the user can access the Cloud from any device with an internet connection [NIST, 2011]. The Resource pooling means the service provider creates resources which could be used by several customers using the same cloud [NIST, 2011]. The rapid elasticity is related with the scalability characteristic that allows the end-user to increase or decrease the Cloud Services as he or she wants and needs [NIST, 2011]. Finally, the Measure Service characteristic means that the Cloud services provided are measured [NIST, 2011] , the customer which buys the service can be charged in several metrics as for example the amount of storage used or the processing power [NIST, 2011].

These main characteristic contributed to a considerable increase on the revenues from Cloud Computing services, according to IDC [IDC, 2009] the revenues from the worldwide IT Cloud services will increase from $17.4 billion registered in 2009 to $44.2 billion in 2013 [IDC, 2009] . Taking into account the figure 1 it is possible to verify an increase of the spending in IT cloud services, being forecast that in 2013 they already represent 10% of the total spending with IT services [IDC, 2009].

Figure 1 – Worldwide IT spending by Consumption Model



Moreover, when exploring the Cloud Computing phenomenon some authors strive to establish the connection between this technology and the concepts of virtualization and abstraction [Böhm et al, 2009; Sosisnsky, 2010]. According to Barrie Sosinsky [Sosisnsky, 2010] apart from the internet these concepts are extremely important so Cloud Computing could occur. The concept of abstraction allows Cloud Computing to hide the implementations details from the users which means the physical systems are not specified, data location is not known by the users and the administration of the systems it not responsibility of the end users [Sosisnsky, 2010]. On the other hand virtualization is important because Cloud Computing virtualizes systems and servers which allow the data center to scale and adjust resources on demand and consequently using the hardware more efficiently [Böhm et al, 2009]. The concept of virtualization and its importance will be further developed in the chapter about the Infrastructure as a Service (IaaS).

Cloud computing is in the majority of the times divided into Deployment models, which are related to the location of the Cloud Hardware and into Service models that are the services Cloud Computing provides [NIST, 2011]. The most relevant deployment models are: The Private Cloud; Hybrid Cloud, the Community Cloud and the Public Cloud [NIST, 2011]. These deployment models will be further developed in the chapter related with Infrastructure as a Service (IaaS) and its categories. Concerning Services models they are divided into three main categories: Software as a Service (SaaS); Platform as a Service (PaaS) and Infrastructure as a Service (IaaS) [NIST, 2011]. These service models will be also further developed in the chapters regarding SaaS, PaaS and IaaS.

2.2.2 Cloud Computing Main Players

Although according to IDC and Gartner [Bloomberg, 2011] the cloud just represent 5% of the $1.5 trillion spending in corporate IT, the truth is that some of the biggest IT companies in the world are already investing heavily in this technology [Accenture, 2009]. Currently, the most important and most quoted worldwide providers of Cloud Computing Services are: Amazon [Aljabre, 2012], Google [Wang and Jin, 2010], SalesForce [Mathew and Spraetz], Microsoft [Bojanova and Samba, 2011] and Rackspace [Nepal et al, 2011]. These companies believe Cloud Computing will change considerably the IT sector and how companies buy computer technology [Barnatt, 2010]. These companies main goal is to transform computing power and software applications into a public utility, such as electricity [Carr, 2008].

Amazon launched in 2002 the Amazon Web Service (AWS) which is a Cloud Computing platform being the most well known services the Amazon EC2 and Amazon S3[2] [Aljabre, 2012]. Although AWS still represent only a small percentage of Amazon overall sales [Sosisnsky, 2010], AWS services are growing incredible fast, with for example EC2 generating more than 220 million annually in 2009 [Sosisnsky, 2010]. Google is the ultimate example of a Cloud Computing service company [Barnatt, 2010], being a very profitable company as it is (in 2009 the company revenues were above $23.6 billion) invested heavily in infrastructure data centres allowing them to provide all sort of applications and a software Platform [Sosisnsky, 2010]. The most important Google Cloud Computing services could be found in the appendix 1 and 2.

Then, we have Salesforce.com which is considered as one of the pioneers of the concept of Cloud Computing, especially the concept Software as a Service (SaaS) [Mathew and Spraetz]. SalesForce has around 70.000 companies as customers, being its most well known and quoted services its CRM service and the Force.com its software Platform[3] [Barnatt, 2010]. Microsoft is also a strong player concerning Cloud Computing services, although the company entered the "game" a bit after its main competitors [Bloomberg, 2011] it still have a very extensive portfolio of services as for example its cloud operating system the Windows Azure Platform or its Microsoft office for the Cloud[4] [Bojanova and Samba, 2011]. Finally, there is Rackspace, a traditional hosting service provider which dealt very well with the phenomenon of the cloud becoming a very important player and one of the firsts to commercialize Cloud Computing services [Nepal et al, 2011]. Rackspace main services are Rackspace Cloud services and Rackspace Cloud Files, considered mainly as direct competitors of Amazon services EC2 and S3[5] [Barnatt, 2010].

On the other hand, there are the traditional infra-structure makers as IBM, HP, EMC, AT&T, Oracle and VMware which have earned a lot throughout the years thanks to the creation of data centres inside the large corporations [Bloomberg, 2011]. These companies are also investing in cloud services, but mainly on the so-called Private cloud [Barnatt, 2010] (this concept will be further developed in the chapter related with IaaS and its deployment models). Examples of that is IBM, which is developing customized clouds or VMware which is creating specialized software to flexible data centres. These companies argue [Bloomberg, 2011] as well

[2] See appendix 3 for more details about these services
[3] See appendices 1 and 2 for more details about these services
[4] See appendices 1 and 2 for more details about these services
[5] See appendix 3 for more details about these services

as some authors [Staten, 2008; Aljabre, 2012] that for large companies to transfer all their information system to the cloud and to use only cloud applications can be time consuming and costly.

Nevertheless, as Nicholas Carr argues [Carr, 2008] computing can become a utility in the near future. As the companies which in the past run their own generators of electricity realize it would become cheaper and easier to buy it to the large providers [Carr, 2008] the same could happen with computing power and software applications.

2.3 SaaS – Software as a Service

This chapter highlights the concept of Software as a Service (SaaS) and its most important advantages comparative to the traditional installed software. Moreover, it is analysed the SaaS' market value as well as its most relevant providers and applications.

2.3.1 SaaS – Software as a Service

Software as a Service (SaaS) is considered the most visible and well known form of Cloud Computing [Barnatt, 2010] and it is improving the business operations worldwide [Robinson, 2011]. SaaS is all the software which can be accessed through the internet (most of the times using a browser) but that is hosted in a remote location, not locally installed in the user device or service [Haag and Cummings, 2010]. Consequently, the service provided is closely monitored by the SaaS vendor [Wu et al, 2011].

The licence of this kind of software is often on a subscription or usage based [Sun et al, 2008], which means that the majority of the times SaaS applications are much reasonable priced then the installed software [Ma, 2007]. Additionally, SaaS are normally more user friendly and simpler than installed software [Neves et al, 2011]. Although simplicity could be seen at first as a potential drawback the truth is that even Microsoft states that most of the users only use 10% of all the functionalities of the Microsoft Office [Barnatt, 2010].

Moreover, as this kind of software is always accessed through the internet it means it can be accessed with any device as a PC, a mobile phone or a tablet [Jena and Mahanti, 2011]. Furthermore, the upgrade of the software is much easier and faster than the traditional locally installed software [Miller, 2008] and compatibility issues are non-existent since all the users have the same version [Miller, 2008]. Another important advantage of SaaS is the possibility that same application have to use collaboration tools [Tumer, 2010], which could increase and fosters innovation [Tumer, 2010].

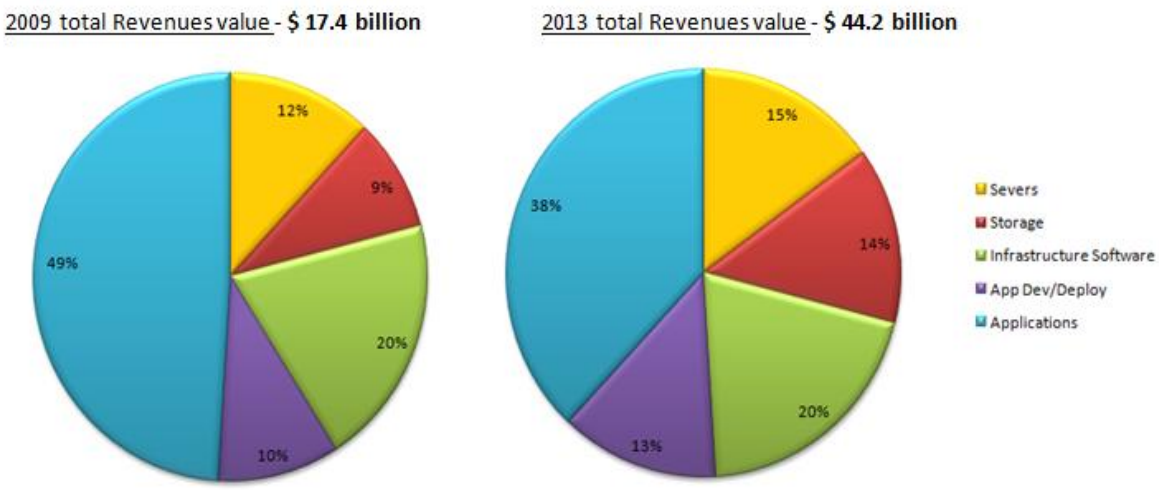
One of the drawbacks pointed to SaaS is the customization issue [Sun et al, 2008] but there are already SaaS which allow the users to create their own applications trough API - Application Programming Interfaces [Liu et al, 2010]. For example one of the leading SaaS called SalesForce has strongly invested on configuration and customization capabilities in their applications [Sun et al, 2008].

Finally according to Maninsh Godse and Shrikant Mulik [Godse and Mulik, 2009] several factors should be take into account when choosing a SaaS provider being the most relevant the following: Functionality – the attributes of the SaaS [Godse and Mulik, 2009]; Architecture – as the integration with other applications and its reliability [Godse and Mulik, 2009]; Usability – as for example the user interface and its easiness to use [Godse and Mulik, 2009] and lastly the Vendor Reputation - especially the brand name of the vendor and the number of customers that already use the application [Godse and Mulik, 2009].

2.3.2 SaaS market value

According to IDC [IDC, 2009] the world wide IT services Revenues represented around $17.4 billion in 2009 with SaaS representing 49%. In 2013 is forecast a considerably increase to $44.2 billion with SaaS representing 38%, which means that the SaaS market value is expected to be around $16.8 billion in 2013 [IDC, 2009].

Figure 2 - Worldwide IT Cloud services Revenue by Product/Service Type



Source: IDC, September 2009

2.3.3 SaaS Applications

The most relevant and quoted SaaS in the Academic Literature and in the IT journals are from companies as Google (Gmail, Google Docs and Google apps) [Wang and Jin, 2010], Microsoft (Windows live Hotmail, Microsoft Office web Apps and Microsoft SkyDrive) [Briscoe and Marinos, 2009], Salesforce CRM service [Godse and Mulik, 2009] and Zoho (Zoho Creator and Zoho Work.online) [Carr, 2009]. In the appendix 1 there is a brief description of the SaaS mentioned above and other important SaaS mentioned in the Academic Literature and in the IT sector.

2.4 PaaS – Platform as a Service

This chapter focuses on the concept of Platform as a Service (PaaS) and its potentialities and drawbacks. In addition is it also analyzed PaaS expected market value for 2013 and its main providers and applications.

2.4.1 PaaS – Platform as a Service

As explained in the above chapter about SaaS, this type of service the majority of the times does not allow the users to create their own applications. According to Christopher Barnatt [Barnatt, 2010] it is a "take-it-or-leave-it option" which could not fully address the needs of some companies and individuals. PaaS will fulfill that need since basically will allow the users to have access to a software environment where they can create, test and deploy their own and customize SaaS [Bernstein et al, 2010]. The main advantage highlighted of the PaaS is that someone with some programming knowledge can with a relatively minimum cost creates an application and delivers it worldwide [Boniface et al, 2010]. Before PaaS the only way to create an application was trough an internal system which implicated a much more costly and difficult process [Lawton, 2008].

Another advantage is related with the migration process, as the application is created in the same platform where the end users will use it, there won't be in theory mal functions or bugs [Lawton, 2008].

In a PaaS variant the users do not have control over the platform they are using to create their applications [Sosinsky, 2011]. It is the vendor who is responsible for all the operational and maintenance aspects [Sosinsky, 2011]. Consequently, this means that if a user his using a PaaS that only accepts a programming language as for example Java his applications can only be

written in this kind of language program [Taft, 2011]. Consequently one possible drawback of PaaS is related with this vendor lock- in since the user would be completely dependent on the PaaS vendor [Lawton, 2008]. This way it is important that the company or the user understands if the benefits of creating their own applications faster and easier outweigh some limitations regarding programming languages and tools [Barnatt, 2010].

Nevertheless, PaaS is starting to become the main trend for software development [Cui et al, 2011]. According to Sacha Labourey CEO of CloudBees (one of the most important PaaS providers) PaaS will be responsible for "the death of enterprise software as we've known it" [Taft, 2011].

2.4.2 PaaS Market value

According to IDC [IDC, 2009] and taking into account the figure 2 it is possible to verify that the expected market value of PaaS for 2013 is around $5.75 billion.

2.4.3 PaaS Applications and Providers

As already mentioned the choice of the PaaS provider could be critical because of the vendor lock-in, which as consequence means that most of the customers opt for choosing large and well known organizations as Microsoft and Google [Accenture, 2009]. The most quoted PaaS in the Academic Literature and in the IT sector are the Google App Engine [Dillon et al, 2010], the Force.com from SalesForce [Mathew and Spraetz] and the Microsoft Windows Azure [Bojanova and Samba, 2011]. In the appendix 2 there is a brief description of the PaaS mentioned above as well as other well known and quoted PaaS.

2.5 IaaS – Infrastructure as a Service

In this chapter first is presented the concept of Infrastructure as a Service (IaaS) and it is highlighted the concept of virtualization. After a brief description of the concept of virtualization are presented the main Cloud Computing deployment models. Finally, this chapter focuses in the expected market value of IaaS for 2013 and in IaaS main providers and services.

2.5.1 IaaS – Infrastructure as a Service

IaaS permits the companies to close entirely their local servers and data centers [Bakshi, 2011] since it allow the companies to migrate all their data, applications and programs into the Cloud [Barcomb, 2011]. Therefore, an IaaS vendor basically rents computer hardware and administrative services need to store and run applications in the Cloud [Bakshi, 2001]. The

main advantage of IaaS according to Sushil Bhardwaj [Bhardwaj, 2010] is that the users are only charged for what they use it when they need it.

Infrastructure as a Service is currently the most important variant of the Cloud Computing business since it is where the Cloud "fighting" is really taking place between the biggest Cloud companies [Barnatt, 2010]. This happens because the CAPEX necessary to be a competitive IaaS provider is extremely high [Barnatt, 2010] which makes difficult for small players to compete in this service model [Barnatt, 2010].

The most important component of this infrastructure is the server which implies several high costs such as the server itself, constant and trustworthy power supply, costs with the cooling systems and of course a strong and high-speed internet connection [Bhardwaj, 2010]. Therefore, one of the most important advantages of contracting an IaaS vendor is the cost savings since the company does not have to invest a considerably amount of money in their own server nor in the complementary costs such as cooling systems, security, specialized employees or the strong investment in power systems [Bhardwaj, 2010].

2.5.2 Virtualization

Apart from a computer and an internet connection virtualization is the most important technology which allows Cloud Computing to reach its full potential [Böhm et al, 2009]. Thanks to virtualization a physical server can be split into several virtual servers, this way an entirely new service emerged [Zhang et al, 2010]. These virtual severs are called "virtual instances" [Zhang et al, 2010]. Consequently, the IaaS vendor could sell two different basic options: the rent of the physical servers and the rent of these virtual instances [Mazzuco and Dumas, 2011]. Although these two options are able to perform the same functions there are some differences, for example the virtual instances are cheaper since it is not necessary the physical server but they are also seen as less secure than the physical servers [Barnatt, 2010].

2.5.3 IaaS Categories – Deployment Models

As a result of these basic options, IaaS providers have four main IaaS categories [NIST, 2011]: the Private Cloud, the Community Cloud, Hybrid Cloud and the Public Cloud

2.5.3.1 Private Cloud

The Private cloud as the name indicates means that the infrastructures Cloud is operated for the private and exclusively use of a specific organization [Liao and Su, 2011]. This cloud is

totally separated from the cloud hardware used by other consumers [Liao and SU, 2011]. In the private cloud there is a rent of an effective physical part of a data centre which is entirely dedicated to the customer that paid for that service [Sosinsky, 2011]. As a result, this category is considered as the safest form of deployment model [Zheng et al, 2011]. This option is costly than the others and does not benefit from some Cloud Computing advantages, but still allows the company to save considerably money with the cost of the server itself, its maintenance, the costs with the cooling of the server, security of the data centre and the specialized HR [Barnatt, 2010].

2.5.3.2 Community Cloud

This deployment model could be managed by the organization or by a third-party [NIST, 2009]. The cloud community is when several organizations shared the same cloud infrastructure and have similar objectives, rules and concerns [Choubey et al, 2011].

2.5.3.3 Hybrid Cloud

The Hybrid is a combination of the two different rent options [Makris et al, 2011]. The customer rents dedicated physical servers as in the Private Cloud but also rents virtual servers, as already mention above the so-called server instances [Zhang et al, 2010]. Consequently, each deployment model is or internal or external [Choubey et al, 2011]. The company can this way save more money than in the private Cloud since it still use some instance servers which are cheaper than the physical servers [Barnatt, 2010].

2.5.3.4 Public Cloud

The public Cloud also called the Cloud Hosting is the opposite of the Private Cloud, the customer rents the virtual servers (instances) on a pure demand basis [Sosinsky, 2011]. These customers share the instances with other customers and they do not know the exact location of the physical data centre [Barnatt, 2010]. Although this category could be seen as one of the less safe options of Cloud Computing (because the customer only rents virtual servers and share them with other customers) [Barnatt, 2010], it is indeed the one which benefit the best from the Cloud Computing advantages [Barcomb, 2011]. It is the cheapest category of the four and the option that allow the companies to save more money in IT costs and to benefit the most from scalability and flexibility advantages [Barcomb, 2011].

2.5.4 IaaS Market Value

According to IDC [IDC, 2009] and taking into account the figure 1 it is possible to verify that the expected market value of PaaS for 2013 is around $21.56 billion.

2.5.5 IaaS main Providers

There are providers more specialized in one IaaS category than in other [Sotomayor et al, 2009] nevertheless the most quoted IaaS providers in the Literature and in the IT sector is Amazon Web services (AWS) with services like EC2 (Amazon Elastic Compute Cloud) and S3 (Amazon Simple Storage Service) [Aljabre, 2012]. Then, there are also some well known IaaS providers as GoGrid [Sotomayor et al, 2009] and Rackspace [Nepal et al, 2011]. In the appendix 3 there is a brief description of these services.

2.6 Advantages & Potential Risks of Cloud Computing for SMEs

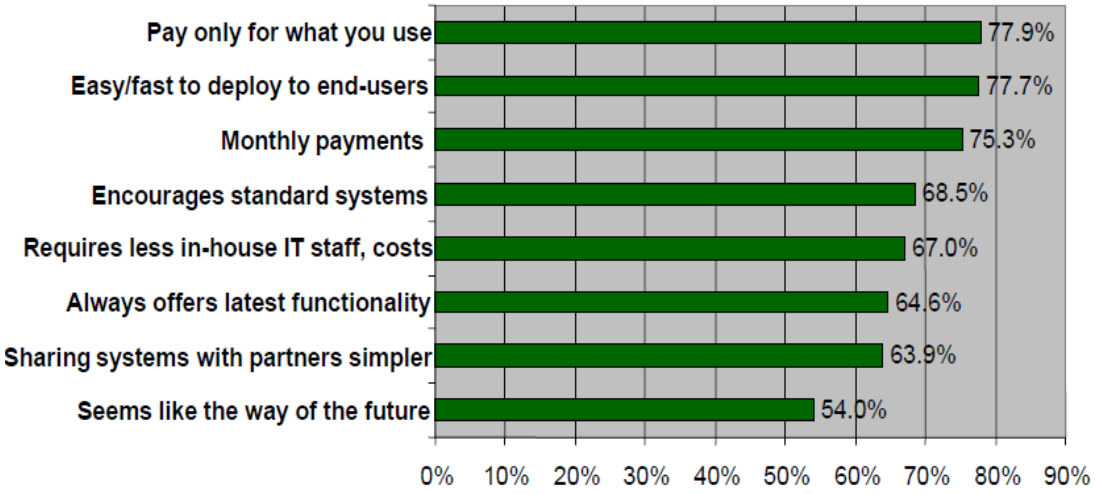
It is extremely important for the overall productivity of a country the performance of their national SMEs since they are considered as the driving force of economic growth [Petrakou, 2011]. More and more SMEs are realizing the importance Cloud Computing could have if they want to succeed in such competitive and globalized world [Sultan, 2011]. As a result many Small and Medium Enterprises are already embracing Cloud Technologies, being the most common applications related with email, calendars, address books, website and storage [Sultan, 2011]. Therefore, this chapter highlights Cloud Computing most important advantages for Small and Medium Enterprises but also some of its potential risks.

2.6.1 Advantages

An increasing number of companies (large and small) are adopting and embracing Cloud Computing services [Jena and Mahanti, 2001] but according to Abdulaziz Aljabre [Aljabre, 2012] are the SMEs which can benefit more from this new technology.

According to the IDC survey [IDC, 2009] the most important advantages the companies in their questionnaire had identified have been the following:

Figure 3 –Cloud Computer main Benefits



Source: IDC, September 2009

The principal benefit identified is the pay-per-use model, in which the end user only pays what he or she actually consumes [Briscoe and Marinos, 2009]. This allows to save money and to run the business in a much more efficient way [Cai et al, 2009].

Another very important advantage of Cloud Computing for SMEs is the opportunity to considerably decrease the costs with IT [Neves et al, 2011]. For small and medium enterprises to have their own servers could be extremely expensive [Dimitrakos, 2010]. Not only because of the initial investment with the server but also with other additional costs already referred above [Barnatt, 2010].

In addition, contrary to large organizations most of the SMEs do not have the amount of capital needed or the knowledge to have their own server [Sultan, 2011]. Also, the scale of Cloud Computing networks make them more reliable then what a single organization could achieve with in-house IT services [Sosinsky, 2011]. Consequently, more and more SMEs are transferring their data and applications to the Cloud [Staten, 2008], contrary to larger companies for which is it a quite costly and time consuming process [Staten, 2008].

Furthermore, SMEs can save in other IT expenses, as for example with a reduction in IT staffing [Sosinsky, 2011] or even with software [Cai et al, 2009]. If we consider that a deployment serve 10 employees and that the cost with an IT manager per hour is around $50, it is possible to verify a considerably save when comparing Google Apps service with Microsoft office Professional [Google, 2011]. The Annual cost per employee (over 3 years, excluding labor) of Google apps is $50 against the $670 of the Microsoft office Professional [Google, 2011].

Besides the companies do not have to buy separate software package from each employee or to have high powered computers because they run the software and applications directly from the Cloud [Aljabre, 2012]. In addition is much easier and faster the upgrades of the Software [Choubey et al, 2011].

Moreover, with this technology SMEs can save some money with backups and the storage of their important data since it is all on the Cloud [Miller, 2009]. Thanks to the Cloud Computing Scalability characteristic SMEs can increase or decrease their computing power on a demand basis [Neves, 2011]. Additionally, there are no complications with compatibilities of Operational Systems [Aljabre, 2012], even if using different OS, employees can easily share documents between them [Aljabre, 2012].

The potential of Cloud Computing for SMEs does not restrict to costs savings with IT, there are other important advantages for these types of companies [Neves, 2011]. Cloud Computing applications could fosters innovation through the use of collaborative tools [Tumer, 2010] this way helping employees, customers and suppliers to share ideas [King, 2008]. Another important advantage for SMEs is the possibility the employees have to access the cloud from any device anywhere [Gagliardi et al, 2010]. Consequently, there is the opportunity for employees to work remotely since they can access any document from the cloud being the only requisite a device with an internet connection [Miller, 2008]. Additionally, this characteristic from Cloud Computing allows the companies to save in travel costs [Sultan, 2010]. Moreover, the speed of implementation of a cloud application could be very important for SMEs, which could get access to a new and innovative application in days or even in a couple of hours [Choubey et al, 2011].

As most of the Cloud Computing applications are very user friendly [Daneshgar et al, 2011], all SMEs' employees (independent of their education background) can develop new skills which may lead also to increase job satisfaction [Khajeh-Hosseini et al, 2010]. The companies and employees that embrace Cloud Computer services can get access to sophisticated software and applications which can contribute to enhance business competiveness [Dimitrakos, 2010]. The access to these types of applications without Cloud Computing services would be almost impossible for SMEs [Neves, 2011]. According to Christopher Barnatt [Barnatt, 2010] Cloud Computing will be essential if the companies want to stay competitive in the future since the next generation of computer applications will only work in the cloud.

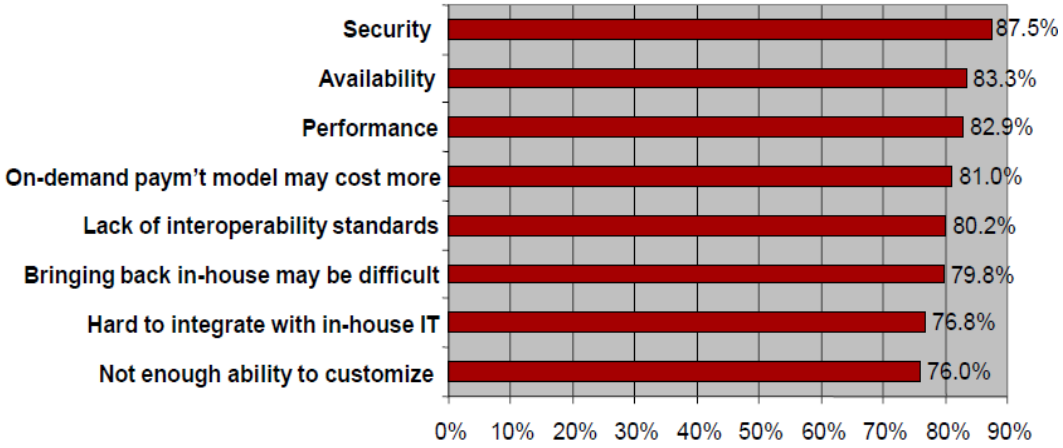
Finally, another advantage that has been increasing in importance in the last years is related with environmental issues, Cloud Computing would be essential in the future to be a "green"

company [Choubey et al, 2011]. SMEs that use Cloud Computing can use considerably less energy, for example Netsuite said that in 2008 its customers save around $61m in energy bills by using its Cloud services [Barnatt, 2010].

2.6.2 Drawbacks and Potential Risks

Cloud Computing as any other technology has some drawbacks and potential risks [Briscoe and Marinos, 2009]. According to a survey from IDC [IDC, 2009] the most relevant challenges and issues related with Cloud Computing can be found in the graph below.

Figure 4 – Challenges and Issues of Cloud Computing Services



Source: IDC, September 2009

Although it is not referred in the IDC study as main issue, in order to access the Cloud it is necessary a robust and high-speed internet connection [Aljabre, 2012]. Thus, several governments around the world are already investing in more powerful and reliable internet infrastructures [Barnatt, 2010] which will contribute to decrease this drawback.

Then, there is the security and privacy of confidential data which is considered as the most relevant issue and potential risk of Cloud Computing [IDC, 2009]. For some companies and individuals the idea of placing their data and confidential information and running their own software using someone else CPU appears to be risky [Hofmann and Woods, 2010]. For most of the Cloud Computing providers to meet some legislation standards is extremely difficult as for example in the Health sector [Hofmann and Woods, 2010]. Nevertheless, when it comes to concerns about potential hackers, the truth is that is much easier for a hacker to enter in a SMEs own server than to enter in for example a Google or Amazon server [Barnatt, 2010].

Another potential drawback is related with the availability and reliability of the service [IDC, 2009], meaning the users of Cloud Computing are worried they could not access the Cloud every time they want everywhere they want [Carroll et al, 2011]. This risk is close related with the problems of the absence of a proper Service-Level Agreements [Carroll et al, 2011], Cloud Computing providers should offer more protections to the companies which trust their services [Hofmann and Woods, 2010]. According to Paul Hofmann and Dan Woods [Hofmann and Woods, 2010] the problem of SLAs is even more amplified when "customers rely on multiple cloud providers that offer different levels of guarantees". Without a proper SLA the loss is all on the user since he or she is not able to put claims against the provider of the Cloud Computing service [Choubey et al, 2011].

Moreover, a very important drawback pointed out by several authors [Buya et al, 2008; Choubey et al, 2011] is related with the lack of audit of the Cloud provider .It is almost impossible for the user to inspect the activity of the provider, which may lead for example the Cloud provider to outsource some services to a third-party without the consent of the user [Choubey et al, 2011].

As well, the companies must be aware of and have a strategy for a potential downtime [Sosinsky, 2011] of the Cloud service. Even the largest Cloud Computing providers could experience problems as Google App Engine in 2009 which entered in "unplanned maintenance mode" and no one could deploy applications [Barnatt, 2010] or Rackspace IaaS provider which was down for 45 minutes which affected more than 2000 of their customers [Barnatt, 2010].

Another risk highlighted is that the users of Cloud Computing services have little control over the services offered by the Cloud providers [Choubey et al, 2011]. In addition another problem mentioned by several authors [Buya et al, 2008] is the migration from one cloud provider to another. This is difficult mainly due to the different architectures, the majority of the times, different Cloud Computing providers have [Buya et al, 2008].

In addition there could be, in some situations, a jurisdiction problem if the end user and the Cloud Computing service provider are from different countries [Choubey et al, 2011]. This drawback is mainly problematic in case of a legal dispute since it would be conflicts regarding what country law should be pursued [Choubey et al, 2011]. Finally, another issue the users of Cloud Computing services should be aware is the problem of the vendor lock-in [Tumer, 2010].

2.7 Cloud Computing services and the Portuguese SMEs

There are some important research studies and papers about the concept of Cloud Computing and its use by SMEs made by Portuguese researchers as for example the one called "The Adoption of Cloud Computing by SMEs: Identifying and Coping with External Factors" from several professor from Universidade Nova [Neves et al, 2011]. Nevertheless, there are few papers studying the use of Cloud Computing specifically by Portuguese SMEs.

This way and in order to be able to present a brief description of the situation of the Portuguese SMEs regarding the use of Cloud Computing, a interview[6] has been made to several experts with experience in Cloud Computing and its use by the Portuguese SMEs. This pool of experts has individuals from different companies, sectors and experiences. From a telecommunication company and a Cloud Computing service provider (Portugal Telecom) we have Dr. Abel Aguiar and Eng. Orlindo Santos, then from IT consultancy companies there are Eng. Eduardo Fitas and Dr. Pedro Lopes, both from Accenture and Dr. Carlos Lourenço from Logica. In addition from the association EuroCloud Portugal there is the associate Jorge Sousa.

Concerning the perception these experts have in relation to the awareness of the Portuguese SMEs about the concept of Cloud Computing, there is a common belief that the concept is still unknown for several companies, although it has been registered an increase in awareness in the last years. Carlos Lourenço mentioned a study[7] from the consultancy company Vanson Bourne where it concludes that the managers of Portuguese SMEs when asked about what is cloud computing, 22% said to be related to the services used at home and in the personal sphere (hotmail, messenger, photo sharing, windows live, photo gallery), 36% reported to be related to the rental service of computer housed on the web, while 14% have referred they have heard but do not know what it means and 29% report never having heard.

Moreover, Carlos Lourenço believes that with the actual financial crisis the Portuguese SMEs are more aware and interested in services with the characteristics and benefits of Cloud Computing. Nevertheless, he believes the majority of the SMEs in the next three years will opt for local Cloud Computing providers.

Abel Aguiar argues that in his opinion the knowledge of cloud services by SMEs in Portugal is highly variable taking into account the size, sector and company specific technological maturity. However, he considers that on average it is reduced in terms of actual knowledge of

[6] See appendix 4 - Interview to the Experts

[7] http://www.microsoft.com/portugal/presspass/SalasdeIV.aspx?ID=184

the Cloud Computing services offer and average in terms of the awareness of the concept. In addition Abel Aguiar believes that SMEs with 50-100 employed and / or from sectors with greater technological weight, for example, information systems or financial companies have higher percentages of knowledge than smaller firms in the retail food sector for example.

According to Eduardo Fitas the few Portuguese SMEs that actually use Cloud Computing services still do not take the best of the benefits of this technology. Pedro Lopes argues the Portuguese SMEs are taking the first steps in its use, almost with the perspective to test the concept so that in future it can be applied more broadly, now with more security and confidence. After all, to Pedro Lopes there are still many myths around security, reliability and confidentiality of data that gradually have been demystified leading to a wider adoption by the SMEs, particularly in infrastructure components and collaborative platforms. Moreover, Abel Aguiar thinks some companies that already use Cloud Computing applications do not know they are using this technology.

2.8 Michael Porter's Value Chain

The term *value chain* was first described in 1985 in the well known book called "Competitive Advantage: Creating and Sustaining Superior Performance" written by Michael E. Porter [Porter, 1998]. This value chain describes the company's activities both inside and outside of the organization that allows the company to deliver a final product or service [Porter, 1998]. According to Porter [Porter, 1998] it is the way the employees of an organization perform a specific activity and the way the linkages between the several activities are managed that could result in a strong competitive advantage [Porter, 1998]. It is very important for a company to comprehend how to evaluate its value chain since it allow the managers to carefully analyze each activity, helping them to understand the value created by each one of them and how to better secure the company competitive advantages [Porter, 1998].

According to Porter [Porter, 1998] these activities that generate value could be divided into two main classes: Primary activities and Support activities. The Primary activities are responsible for the creation of the service or product, its sale, its deliver and finally of its after sales services [Porter, 1998]. The Primary activities are then [Porter, 1998]:

- **Inbound logistics** – Includes mainly the reception, warehousing, storing and inventory of the inputs;
- **Manufacturing –** The activities which transform the inputs into the final product or service;

- **Outbound logistics –** Includes the activities necessary to deliver the finish product or service to the final customer;
- **Marketing and sales –** Includes the necessary activities to persuade the buyers to pay for the product or services.
- **Service –** Includes the activities needed to maintain or enhance the value of the product or service delivered.

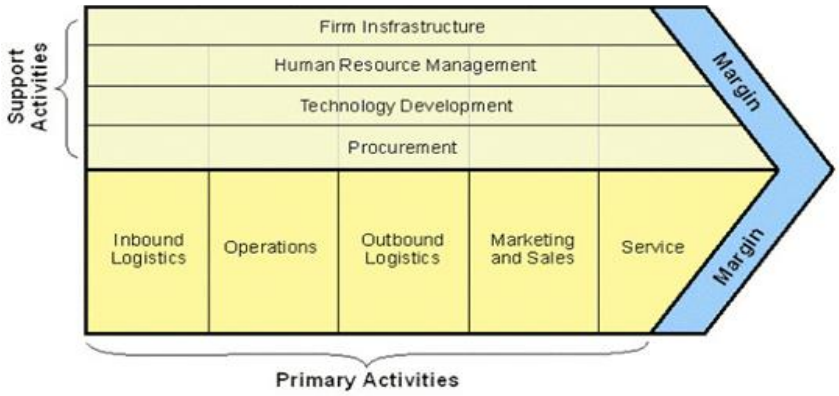
The Support activities then are responsible for supporting the Primary activities [Porter, 1998].

The Support activities are the following:

- **Corporate Structure –** Includes activities related with management, planning, legal and finance, accounting and others;
- **Human resource** – Includes all the activities related with the HR management as the recruitment process, the training and the remuneration;
- **Technological development** – Includes all the technological support of the Primary activities. Includes activities related with R&D, Design, Know-how and Processes;
- **Procurement** – Includes the activities related with the purchasing of the raw-materials.

The figure 5 represents the Porter's value chain with its Primary and Support activities:

Figure 5 – Porter's Value Chain



Source: "Competitive Advantage: Creating and Sustaining Superior Performance" by Michael E. Porter (1998)

2.9 Cobit Maturity Attribute Model

The international professional association called ISACA was the responsible for the creation of the Cobit framework [ISACA, 2007]. According to the ISACA [ISACA, 2007] the Cobit framework "is an IT governance framework and supporting toolset that allows managers to bridge the gap between control requirements, technical issues and business risks" and at the same time "enables clear policy development and good practice for IT control throughout organizations"[8].

[8] www.isaca.org

The most important and relevant COBIT components are the following [ISACA, 2007]:

- **Framework:** This framework is responsible for the organization of the IT governance objectives and good practices which are divided by IT domains and processes. In addition this framework makes the connection with the business requirements
- **Process descriptions**: It is a reference process model for everyone in a company.
- **Control objectives**: It is a set of high-level requests to be considered by the management team for effective control of all the IT processes.
- **Management guidelines**: these guidelines assist the managers allocating responsibilities and measuring performance
- **Maturity models:** Measure maturity and capability per process or technology

Taking into account the purpose of this work the most important component is the maturity model. More specifically it is important to focus on the Maturity Attribute table[9], which according to ISACA [ISACA, 2007] "lists the characteristics of how IT processes are managed and describes how they evolve from a non-existent to an optimised process". The Maturity Attribute table can be divided into several levels: Awareness and communication; Policies, plans and procedures; Tools and automation; Skills and expertise; Responsibility and accountability and finally Goal setting and measurement [ISACA, 2007]. To the purpose of this study we will focus more on the levels of *Awareness and Communication* and *Policies, Plans and Procedures*. The adaptation of these levels will be further developed in the chapter III.

2.10 Chapter conclusion

In this chapter it has been analyzed the evolution of the concept of Cloud Computing throughout the years as well as its Service Models and Deployment Models. Each Service Model (SaaS, PaaS and IaaS) has been analyzed detailed, not only the evolution of the tree concepts but also their market value and main providers. The Deployment Models have been also carefully explored in their four main types: Public, Private, Hybrid and Community. In addition, it has been as well explored, Cloud Computing main advantages and potential risks according to the literature of Cloud Computing. Moreover, and taking into account the experience and knowledge of our pool of experts on this paradigm, an overview of the reality of the Portuguese SMEs and the concept of Cloud Computing has been presented.

In the end of the chapter, it is briefly described the Porter value chain and the Cobit Maturity Attribute model.

[9] The table could be found in the appendix 5

III. Research Methodology and Model, Research Hypothesis and Data Collection

3.1 Chapter Introduction

In this chapter it is analyzed the Research Methodology and Model used in this work. In order to address the Research Questions purposed, three Dimensions are defined: *The knowledge of the Concept of Cloud Computing; The management of Cloud Computing services* and *How Portuguese SMEs are using Cloud Computing*. In this chapter the processes and models used to define those Dimensions are carefully explained as well as the Research Hypothesis set. In addition, in this chapter it is also explored the Data Collection method and the variables of this work: the Dependent variable, the Independent variables and finally the control variables.

Moreover, it is also addressed the Data analysis Model and its crosstabs to understand and study the relationship/influence of some control variables in the results of this dissertation.

3.2 Research Methodology

In order to achieve the objectives of this work, a knowledge model is created based on relevant knowledge from the Literature Review and from the contributions of the experts on the field of Cloud Computing. The experts advisors are as mentioned before: Dr. Abel Aguiar – Director of Outsourcing and Consultancy Services at Portugal Telecom and Eng. Orlindo Santos – Director of IT Cloud Services and Security at Portugal Telecom. Both Abel Aguiar and Orlindo Santos were part of the team responsible for the creation and launching of Cloud Computing services by Portugal Telecom. In addition there also three other experts in the field of Cloud Computing: Eng. Eduardo Fitas and Dr. Pedro Lopes – both Partners of Accenture responsible for the Technological area and Dr. Carlos Lourenço – Outsourcing Director at Logica. Finally the EuroCloud Portugal association was also contacted and an interview to Jorge Sousa, one of the members, has been also made. The contact with the experts was accomplished through personal interviews[10].

In order to fulfill the objectives of this dissertation, the model used is an adaptation of the Cobit Maturity Attribute Model [ISACA, 2007] and the Porter's Value chain [Porter, 1998]. Both models were modified and adapted bearing in mind the concept of Cloud Computing extracted from the Literature Review and the feedback provided by our pool of experts. Consequently,

[10] Appendix 4 – Interview of the experts

the model created allowed the extrapolation of the relevant dimensions needed to understand how Portuguese SMEs are using Cloud Computing and managing this technology. Each dimension is linked to a variable that has a direct influence on how Portuguese SMEs use and approach Cloud Computing services. Hence, it is possible to identify the importance of each variable on the several dimensions defined.

Each dimension of the model corresponds to one or more hypothesis with the objective to address the Research Questions purposed by this dissertation. Therefore, and to gather the necessary information and data, an online questionnaire[11] was sent to several Portuguese SMEs managers from different sectors.

Consequently, after the results from the questionnaire the data is analyzed and the hypothesis verified.

3.3 Research Model

As already mentioned this dissertation uses an adaptation of two different models: the Cobit Maturity Attribute Model and the value chain from Michael Porter. The need to use two different models arise from the objective of analyzing the use of Cloud Computing by Portuguese SMEs in several dimensions and perspectives.

On one hand this dissertation aims to understand the knowledge the managers of Portuguese SMEs have of the concept of Cloud Computing and how they are managing this technology. To address these challenges the model used is the Cobit Maturity Attribute Model. As mentioned in the Literature Review this model has five main dimensions. Taking into account the objectives mentioned above our dissertation model uses as base only the *Awareness and Communication* dimension and the *Policies, Plans and Procedures* dimension. The first dimension fits the purpose of understanding the knowledge the managers have about the concept of Cloud Computing. The second dimension fits the purpose, alongside with the first, to understand some of the management procedures regarding Cloud Computing services. Therefore the first two dimensions of this dissertation that have been defined are:

- **The knowledge of the Concept of Cloud Computing**
- **The management of Cloud Computing services**

[11] Appendix 6 – On-line questionnaire

In order to better understand these dimensions and what variables could influence them each dimension was detailed analyzed basing on the Literature Review and on the feedback provided by our pool of experts. The elaboration of each dimension and its variables is further developed in more detail in the chapter 3.3.1 and 3.3.2.

On the other hand, this dissertation strives to understand from those Portuguese SMEs that actually benefit from Cloud Computing which Service and Deployment Models are they using currently and what Services and Deployment Models are expected to be used in the near future. In addition it is also analyzed in which areas of the Portuguese SMEs value chain is Cloud Computing services being used. Bearing these objectives in mind the Porter value chain has been used as base to create a model that allowed addressing those goals. Consequently, another dimension of this work is defined:

- **How Portuguese SMEs are using Cloud Computing**

Once again the elaboration of this dimension and its variables is further developed in more detail in the chapter 3.2.3 and it was based on the Literature Review and feedback from our pool of experts.

3.3.1 The knowledge of the Concept of Cloud Computing Computing – 1st Dimension

In order to have an accurate definition of this dimension and of its variables it has been done a combination of the knowledge from several important authors from the Literature Review with the knowledge and experience provided by the experts. It is noteworthy to state this dimension was based on *Awareness and Communication* dimension from the Cobit Maturity Attribute Model.

According to the experts Abel Aguiar and Orlindo Santos knowledge of the concept Cloud Computing, means not only know the most important characteristics of this technology but also know its most important advantages and potential risks. This way, first it is created a table[12] with the most important characteristics from the Literature Review:

[12] Each characteristic was already developed in more detail in the Literature Review

Table 1 – Cloud Computing most important characteristics according to the Literature Review

	Main characteristics	Authors
Cloud Computing chararistics	It is a model in which software, processing power, storage capacity, data backups, development tools, and others are provided as a set of services over the Internet	[NIST, 2011; Sosisnsky, 2010; Barnatt, 2010; Böhm et al, 2009; IDC, 2009; Aljabre, 2012; Williams, 2010; Rhoton, 2011, Youseff et al, 2008, Neves et al, 2011]
	To benefit from Cloud Computing services the company necessarily requires an internet connection	[NIST, 2011; Sosisnsky, 2010; Barnatt, 2010; Vaquero et al, 2009]
	A company and its employees can access the cloud from any device (computer, tablet or mobile).	[Sosisnsky, 2010; Aljabre, 2012; Neves et al, 2011; Barnatt, 2010; Williams, 2010]
	A company can contract cloud services without having to directly contact the service provider of Cloud Computing	[NIST, 2011; Barnatt, 2010; Vaquero et al, 2009
	Different companies may share the same Cloud	[NIST, 2011; Vaquero et al, 2009]
	A company can increase or decrease the cloud services according to their needs at a precise moment	[Choubey et al, 2011; Vaquero et al, 2009; Williams, 2010; Rhoton, 2011]
	In a model of Cloud Computing the company pays the service to the Cloud Computing provider on what the companies actually use/consume. A model known as pay-per-use.	[NIST, 2011; Youseff et al, 2008; IDC, 2009; Barnatt, 2010; Sosisnsky, 2010; Williams, 2010; Rhoton, 2011]
	The models of cloud computing services are the most common: SaaS (Software as a Service), PaaS (Platform as a Service) and IaaS (Infrastructure as a Service)	[NIST, 2011; Youseff et al, 2008; IDC, 2009; Barnatt, 2010; Sosisnsky, 2010; Williams, 2010; Rhoton, 2011]
	The Cloud Computing Deployment models most common are Public, Private, Community and the Hybrid	[NIST, 2011; Youseff et al, 2008; IDC, 2009; Barnatt, 2010; Sosisnsky, 2010; Williams, 2010; Rhoton, 2011]

According to the table above, it has been considered that the most important characteristics of this technology to the Literature review are the ones more quoted and mentioned by the authors. Then, this table has been shown to the experts and they have been asked to indicate what they considered as the most important characteristics of Cloud Computing. This way, it is possible to have a broader notion of the main characteristics of this technology. The table below illustrates the cross between the Literature Review and the opinions of the experts:

Table 2 – Cross between experts and the Literature Review regarding Cloud Computing main characteristics

Cloud Computing main characteristics	Literature Review	Abel Aguiar	Orlindo Santos	Eduardo Fitas	Pedro Lopes	Carlos Lourenço	Jorge Sousa	TOTAL
It is a model in which software, processing power, storage capacity, data backups, development tools, and others are provided as a set of services over the Internet	●	●	●	●	●	●	●	7
To benefit from Cloud Computing services the company necessarily requires an internet connection		●	●					2
A company and its employees can access the cloud from any device (computer, tablet or mobile).				●	●	●		3
A company can contract cloud services without having to directly contact the service provider of Cloud Computing		●	●				●	3
Different companies may share the same Cloud							●	1
A company can increase or decrease the cloud services according to their needs at a precise moment	●	●		●	●			4
In a model of Cloud Computing the company pays the service to the Cloud Computing provider on what the companies actually use/consume. A model known as pay-per-use.	●		●	●	●	●	●	6
The models of cloud computing services are the most common: SaaS (Software as a Service), PaaS (Platform as a Service) and IaaS (Infrastructure as a Service)	●		●	●	●	●	●	6
The Cloud Computing Deployment models most common are Public, Private, Community and the Hybrid	●		●	●	●	●		5

It is noteworthy to state that it has been ask to the experts if there were other Cloud Computing characteristics not mentioned in the table above. None of the experts mentioned a new one. When analysing the table is possible to conclude that the most important characterisitcs of this techonology, according to the Literature Review and our pool of experts, are the first characteristic, the pay-per-use model and the service model characteristic.

Similar method is used now regarding Cloud Computing main advantages. Consequently the table[13] below highlights the most quoted advantages of Cloud Computing according to the Literature:

Table 3 - Cloud Computing most important advantages according to the Literature Review

Cloud Computing advantages	Main advantages	Authors
	Flexible payment – Trough the Pay-per-use model the end user only pays what he or she actually consumes.	[Briscoe and Marinos, 2009; Choubey et al, 2011; Barnatt, 2010; Williams, 2010; Rhoton, 2011
	Decrease the costs with IT – In hardware, software, maintenance and IT staff.	[Neves et al, 2011; Dimitrakos, 2010; Barnatt, 2010; Sosinsky, 2011; Cai et al, 2009; ; Barnatt, 2010; Williams, 2010; Rhoton, 2011]
	Easier and Faster to upgrade software services	[Choubey et al, 2011; Barnatt, 2010
	Increase Reliability - Cloud Computing networks make them more reliable then what a single organization could achieve with in-house IT services	[Sosinsky, 2011; Barnatt, 2010; Williams, 2010; Rhoton, 2011; Neves et al, 2011; Aljabre, 2012]
	No complications with compatibilities of Operational Systems	[Aljabre, 2012; Williams, 2010]
	Fosters innovation – For example through the use of collaborative tools	[Tumer, 2010; King, 2008; Sosinsky, 2011; Barnatt, 2010; Williams, 2010]
	Access from any device anywhere - possibility the employees have to access the cloud from any device with an internet connection anywhere they are.	[Gagliardi et al, 2010; Neves et al, 2011; Barnatt, 2010; Rhoton, 2011
	Speed of Implementation – SMEs get access to a new and innovative application in days or even in a couple of hours	[Choubey et al, 2011]
	Possibility to save in travel costs –Directly related with the advantage of access the cloud from anywhere and from any device.	[Sultan, 2010; Aljabre, 2012]
	Applications are user friendly	[Daneshgar et al, 2011; Aljabre, 2012; Barnatt, 2010]
	Enhance business competiveness – SMEs can get access to sophisticated software and applications that without Cloud Computing could not benefit	[Dimitrakos, 2010; Barnatt, 2010; Aljabre, 2012]
	Cloud Computing will be essential to remain competitive - next generation of computer applications will only work in the cloud	[Barnatt, 2010]
	Cloud Computing will be essential for the companies to be Green – SMEs can use considerably less energy and significantly reduce carbon emissions.	[Barnatt, 2010; Sultan, 2010]

Therefore when analyzing the table it is possible to verify that the most quoted advantages of Cloud Computing according to the Literature Review are: the Flexible payment; Decrease the costs with IT; Increase the reliability; the ability of accessing the cloud anywhere and from any device and finally the possibility to foster innovation. Once again a table with these advantages

[13] Each advantage was already developed in more detail in the Literature Review

is presented to the experts and they are asked to point out the advantages they consider as the most relevant a manager of a SME should know about Cloud Computing. The table with the results is presented below:

Table 4 - Cross between experts and the Literature Review regarding Cloud Computing main advantages

Cloud Computing main Advantages	Literature Review	Abel Aguiar	Orlindo Santos	Eduardo Fitas	Pedro Lopes	Carlos Lourenço	Jorge Sousa	TOTAL
Flexible payment	●	●	●	●	●	●	●	7
Decrease the costs with IT	●	●	●	●	●	●	●	7
Easier and Faster to upgrade software services							●	1
Increase Reliability	●	●		●		●		4
No complications with compatibilities of Operational Systems								0
Fosters innovation	●	●	●	●	●			5
Access from any device anywhere	●	●		●				3
Speed of Implementation			●	●	●	●	●	5
Possibility to save in travel costs								0
Applications are user friendly								0
Enhance business competiveness			●	●		●	●	4
Cloud Computing will be essential to remain competitive							●	1
Be essential for companies to be Green							●	1
Self provisioning (Abel Aguiar)		●						1

Once again it was asked to the experts if there is some advantages not mentioned in the table above, only the expert Abel Aguiar point one: Self-provisioning - the ability/possibility the client has to terminate the use or provision of the Cloud Computing services through customer portals. Concerning the analysis of the table above is possible to conclude that the most important advantages of this techonology, according to the Literature Review and our pool of

experts, are the following: Flexible payment, Decrease the costs with IT, Speed of implementation and fosters innovation.

Following the same reasoning in the table[14] above are the most quoted risks according to the Literature:

Table 5 - Cloud Computing most important risks according to the Literature Review

Cloud Computing Potential Risks	Main Risks	Authors
	Robust and high-speed internet connection – More than a risk could be a drawback if the SMEs do not have it.	[Aljabre, 2012; Barnatt, 2010; Williams, 2010; Rhoton, 2011]
	Security and privacy of confidential data	[IDC, 2009; Hofmann and Woods, 2010; Aljabre, 2012; Barnatt, 2010; Williams, 2010; Rhoton, 2011]
	Possibility of non-compliance of some legal requirements. For example the need for some data to be in the territory from which the company has its headquarters	[Hofmann and Woods, 2010]
	Possibility that there are fails in the availability and / or reliable on the access to enterprise data. Possibility of downtime even with reputed companies in the panorama of Cloud Computing.	[Carroll et al, 2011; IDC, 2009]
	Absence of a proper Service-Level Agreements – Directly related with the difficult of availability and reliability of the service	[Carroll et al, 2011; Hofmann and Woods, 2010; Williams, 2010; Rhoton, 2011]
	Lack of audit of the Cloud provider - almost impossible for the user to inspect the activity of the provider	[Choubey et al, 2011]
	Difficult of migration between Cloud service providers	[Buya et al, 2008]
	Little control over the services offered by the Cloud providers	[Choubey et al, 2011]
	Too much dependence on the Cloud Computing provider that can generate a problem of lock-in. This problem of lock-in is also linked to the difficulty of transition between Cloud providers	[Tumer, 2010; Barnatt, 2010; Williams, 2010; Rhoton, 2011; Sosinsky, 2011]

When analyzing the table is it possible to verify that the most quoted potential risks of Cloud Computing according to the Literature Review are: The need to have a robust and high-speed internet connection; the security and privacy issue; the absence of a proper SLA and finally the vendor lock-in (too much dependence on the Cloud Computing provider).

Again a table with these risks was presented to the experts and they were asked to point out the potential risks they consider as the most relevant.

The table with the results is presented below:

[14] Each potential risk was already developed in more detail in the Literature Review

Table 6 - Cross between experts and the Literature Review regarding Cloud Computing main risks

Cloud Computing Potential Risks	Literature Review	Abel Aguiar	Orlindo Santos	Eduardo Fitas	Pedro Lopes	Carlos Lourenço	Jorge Sousa	TOTAL
Robust and high-speed internet connection	●	●						2
Security and privacy of confidential data	●			●		●	●	4
Difficult to meet some legislation standards		●				●	●	3
Availability, reliability and downtime of the service							●	1
Absence of a proper Service-Level Agreements	●			●	●		●	4
Lack of audit of the Cloud provider				●		●		2
Little control over the services offered by the Cloud providers				●		●		2
Difficult of migration between Cloud service providers		●		●	●	●	●	5
Vendor lock-in	●		●	●	●		●	5
Difficult in some applications to create a customer differentiation (Carlos Lourenço)						●		1

Once again it was asked to the experts to point out other risks they belived were not mentioned in the table above. The expert Carlos Lourenço was the only that identified a new one – the dificulty in some applications to create a customer differentiation, for example it is not easy to offer a different service to a premium client and another one to an ordinary customer for instance in an application as email. Concerning the analysis of the table is possible to identify as the most relevant risks, according to the Literature Review and the experts, the security and privacy of confidential data, absence of a proper SLAs, Difficult of migration between Cloud Provider, and finally the vendor lock-in.

3.3.2 The Management of Cloud Computing services – 2nd Dimension

According to experts as Abel Aguiar, Eduardo Fitas and Jorge Sousa, it is crucial for a manager that wants to use Cloud Computing services that he or she has a good knowledge of the concept of Cloud Computing. This knowledge can be measured by the dimension above analyzed. In addition and according to the experts Carlos Lourenço and Jorge Sousa and authors as Mark Williams [Williams, 2010] and Christopher Barnatt [Barnatt, 2010] it is also

important that the managers of the SMEs are not only aware of the potential risks but also know the right procedures to overcome and safeguard from them.

Finally, some authors [Williams, 2010; Sosinsky, 2010; Rhoton, 2011] and experts as Abel Aguiar, Eduardo Fitas and Pedro Lopes also mentioned the crucial importance of having SLAs (service Level Agreements) and KPI (Key Performance Indicators) as a sign of maturity regarding the utilization and management of Cloud Computing services.

This way, three important factors can illustrate how Cloud Computing services are being managed and how mature are these managers towards this technology. According to authors from the Literature Review and our pool of experts the three as aspects are then:

- **The knowledge of the concept Cloud Computing**
- **The procedures to overcome potential risks of Cloud Computing**
- **SLAs and KPIs**

These three aspects are also based on two of the dimensions of the Cobit Maturity Attribute Model. As already mentioned before, the Knowledge of the concept of Cloud Computing is based on the *Awareness and Communication* dimension whereas the procedures to overcome potential risks and the utilization SLAs and KPIs are based on the *Policies, Plans and Procedures* dimension. As the Knowledge of this technology has been already discussed above, the last remaining aspects of the maturity are addressed below.

<u>The procedures to overcome potential risks of Cloud Computing</u>

Taking into account the main potential risks and the most quoted procedures to overcome them, mentioned by the Literature and by our pool of experts, the following table is created:

Table 7 – Procedures to overcome Cloud Computing potential risks

Cloud Computing Potential Risks	Procedures to Control the Main Risks
Robust and high-speed internet connection	• The company should upgrade its SLAs with its ISP and developing a proper continuity plan to ensure continued access to network infrastructure and Internet technologies (e.g. wireless access as a continuity option for fixed line downtime) [Enslin, 2012].
Security and privacy of confidential data	• According to the expert Abel Aguiar and the author Christopher Barnatt [Barnatt, 2010] the companies could control this potential risk by establishing a Cloud computing Policy specific to the company and by ensuring safe access to the cloud (related with usernames and passwords needed to enter in the Cloud applications of the company, for example ensure online security and constantly update firewall and antivirus).
Absence of a proper Service-Level Agreements	• The company should draw a proper and enforceable (both legally and logistically) SLAs and other contracts with the Cloud Computing provider, which should include remedial and penalty-related agreements. These contracts and SLAs should be inspected by a team of IT, business and legal professionals [Enslin, 2012].
Vendor lock-in	• The experts Orlindo Santos, Pedro Lopes and the author Mark Williams [Williams, 2010] argue that the Cloud Computing provider should be selected with great care, using a meticulous selection and approval process, to minimise the possibility of the enterprise wishing to change from one provider to another. If possible, the company select a Cloud Computing provider that uses generally established standards to ensure provider portability.
Jurisdiction problem and legal issues	• The expert Abel Aguiar and the author Enslin [Enslin, 2012] argue Cloud contracts which could possibly span juristic borders should be reviewed by legal advisors knowledgeable in international law.
Lack of audit of the Cloud provider	• The company should secure that a third party enterprises audit the adequacy of a Cloud Computing provider. This way the company will then be able to check a Cloud Computing provider level of certification or accreditation in order to determine the relevant level of controls implemented by the provider [Williams, 2010].

The more knowledge the managers of the Portuguese SMEs have regarding the procedures illustrated in the table above, the more matured they are to embrace Cloud Computing services.

SLAs and KPIs

The KPI are deeply related with the Service Learning Agreements of the Cloud Computing provider since they help to measure and control the level of the service provided [Williams, 2010]. Most of the suppliers which have SLAs use it more to protect themselves than their customers [Williams, 2010], so it is important that the companies be aware of three important key areas to consider when analyzing Service Level Agreements: Data protection; Continuity of service and Quality of Service (QoS) [Williams, 2010]. The table below, based on the Literature and on the experience from our experts, highlights some concerns the SMEs should have regarding the performance of the service by the Cloud Computing provider:

Table 8 – SLAs and KPIs of Cloud Computing

SLAs	Description
Data Protection	• In the contract the company must know who owns the data [Barnatt, 2010]; • The expert Abel Aguiar argues the SMEs should know if the security of the Cloud Computing provider is tested and certified, preferably by an independent audit. • In the contract the company must know what happens to its data copies if the business finish or when the contract finish [Rhoton, 2011].
Continuity of Service	• The SME should know the notice period the CC provider has to give before any scheduled downtime and to know how often these schedule downtimes occur. The company should have performance indicators to monitor the Cloud Computing provider [Rhoton, 2011]. • The company should measure the Cloud Computing provider downtime and the severity of the outages. The compensations by these outages must be in contract if applicable [Williams, 2010];
Quality of Service (QoS)	• According to experts as Orlindo Santos and Jorge Sousa the company should know how quickly resources are allocated dynamically to overload applications. The company should have performance indicators which could measure the Cloud Computing provider performance ; • The company should know the general QoS metrics the Cloud Computing provider has and be capable to compare them with its own performance indicators [Williams, 2010].

Consequently and having into account the information present in the table above the companies should have the KPI presented below in order to carefully measured the performance of the service provided by the Cloud Computing company:

- Performance indicators to measure and monitor the possible length of downtime and disruption of the Cloud Computing services;

- Performance Indicators to assess the speed and flexibility with which the supplier of the Cloud Computing allocates resources if there is an overload or if there is a fault in a server;
- Indicators of QoS (Quality of Services) so the company can measure internal the quality of the service provided by the Cloud Computing company and compare it with the indicators of quality the Cloud Computing provider claims to have delivered.

Consequently, it is possible to conclude that the more a manager of a Portuguese SMEs knows about the three aspects presented above (knowledge of the concept of Cloud Computing, knowledge about the right procedures to overcome potential risks and the use of SLAs and KPIs), the more is the manager prepared and mature to manage Cloud Computing services.

3.3.3 How Portuguese SMEs are using Cloud Computing – 3rd Dimension

This chapter addresses the last dimension of this work. First, this works strives to understand the Service and Deployment models the Portuguese SMEs are using currently, and if in the future it is expected they change or use other type of Service or Deployment model in their organization. Then, this dissertation aims also to identify in which areas of the value chain Cloud Computing is being currently used and which areas are expected to be explored in the future by the Portuguese SMEs. In addition, it is noteworthy to learn if the managers are using Cloud Computing services in crucial areas of their business or in contraire they are using it just in support areas.

<u>The type of Service and Deployment Models used by Portuguese SMEs</u>

This dimension strives then to understand which type of Service Models (SaaS, IaaS and PaaS) and Deployment Models (Public, Private, Hybrid and Community) are the Portuguese SMEs using. According to the perception the experts have about the reality of the Portuguese SMEs, the most important Service Models are the SaaS and IaaS. According to Eduardo Fitas, SaaS is more used for basic and commoditized applications as web hosting and email. Eduardo Fitas argues that SaaS could be a way of leveraging productivity and competitiveness levels to companies that do not have technological solutions to support their business. Concerning IaaS, Abel Aguiar see this Service Model being utilized by Portuguese SMEs mainly as storage, backup services, and as a way to considerably decrease the costs with data centers. Concerning PaaS, Carlos Lourenço argues that although very important this service can be seen more as a “future bet” for SMEs.

When it comes to Deployment models all the experts believe today the most used deployment model is still the Private one. According to Jorge Sousa there is still a lot of mistrust and suspicion with issues as privacy and security what lead SMEs to prefer to opt for that option. Nevertheless, the experts believe that with the increasing use of Cloud Computing the Deployment Model more used will be the Hybrid or even the Public.

This way, this dimension allows identifying what Service and Deployment Models are being used by Portuguese SMEs and compare them with the experts' perceptions. With that purpose in mind and to analyze this dimension the main characteristics of the Service Models and the Deployment models have been extracted from the Literature Review and asked in the on-line questionnaire made to the SMEs. The tables below highlight the most important characteristics of the Service and Deployment Models.

Table 9 – Cloud Computing Service Models

Service Models	Main characteristics	Well known Services
SaaS – Software as a Service	• Provides complete business applications delivered through the internet [Williams, 2010]; • No need to be installed in the PC [Williams, 2010]; • Much reasonable priced then the installed software [Ma, 2007]; • More user friendly and simpler than installed software [Neves et al, 2011]; • Upgrade of the software easier and faster than the traditional locally installed software [Miller, 2008]; • Compatibility issues are non-existent since all the users have the same version [Miller, 2008].	• SaaS E-Mail: Gmail; Yahoo; Hotmail. • Office SaaS: Google Docs; Google Apps; Zoho; Acrobat; Windows office web apps; SlideRocket. • SaaS Desktops: StartForce; Eyeos; IT Farm. • SaaS Business Applications: Zoho creator; SalesForce; ADP; Clarizen; NetSuite; Webex; • SaaS online storage: Dropbox; LiveDrive; Box;Windows Skydrive.
PaaS – Platform as a Service	• A stable environment where the user can create, test and deploy web applications Williams, 2010]; • An end-user with some programming knowledge can with a relatively minimum cost create an application and deliver it worldwide [Boniface et al, 2010]; • PaaS is starting to become the main trend for software development [Cui et al, 2011]	• Google app engine; • Force.com; • Windows Azure; • Zoho creator.
IaaS – Infrastructure as a Service	• IaaS vendor basically rents computer hardware and administrative services need to store and run applications in the Cloud [Bakshi, 2001]; • Allow companies to migrate all their data, applications and programs into the Cloud [Barcomb, 2011]; • The CAPEX necessary to be a competitive IaaS provider is extremely high [Barnatt, 2010] which makes difficult for small players to compete in this service model [Barnatt, 2010].	• Amazon web services (AWS); • Gogrid; • Rackspace

Table 10 – Cloud Computing Deployment models

Deployment Models	Main characteristics
Private Cloud	• There is a rent of an effective physical part of a data centre which is entirely dedicated to the customer that paid for that service [Sosinsky, 2011] • Totally separated from the cloud hardware used by other consumers [Liao and SU, 2011]; • This category is considered as the safest form deployment model [Zheng et al, 2011];
Community Cloud	• This deployment model could be managed by the organization or by a third-party [NIST, 2009]; • Several organizations shared the same cloud infrastructure and have similar objectives, rules and concerns [Choubey et al, 2011].
Hybrid Cloud	• Combination of the two different rent options, the private and the public [Makris et al, 2011]; • The customer rents dedicated physical servers as in the Private Cloud but also rents virtual servers [Zhang et al, 2010].
Public	• Also called the Cloud Hosting is the opposite of the Private Cloud, the customer rents the virtual servers (instances) on a pure demand basis [Sosinsky, 2011]; • Customers share the instances with other customers and they do not know the exact location of the physical data centre [Barnatt, 2010]; • It is the cheapest category of the four and the option that allow the companies to save more money in IT costs and to benefit the most from scalability and flexibility advantages [Barcomb, 2011].

The areas of the value chain using Cloud Computing services

In addition, another objective, as already mentioned, is to understand in which areas of the value chain are the service models being applied currently and which areas are the Portuguese SMEs expect to explore in the future. Therefore, and as the companies analyzed are from different sectors we opted to used the Porter value chain model since it is a framework globally accepted which can be easily adapted to companies from different sectors and with diverse strategies [Porter, 1998]. In order to understand in which areas Cloud Computing is being utilized by the Portuguese SMEs, it is necessary to know which main characteristics have some of the Cloud Computing services especially designed for the different areas of the value chain. This way, the following tables[15] have been created:

Table 11 – Primary Activities main characteristics and services

Value chain areas (PRIMARY ACTIVITIES)	Examples of CC services	Main characteristics
Inbound logistics	• ASP Global Services • E2open	• Inventory & Warehouse Management System; • Solutions designed to address critical supply chain management processes, including order management, inventory management, demand/supply synchronization, spend consolidation, logistics visibility, multi-tier visibility, manufacturing visibility and eco-compliance; • Applications to reduce direct materials costs, increase supply assurance, cut cycle time, reduce buffer inventories, improve operational efficiencies and increase flexibility.
Manufacturing	• Plex Systems • Amitive	• Fully integrated on demand performance manufacturing software system; • There are applications for companies that outsource manufacturing and multi-enterprise business networks; • Applications to access to operational data, allowing managers to make better decisions and continually improve their processes.
Outbound logistics	• Cube Route Inc. • Transwide	• Applications of sophisticated routing, tracking and planning functionality is used to optimize routes as well as track and monitor fleets in real time - at the lowest possible cost; • Applications to improve the process of replenishment planning, order processing, transportation load building, fleet management and transportation route planning; • Applications for real-time visibility and collaboration between all actors of the logistics process.
Marketing and sales	• SalesForce • Act-on • Alsamarketing	• Applications to manage sales data and processes online. The contacts of the customers and their records are all available from the cloud; • Collaborative tools between sales representatives and marketing teams; • Applications for B2B marketing and sales including email, web forms, website visitor capture, event management, and partner marketing portals.
Service	• RapidCase • Banckle Remote Access	• Applications which could improve customer support for example trough empowerment of call center support representatives to handle calls from first-time and existing customers much faster; • Applications which provides secure IT helpdesk support for the company's clients

[15] The Cloud Computing applications in both tables were chosen from two independent Cloud Computing directories: www.cloudbook.net and www.saas-showplace.com . The applications were chosen randomly but that fit the respectively value chain areas.

Table 12 - Primary Activities main characteristics and services

Value chain areas (SUPPORT ACTIVITIES)	Examples of CC services	Main characteristics
Corporate structure	• Adaptive Planning - By Adaptive Planning (Finance) • ActionStep (ERP) • Business Design Corporation (Planning)	• Finance - On-demand budgeting, forecasting, and reporting solutions. Set of planning components, financial statements, metrics, automated consolidation, data entry sheets, multi-dimensional data collection; • ERP - End-to-end business system including Marketing-CRM-Sales-Operations-Accounting-HR. Multi-divisional, multi-currency and integrated accounting; • Web-based app to consistently document and easily implement standard operating procedures.
Human resources	• Mongoose Recruitment System – By Mongoose • Time and Attendance Software - By NextPunch • Web Timesheet - By Pacific Timesheet	• Allows to manage Job Orders and Assignments, Candidates, and Client; • Help to collect the hours employees are working, where they are working from and what they are working on via the web, telephone and mobile devices; • Web-based payroll timesheet, project time tracking, time off management, time and attendance features.
Technological development	• AccelOps, Inc • Accept Software	• Assure service reliability via integrated datacenter monitoring, alerting, analysis and reporting; • Applications to integrated end-to-end product innovation management solution;
Procurement	• Absolute Value; • SupplyOn AG; • PurchaseControl	• Formulas to forecast and multi-site replenishment solution for distributors. Applications that allow users to reduce inventory levels; • Applications to facilitate procure-to-pay, implementation of consumption-controlled logistics concepts and support for customs-relevant processes; • Purchase Order Control

Moreover, trough the questionnaire, it is also analyzed if the SMEs are using a specific application for each area of the value chain, or if they are using a more end-to-end application (including services and applications suitable for more than one area of the value chain).

3.4 Research Questions, Dimensions and Variables and Research Hypothesis

As mentioned already in this dissertation the Research Questions are the following:

1. **Are the managers of the Portuguese SMEs aware of Cloud Computing main characteristics, advantages and potential risks?**
2. **How are the managers of the Portuguese SMEs managing Cloud Computing?**
3. **Which Services and Deployment Models are used in SMEs value chain currently and in the future?**

In order to be able to answer these Research Questions it is crucial to gather and analyze a considerable amount of information. It is very important to understand the dimensions and its

variables, which influence and help to answer to the Research Questions illustrated above. In conclusion of the previous chapter the Dimensions and its variables are the following:

1. The knowledge of the Concept of Cloud Computing, which relates to the knowledge and awareness the managers of the Portuguese SMEs have about this technology. This dimension has as variables the awareness of the term Cloud Computing, the knowledge of Cloud Computing main characteristics, the knowledge of Cloud Computing main advantages and finally the knowledge of Cloud Computing main risks. In addition also have as variables the Reasons and fears behind the adoption of Cloud Computing

2. The Management of Cloud Computing services which evaluates how are the managers of the Portuguese SMEs managing this technology. Its variables are the Knowledge of the concept of Cloud Computing, the use of the procedures to overcome some of the potential risks and finally the knowledge and proper use of SLAs and KPIs.

3. How Portuguese SMEs are using Cloud Computing services that evaluates what kind of Service Models and Deployment Models have being used by the managers of the Portuguese SMEs currently and also strives to understand what types are expected to be used in the near future. In addition this work strives to understand in which areas are the managers of the Portuguese SMEs currently using Cloud Computing and what areas are expected to be explored in the future with this technology. The variables are the Services and Deployment Models used currently and in the future and what areas of the value chain are the SMEs using Cloud Computing, trough which is also possible to conclude if Cloud Computing is being used in primary or support areas for SMEs. In addition is also verified if the applications used are end-to-end applications or more specific to a single area.

In order to successful answer the Research Question and bearing in mind the Dimensions and its variables the following Hypothesis are formulated:

H1. Portuguese SMEs managers are aware of Cloud Computing main characteristics, advantages and drawbacks

This hypothesis tests the knowledge the managers have concerning the concept of Cloud Computing. This hypothesis is directly related with the first dimension.

H2. Are Portuguese SMEs managers prepared to manage Cloud Computing services

This hypothesis tests if the Portuguese managers are already mature to manage and use cloud Computing services. This hypothesis is related with the second dimension and it is directly dependent of the sub-questions below.

Cloud Computing can be considered as an outsourcing service [Barnatt, 2010], and this way it is crucial that it has proper and robust SLAs - Service Learning Agreements [Huang and Goo, 2009]. According to C. Derrick Huang and Jahyun Goo [Huang and Goo, 2009] the "SLAs have proven to be effective tools for managing outsourcing engagements" and consequently the Portuguese SMEs managers should be aware and use these contracts in order to effectively manager Cloud Computing services. The author Alea M. Fairchild [Fairchild, 2004] also mentions Key Performance Indicators (KPIs) as for example Quality of Services (QoS) as a way to improve unexpectedly poor service quality and increase the value added of SLAs. To achieve an efficient management of outsourcing services as Cloud Computing it is important, besides a good utilization of SLAs and KPIs that the company adopts risk management practices [Ari set al, 2008]. These risk management practices concerning Cloud Computing have been based on the Literature Review and our pool of experts and can be found on the table 8, section 3.3.2.

H2.a – Portuguese SMEs managers have proper SLAs and some KPI concerning Cloud Computing services

This hypothesis is directly related with the H2 and it is one of the hypotheses to identify how are the SMEs managing Cloud Computing. This hypothesis is related with the second dimension.

H2.b –The Portuguese SMEs managers are aware and use some of the procedures to overcome some potential risks of Cloud Computing

This hypothesis once again is directly related with the H2 and tests the knowledge the managers have regarding the procedures to overcome potential risks. This hypothesis is related with the second dimension.

H3. Currently, the service model more used by the Portuguese SMEs in their value chains is the IaaS and the deployment model used most is the private

This hypothesis tests what Service Models and Deployment Models are being used currently by the Portuguese SMEs. In addition this hypothesis will test the experts believe about the Service and Deployment Models currently used by the managers of the SMEs. This hypothesis is related with the third dimension.

H3.a – In the future, the majority of the SMEs will continue to use the same service Model and Deployment model they are currently using.

This sub-hypothesis tests what is expected to occur in the future regarding Service and Deployment Models utilization. This hypothesis is related with the third dimension.

H3.b –The Portuguese SMEs do not use and their managers are also not think of using, in the near future, Cloud Computing services in their value chain Primary activities

This hypothesis tests to what extent is Cloud Computing being utilized by the Portuguese SMEs in critical areas of their business or if it is being utilized more in support areas. This hypothesis is related with the third dimension.

H3.c – The Portuguese SMEs use more single and specific applications rather than integrative/end-to-end applications

This hypothesis tests if the Portuguese SMEs use integrative application or in contraire use more single and specific applications. This hypothesis is related with the third dimension.

In conclusion, all of these hypotheses were created based on the adaptation of the Cobit Attribute Maturity Model, the model of the Porter value chain, the Literature Review and the contributions of the experts. Consequently and to sum up, these hypotheses are directly related with the dimensions defined in the previous chapter:

- Hypothesis 1 relate to the *Knowledge of the Concept of Cloud Computing* dimension.

- Hypotheses 2, 2.a, 2.b and 2.c relate to *The Management of Cloud Computing services* dimension.
- Hypotheses 3, 3.a and 3.b relate to *How Portuguese SMEs are using Cloud Computing* dimension.

3.5 Data Collection

In order to gather the necessary information to address the Research Questions an online questionnaire has been made[16]. The online questionnaire was send to several PMEs from diverse sectors and in a random way. The contacts of the companies have been acquired through networking and personal contacts, trough web engines and finally trough the report made by Diário Económico and Banco Espirito de Santo called "PME Líder 2011" [Diário Económico, 2011].

The survey was available and online since the beginning of April 2012 until 10th of May 2012. In order to do this questionnaire an online software specialized in surveys has been used called QuestionPro[17]. A total of 142 of SMEs have opened the questionnaire, 140 have started but just 118 have actual completed it. The analysis is focused only on the SMEs that have completed the entire questionnaire.

Consequently, to interpret the results obtained from the questionnaire a statistical analysis is performed.

3.5.1 Variables from the on-line questionnaire

The table below is a summary of all the variables used in the analysis of this work in order to answer the main Research Questions:

[16] Appendix 6 – The on-line questionnaire questions
[17] www.questionpro.com

Table 13 – Dependent variables, Independent variables and Control variables

Dependent Variable	
The use of Cloud Computing services by Portuguese SMEs	
Independent Variables	
Knowledge of the Cloud Computing concept	
The Management of Cloud Computing services	
How Portuguese SMEs are using Cloud Computing services	
Control Variables	
SMEs characteristics	***Dimension Variables***
• Size	• Awareness of the term Cloud Computing and its use
• Sector	• Knowledge of Cloud Computing main characteristics
• SMEs turnover	• Knowledge of Cloud Computing main advantages
• Annual % invested in ICTs	• Knowledge of Cloud Computing main risks
• Nº of employees w/ ICTs functions	• Reasons and fears behind the adoption of Cloud Computing
• The responsibility of the maintenance of the ICTs	• Knowledge of the procedures to overcome potential risks
-	• Service & Deployment models
-	• Value chain areas
-	• SLAs and KPIs

Dependent Variables

The dependent variable is *The use of Cloud Computing services by Portuguese SMEs* and measures to what extent are the Portuguese SMEs using this kind of services and how they are managing this techonology.

Independent Variables

Knowledge of the concept of Cloud Computing – this variable identify the Portuguese SMEs which know what Cloud Computing is. Moreover, identifies from those SMEs which actually knows the technology what characteristics, advantages and potential risks the managers consider as principal. In addition this independent variable also identifies the main Reasons and Fears behind the adoption of Cloud Computing. This variable is tested by questions Q7, Q8, Q9, Q10, Q11, Q12, Q13 and Q14.

The Management of Cloud Computing services – this variable strives to identify how Portuguese SMEs are managing Cloud Computing services. Identifies which SMEs know about the procedures to overcome the potential risks of Cloud Computing and which SMEs have SLAs and KPIs. This variable is tested by questions Q15, Q24, Q25 and Q26.

How Portuguese SMEs are using Cloud Computing services – this variable strives to identify what type of Service and Deployment models are being used by the Portuguese SMEs. In addition also identify in which areas of the SMEs value chain is Cloud Computing being used and if those areas are crucial or not to the core of the organization. This variable is tested by the questions Q16, Q17, Q18, Q19, Q20, Q21, Q22 and Q23.

Control variables

The group of the SMEs characteristics has the following control variables:

- Size (1-9 employees=1, 10-50 employees=2, 50-250 employees=3, more than 250 employees=4). And is tested by the question Q1.
- Sector (Agriculture, Hunting and Fishing=1; Retail food, Beverages and Tobacco= 2; Automobile sector=3; Rubber and Plastic Materials=4; Retail=5; construction=6; Electricity, Gas and Recycling=7; Electronics and Mechanics=8; Extractive Industry=9; Computers and IT sector=10; Wood and cork sector=11; Paper, Card and Graphic Arts=12; Metal and Steel Products=13; Chemistry sector=14; Textile, Clothing and Footwear=15; Transport sector=16; other – indicate the sector=17). This variable is tested by the question Q2.
- Turnover (Less than 2 million=1; Between 2 and 10 million euros=2; Between 10 to 50 million euros=3; More than 50 million=4). This variable is tested by the question Q3.
- Annual % invested in ICTs (Less than 1%=1; From 1% to 5%=2; From 5% to 15%=3;More than 15%=4). This variable is tested by question Q4.
- Nº of employees w/ ICTs functions (None=1;Between 1-5=2; Between 5-10 = 3; Between 10-20 = 4; Greater than 20 =5). This variable is tested by the question Q5.
- Responsibility of the maintenance of the ICTs (An external organization=1; Employees of their own company=2; Both situations=3). This variable is tested by the question Q6.

This group of control variables has been made in order to understand if the characteristics of the Portuguese SMEs could somehow influence the use of Cloud Computing services. For example to verify if a larger company is more aware of this technology or if the sector influence somehow the use of this technology.

Then, we have the control variables directly related with the Dimensions and independent variables of this dissertation. The variables are the following:

- Awareness of the Cloud Computing term and its use - This variable strives to understand if the managers of the Portuguese SMEs actually know and heard of what it is Cloud Computing, and if they use these services. As our experts have told, several Portuguese SMEs are using Cloud Computing services without knowing they are using this technology. This variable is tested by the questions Q7, Q8 and Q9.
- Knowledge of Cloud Computing main characteristic – this variable is directly related with the independent variable *Knowledge of the Cloud Computing concept*. Trough this variable this work tries to identify which of the several Cloud Computing characteristics defined previously, are the managers more aware of. This variable is tested by the question Q10.
- Knowledge of Cloud Computing main advantages – this variable is directly related with the independent variable *Knowledge of the Cloud Computing concept*. Trough this variable we try to identify which of the several Cloud Computing advantages defined previously are the managers more aware of. This variable is tested by the question Q11.
- Knowledge of Cloud Computing main risks – this variable is directly related with the independent variable *Knowledge of the Cloud Computing concept*. Trough this variable we try to identify which of the several Cloud Computing risks defined previously are the managers more aware of. This variable is tested by the question Q12.
- Reasons and fears behind the adoption of Cloud Computing. With this variable it is verified from those SMEs that actually use Cloud Computing services, the main reasons they had to adopt this services and what kind of fears the managers felt before adopting this technology. This variable is tested by the questions Q13 and Q14.
- Knowledge of the procedures to overcome potential risks - this variable is directly related with the independent variable *The Management of Cloud Computing services*. This variable strives to understand which of the procedures to overcome potential risks the managers use. This variable is tested by the question Q15.
- Service & Deployment models. This variable is directly related with the independent variable *How Portuguese SMEs are using Cloud Computing services.* This variable identifies what type of Service Models (SaaS, PaaS and IaaS) the PMEs are using at this moment and what Service Models will use in the near future. The same happen to the Deployment Models, this variable has the objective of highlighting the most used Deployment Models

(Public, Private, Hybrid and Community) now and in the future by Portuguese SMEs. This variable is tested by the questions Q16, Q17, Q18 and Q19.

- Value chain areas. This variable is also directly related with the independent variable *How Portuguese SMEs are using Cloud Computing services* and verifies in which area of the value chain is Cloud Computing being used now and which areas are expected to be explored in the future. In addition it is also tested if Cloud Computing is being used in Primary activities for the SMEs. This variable is tested by the questions Q20, Q21, Q22 and Q23.
- SLAs and KPIs - this variable is directly related with the independent variable *The Management of Cloud Computing services.* This variable strives to understand to what extent are the Portuguese SMEs managers using SLAs and KPIs while using Cloud Computing services. This variable is tested by the questions Q24, Q25 and Q26.

3.6 Data Analysis Method

The analysis of the data has been made in four different stages. First, it has been made a profile of the Portuguese SMEs of the sample taking into account the *SMEs characteristics* control variables mentioned above. Secondly, the data and information has been segmented according to the three independent variables. The results of the on-line questionnaire have been, this way, all presented and the main conclusions analyzed and discussed.

Third, it was crucial to understand if some the *SMEs characteristics* control variable could somehow influence the *Dimension* control variables and therefore influencing some of the independent variables. The control variables which have been analyzed are the following:

Crosstabs 1 – Size Control variable. This *SMEs characteristics* control variable is crossed with several Dimension Control variables as the *utilization of Cloud Computing*; *Reasons and Fears behind the adoption of Cloud Computing*; *the use of SLAs* and finally the *Service and Deployment Models*. The objective is to understand to what extent can the size of a company influence those dimensions

Crosstabs 2 – Sector Control variable. This *SMEs characteristics* control variable is crossed with several Dimension Control variables as the *utilization of Cloud Computing*; *Reasons and Fears behind the adoption of Cloud Computing*; *the use of SLAs* and finally the *Service and Deployment Models*. The objective is to understand to what extent can the sector of a company influence those dimensions.

Crosstabs 3 – SMEs Turnover Control variable. This *SMEs characteristics* control variable is crossed with several Dimension Control variables as the *utilization of Cloud Computing*; *Reasons and Fears behind the adoption of Cloud Computing*; *the use of SLAs* and finally the *Service and Deployment Models*. The objective is to understand to what extent can the annual turnovers of the SMEs influence those dimensions and in which way.

Crosstabs 4 – SMEs annual invested in ICTs Control variable. This *SMEs characteristics* control variable is crossed with several Dimension Control variables as the *utilization of Cloud Computing*; *Reasons and Fears behind the adoption of Cloud Computing*; *the use of SLAs* and finally the *Service and Deployment Models used* by the SMEs. The objective is to understand to what extent can the annual investment in ICTs of a company influence those dimensions

3.7 Chapter conclusion

In this chapter the Research Methodology is presented, where it is explained how the Research Model is structured in order to address the objectives of this dissertation. Then, the Research Model is presented and it is divided into the tree main Dimensions: The knowledge of the Cloud Computing concept; The Management of Cloud Computing services and How the Portuguese SMEs are using Cloud Computing services.

After the explanation and analysis of the reasoning behind the Research model, the Research Hypothesis are presented as the way to achieve the objectives and answer the Research Questions purposed by this work. Moreover, it is presented in this chapter the Data collection processes and procedures as well as the variables defined of the on-line questionnaire. Finally, it is briefly described the data analysis method developed in the next chapter.

IV. RESULTS AND DISCUSSION

4.1 Chapter introduction

In this chapter it is discussed the main conclusions of the on-line questionnaire. Through this analysis it is expected to gather the necessary data and information to address the Research Questions of this work, thus understanding to what extent are the Portuguese SMEs using and how they are using Cloud Computing services.

The results and its discussions are divided into four main dimensions: the SMEs' characterization profile and the three dimensions direct related to the independent variables. After, it is studied the influence of some of the SMEs' characteristics control variables , namely, the Dimension of the SMEs, its economic sector, SMEs' turnover and finally the Portuguese SMEs investment in ICT. It is tested how these characteristics can influence the utilization of Cloud Computing, the reasons and fears behind its adoption, the Service and Deployment Models used and the utilization of SLAs and KPIs.

4.2 Results and Discussion of the on-line questionnaire

In this section the data is characterized taking into account the answers given by the 118 SMEs in four main domains. First the results from the SMEs characterization are presented, where it is possible to acknowledge the SMEs dimension, their sector as well as their IT investment. Then, the results are presented bearing in the mind the tree independent variables defined above: *Knowledge of the Cloud Computing concept*; *The management of Cloud Computing services* and *How are the Portuguese SMEs using Cloud Computing services.*

4.2.1 SMEs' characterization and IT investment

In the table above are presented the results related with the Dimension and Economic CAE of the SMEs of the sample. It is noteworthy to state that two SMEs (1.69%) have answered their employees were more than 250, consequently, their questionnaires have been excluded. This happened since according to the European Union a company to be considered a SME must have less than 250 employees and a turnover equal or inferior to 250 million euros[18].

[18] http://ec.europa.eu/enterprise/policies/sme/facts-figures-analysis/sme-definition/index_en.htm

Therefore, the rest of the questionnaire results are from the 116 SMEs which fulfill the requisites of a SME.

Table 14 – SMEs' Characterization

SMEs' characterization			
Dimension of the SMEs (Question Q1)	%	**SMEs' Economic CAE** (Question Q2)	%
1-9 employees	14.41%	Fishing and aquaculture	5.08%
10-50 employees	**43.22%**	Mining and quarrying	2.54%
50-250 employees	**40.68%**	Manufacturing	10.17%
More than de 250 employees	1.69%	Electricity	0.85%
SMEs' Turnover (Question Q3)	%	Water	0%
Less than 2 million	20.34%	**Construction**	**11.02%**
Between 2 and 10 million euros	**40.68%**	**Trade/Commerce**	**11.02%**
Between 10 to 50 million euros	**38.98%**	Transportation and storage	7.63%
More than 50 million	0%	Hotels and restaurants	2.54%
-		**Information and Communication Technology**	**15.25%**
-		Real estate	6.78%
-		Consultancy activities	9.32%
-		Administrative Activities	2.54%
-		Education	2.54%
-		Human health activities	4.24%
-		Artistic Activities	1.69%
-	-	Other service activities	6.78%
-		Other	0%

The next table presents the results from the questions which main goal is to understand the IT investment being made by the Portuguese SMEs of the sample.

Table 13 – SMEs' investment in ICT

SMEs' Investment in ICT			
SMEs' total budget invested annually in ICT (Question Q4)	%	SMEs nº of employees with functions related with IT (Question Q5)	%
Less than 1%	24.58%	None	23.53%
Between 1% to 5%	**38.14%**	**Between 1-5**	**40.34%**
Between 5% to 15%	25.42%	Between 5-10	18.49%
More than 15%	11.86%	Between 10-20	8.40%
The maintenance of the infrastructure and ICT services of the SMEs (Question Q6)	%	Greater than 20	9.24%
An external organization	9.24%	-	
Employees of their own company	36.13%	-	
Both situations	**43.70%**	-	
The company does not have ICT services	10.92%	-	

When analyzing both tables, it is possible to conclude that the majority of the companies of the sample have between 10 and 250 employees. The companies from the survey are mainly from the IT sector, Trade/Commerce and Construction sectors.

Concerning the turnover, the majority of the SMEs from the sample have annual turnover between 2 million to 250 million euros. Related to the investment in IT, the total budget invested in IT by the Portuguese SMEs is mostly from 1% to 5% and their employees with functions related with IT are from 1 to 5. In addition, when it comes to the responsibility for the maintenance of the IT infrastructures and services, according to our sample the majority of the companies of the survey have their own employees in charge or the SMEs have a mix situation (both their own employees and an external organization).

4.2.2 Knowledge of the Concept of Cloud Computing – 1st Dimension

When it comes to the knowledge of the concept of Cloud Computing, the results from the on-line questionnaire allows to understand and analyze three main domains: i) the awareness and understanding the SMEs have about the Cloud Computing term; ii) the fears and reasons behind the adoption faced by the SMEs that already use this technology services; and finally, iii) the knowledge of the Concept of Cloud Computing. The knowledge these SMEs have regarding Cloud Computing main characteristics, advantages and potential risks.

i) Awareness and understanding of the Cloud Computing Concept

First through the results from the questions 7, 8 and 9 it is analyzed to what extent are the Portuguese SMEs aware of the term Cloud Computing and also what SMEs from our sample affirm they are already using Cloud Computing services. In addition, it is also tested if there are some companies using Cloud Computing without knowing.

Table 16 – Awareness and the understanding of the concept of Cloud Computing

Awareness and understanding of the Cloud Computing Concept			
SMEs that have heard the term Cloud Computing (Question Q7)	**%**	**The IT services used by the Portuguese SMEs** (Question 8)	**%**
Yes	**79.66%**	**Email hosted on the web**	**21.97%**
No	20.34%	**Web-hosting**	**16.25%**
SMEs that affirm they use Cloud Computing services (Question Q9)	**%**	Instant messaging and chat hosted on the web	11.21%
Yes	41.18%	Collaboration tools such as Google Docs or crowdsourcing platforms	5.26%
No	48.74%	Online office tools	6.86%
Do not know	10.08%	**Applications of online storage**	**15.10%**
-	-	Management applications, web-based HR and SAP	3.89%
-	-	CRM applications based on web such as SalesForce	2.29%
-	--	Business Intelligence Applications hosted on the web	1.14%
-	-	ERP - integrated management systems on the web	9.38%
-	-	Tools for creating, testing and implementation of web applications	2.29%
-	-	None of the above	4.35%
-	-	Other	0%

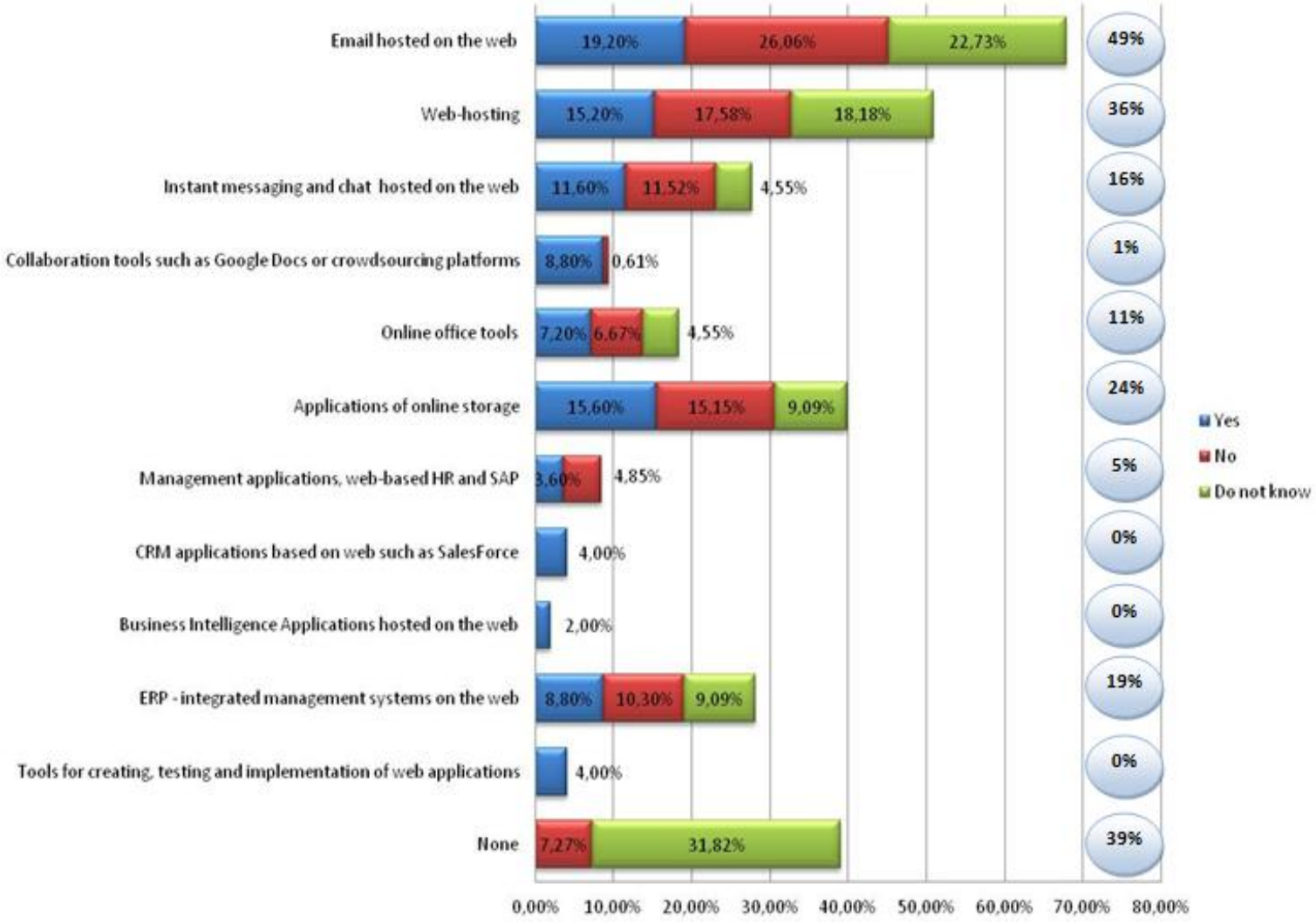
It is important to state that the SMEs which have answered they *do not know* or that *do not use* Cloud Computing services ended the questionnaire, meaning, these companies did not continue the rest of the questionnaire. The main objective of this strategy has been to ensure that, only the companies with a minimum knowledge of what is Cloud Computing answered to the more specific questions about this technology.

Thus, in the rest of the questionnaire only the SMEs which actually know they are using Cloud Computing services answered the other questions. This way, the following answers were from the 49 SMEs that do use Cloud Computing services.

When analyzing the results from the table 16, it is possible to state that almost 80% of the SMEs have heard of the term of Cloud Computing. What could be explained by the hype surrounding Cloud Computing nowadays [Barnatt, 2010]. Nonetheless, only 40% of the SMEs state they use Cloud Computing services. In addition, it is noteworthy and possible to conclude that there are several SMEs using IT Cloud Computing services without realize they are using Cloud Computing technology. In the graph below is a cross between the question 9 (if the SMEs claim to use Cloud Computing) and question 8 (the use of several Cloud Computing services). The circles highlight the percentage of companies that answered they do not know or do not use Cloud Computing services but have affirmed to use some of the several Cloud

Computing applications illustrated below. For example 24% of the SMEs that affirm they are not using Cloud Computing services say they use applications of online storage as Dropbox, which is a Cloud Computing service. The same happen with other Cloud Computing applications described in the graph below. Taking into account the absolute value, 70 SMEs have affirmed they do not use or do not know if they use Cloud Computing services but only 19 SMEs have stated they use none of the applications below, which means around 73% of the SMEs are using Cloud Computing applications without even being aware of it.

Figure 6 – Cross between the use of Cloud Computing services and IT Cloud Computing services



ii) Knowledge of the concept of Cloud Computing

In the table below it is illustrated what characteristics, advantages and potential risks the SMEs from the sample have considered as the most relevant regarding Cloud Computing.

Table 14 – Cloud Computing main characteristics, advantages and potential risks

Knowledge of the Cloud Computing Concept					
CC's Characteristics	**%**	**CC's Advantages**	**%**	**CC's Risks**	**%**
It is a model in which software, processing power, storage capacity, data backups, development tools, and others are provided as a set of services over the Internet	**26.86%**	**Flexible payment model**	**23.49%**	**The need for a fast and robust Internet**	**16.88%**
To benefit from Cloud Computing services the company necessarily requires an internet connection	**13.71%**	**Reduction of IT costs**	**28.92%**	**Possible decrease of security and privacy of sensitive company data**	**20%**
A company and its employees can access the cloud from any device (computer, tablet or mobile)	6.86%	Faster and easier to update software and applications	3.61%	Possibility of non-compliance of some legal requirements.	3.75%
A company can contract cloud services without having to directly contact the service provider of Cloud Computing	4%	Increased reliability of the network company	4.22%	Possibility that there are fails in the availability and / or reliable on the access to enterprise data. Possibility of downtime	13.13%.
Different companies may share the same Cloud	2.29%	There are no compatibility issues of OS	1.20%	Lack of robust SLAs that allow compensation for firms not satisfied with the service provided by the Cloud Computing vendor	9.38%.
A company can increase or decrease the cloud services according to their needs at a precise moment	8%	Can encourage innovation	7.23%	Lack of audit to the firms providing services of Cloud Computing	12.50%
In a model of Cloud Computing the company pays the service to the Cloud Computing provider on what the company actually use/consume. A model known as pay-per-use	9.14%.	**Possibility of employees access the Cloud and work in any device and anywhere they are (as long as they have internet access)**	**8.43%**	Difficulties in the transition between Cloud Computing service providers	6.25%
The models of cloud computing services are the most common: SaaS (Software as a Service), PaaS (Platform as a Service) and IaaS (Infrastructure as a Service)	**16.57%**	Speed of implementation	4.82%	Little control in the services / products sold by the companies of Cloud Computing	2.50%
CC's Deployment models most common are Public, Private, Community and the Hybrid	12.57%	Reducing transport costs	0.60%	**Too much dependence on the Cloud Computing provider that can generate a problem of lock-in. This problem of lock-in is also linked to the difficulty of transition between Cloud providers**	**15.63%**
-		Applications are considered user-friendly	2.41%	None	0%
-		Improving the competitiveness of the SME	6.63%	-	-
-		New generation application will worked in the Cloud	4.22%	-	-
-		Enable companies to be Green.	4.22%	-	-

Taking into account the methodology and model defined, the results of the table above have been compared with the main characteristics, advantages and potential risks defined by the Literature Review and our pool of experts. This way is possible to understand to what extent are the Portuguese SMEs managers having the knowledge of the most important features of this technology.

Concerning the main characteristics, the first characteristic, also the one related with the service models and finally the characteristic related to the pay-per-use model correspond to the most important ones mentioned by the Literature and the experts. Nonetheless, the SMEs mentioned also the need of an internet connection, characteristic which has not been stated as one of the most important according to the experts and the authors of the Literature.

When it comes to the advantages, the answers of the SMEs are mainly focus on the reduction of IT costs and the flexible payment model (both in line with the advantages of the knowledge model created). In addition, they also mentioned as important the possibility the workers have to work anywhere and from any device. When we compare to the main advantages from the model created (advantages from the literature and the experts) is possible to conclude that the Portuguese SMEs still do not understand the full potential of Cloud Computing services, for example to foster innovation. The SMEs are still much focus on the reduction of costs.

In relation to the potential risks there is a match between the SMEs opinion and the opinion from the literature and the experts in two risks: the security and privacy of sensitive company data and the vendor lock-in. However, the SMEs state also that one potential risk is the need of a fast and robust internet connection, a drawbacks that has not been mentioned as principal in our model. Once again the issue of the internet connection is mentioned as critical for the SMEs (it was also a main characteristic mentioned in the questionnaire), so one could conclude that the direct relationship of Cloud Computing and the necessary use of the internet, is a situation still sensitive for the majority of the Portuguese SMEs.

iii) Reasons and Fears behind the adoption of Cloud Computing

From the questions 13 and 14, the main objective is to understand what kind of doubts and worries these SMEs had when they were thinking in adopting Cloud Computing services. Moreover, it is also analyzed the main reasons and motivations behind the move to Cloud Computing.

Table 15 – Reasons and Fears of the adoption of cloud computing services

Reasons and Fears of the Adoption of Cloud Computing			
Reasons for the adoption of CC (Question Q13)	%	Fears of the adoption of CC (Question Q14)	%
Expected cost savings	31.86%.	High costs	0.82%
Expected to improve the expected rate of return on investment (ROI)	7.08%.	Security Issues	20.49%
Support improvements to business processes	16.81%.	"Lock-in" information in a single service provider	25.41%
Use of business models appealing to the customer	12.39%	Lack of control over resources	8.20%.
Facilitate the implementation and delivery of new services	15.93%.	Inability to audit and assess performance measures	9.02%.
Flexible sharing of resources	15.93%.	Interoperability between service providers	9.84%
None of the above	0%	Dependence of the company / institution in a outsider service provider	19.67%.
-	-	Legal constraints	6.56%.

When analysing the table is possible to understand that the main reason for the adoption of Cloud Computing is still very correlated with the decrease of costs and costs savings. Cots saving has been by far the most mentioned reason, with almost the double of the percentage of the second reason. The reason of expected cost savings is in line with the main advantage stated by the SMEs. On the other hand the fears are also close connected to the main riks the SMEs have pointed out, namely, the problem with the security and the lock-in of the information.

4.2.3 The Management of Cloud Computing services– 2nd Dimension

Alongside with a good understanding of the concept of Cloud Computing that has been tested by the questions above, this dissertation aims to analyze how are the Portuguese SMEs managing Cloud Computing in two other dimensions. On one hand, this works strives to study what procedures the SMEs are following to overcome and to reduce some of the potential risks of this technology. On the other hand, this dissertation aims to verify to what extent are the managers aware and using SLAs and KPIs when dealing and contracting Cloud Computing vendors.

Procedures to reduce potential risks

The table below illustrates then the results from the right procedures to reduce some of the potential risks of using this kind of services and applications.

Table 19– Procedures to reduce potential risks

The Management of Cloud Computing Services (I)	
Procedures to control or reduce some of the Potential Risks (Question Q15)	**%**
The company updates its SLA with its ISP and develop an appropriate business continuity plan to ensure continued access to the infrastructure network and Internet access	10.53%
The company sets a policy of using Cloud Computing specific to the company in order to ensure a more secure access to Cloud (eg related to user names and passwords needed to enter the enterprise applications or for example through a constantly updated antivirus and firewall)	**23.16%.**
The company shall establish an appropriate and enforceable (legal and logistically) SLAs and other contracts with the provider of Cloud Computing, which must include corrective measures and penalties related to non-fulfilment of minimum services established in the agreements. These contracts and SLAs should be inspected by a team of IT professionals and legal scholars	**17.89%.**
The company has a process for selecting providers of cloud computing rigorous, using a careful selection and approval process. If possible, the company should select a provider that uses cloud computing standards generally established to ensure an easier transition to another vendor at its discretion	10.53%
Contracts for Cloud Computing that can somehow cross borders should be examined by legal counsel with expertise in international law	6.32%
The company must ensure that the supplier of cloud computing services is audited by third parties	5.26%.
None of the above	**26.32%.**
Other	0%

From the table above it is clear that the majority of the SMEs do not use any of the above procedures to overcome or reduce potential risks. Some of the SMEs have an internal policy specific designed to the use of Cloud Computing.

The use of SLAs and KPIs by Portuguese SMEs

As already mentioned, another dimension to verify how the managers of the SMEs are managing Cloud Computing has been the use of SLAs and KPIs. The table above contains the information and the results about this dimension.

Table 20 – the use of SLAs and KPIs by Portuguese SMEs

The Management of Cloud Computing Services (II)			
The use of SLAs by the SMEs (Question Q24)	**%**	**The use of KPIs by SMEs** (Question Q26)	**%**
Yes	32.65%	Yes	20%
No	**55.10%**	**No**	**80%**
Do not know	12.24%	-	-
The information present on the SLAs (Question Q24)	**%**	**The KPIs used by the SMEs** (Question Q26)	**%**
Your company knows who has control over the organization's data	**18.03%.**	Performance indicators to measure and monitor the possible length of downtime and disruption of the cloud services	30%
The company is aware if any other company can have access to your data or if the company has contracted service provider that can outsource to third parties the security of your data	8.20%.	Performance Indicators to assess the speed and flexibility with which the supplier of the Cloud Computing service allocates resources if there is an overload or if there is a fault in a server	30%
Specified in the contract what happens to back up of your data if the supplier of the services or your company closes	6.56%	**Indicators of QoS (Quality of Services) in order to compare internal data provided by Cloud Computing provider**	**40%**
Your company is aware of the security of the Cloud Computing provider and knows how this security is audited	3.28%	-	
If the company knows how to report service problems and in case of prolonged inactivity of the service if there is alternative ways to access data / enterprise applications	13.11%	-	
The company knows the downtime and interruptions and how these are measured	**21.31%**	-	
The company is aware of the delay time to restart or switch to a virtual server fails	14.75%.	-	
The company is aware of the key metrics QoS (Quality of Service) used by the supplier of the service of Cloud Computing	14.75%	-	

Taking into account the information and the results of table, it is possible to state that only 32% of the Portuguese SMEs are using SLAs when contracting Cloud Computing services and only 20% of the SMEs claim to have KPIs for measuring their Cloud Computing vendors. Nevertheless, it is important to mention that, although there are few SMEs using SLAs, the information present in their SLAs with a higher percentage is the downtime and interruption times, and how are they measured. According to Mark Williams [Williams, 2010] this is the most important information that should be present in an SLA or another type of contract between the company and the Cloud Computing provider. Concerning the KPIs the most used is the QoS, also very important in order to "confront" the Cloud Computing vendor with the data it has provided [Williams, 2010].

4.2.3 How Portuguese SMEs are using Cloud Computing services – 3rd Dimension

After analyzing which SMEs are using Cloud Computing and how are these SMEs managing and prepare to deal with this technology, this work strives to understand and study how are the Portuguese SMEs using Cloud Computing. Concerning this dimension this dissertation focus mainly on what kind of Service and Deployment models the SMEs are benefiting from and in which areas of their value chain is Cloud Computing being explored.

The Service and Deployment Models used by the Portuguese SMEs

In the graphs below is possible to understand the most used Service Models and Deployment models currently used by the Portuguese SMEs.

Figure 8 – Service Models used by SMEs

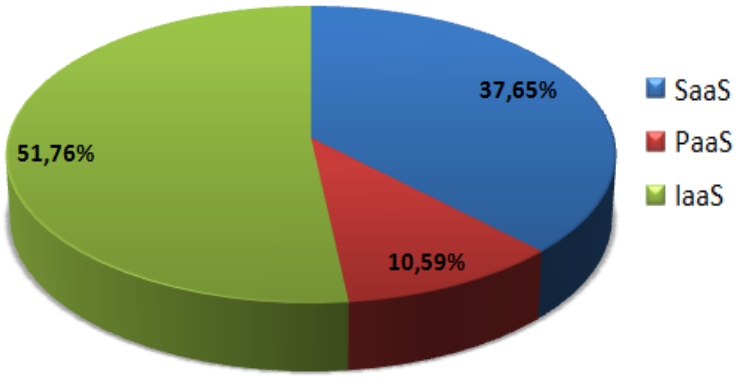
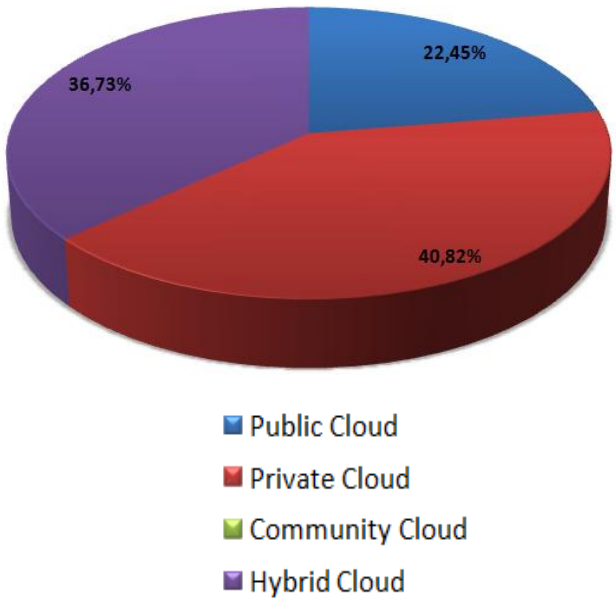


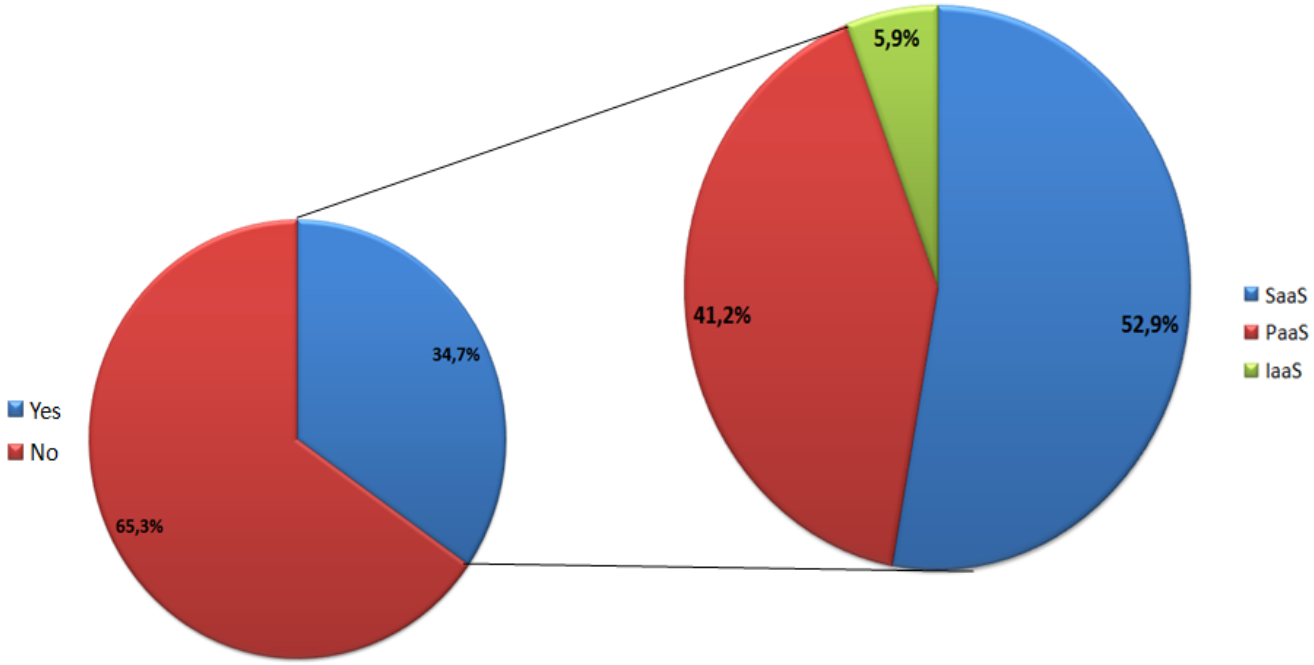
Figure 7 – Deployment Models used by SMEs



Regarding the Service Models the results are in the line with the general believe of the experts, is the IaaS service model which is currently more used, followed by the SaaS. The same happens with the Deployment models, being the most used models the Private and the Hybrid ones as previously believed by our pool of experts. According to the expert Jorge Sousa, this fact can be explained by the mistrust and suspicion that still surround Cloud Computing.

This work aims also to study what, in the future, are the expected tendencies regarding the use of Service and Deployment models by the Portuguese SMEs. The graphs below are the results of those findings:

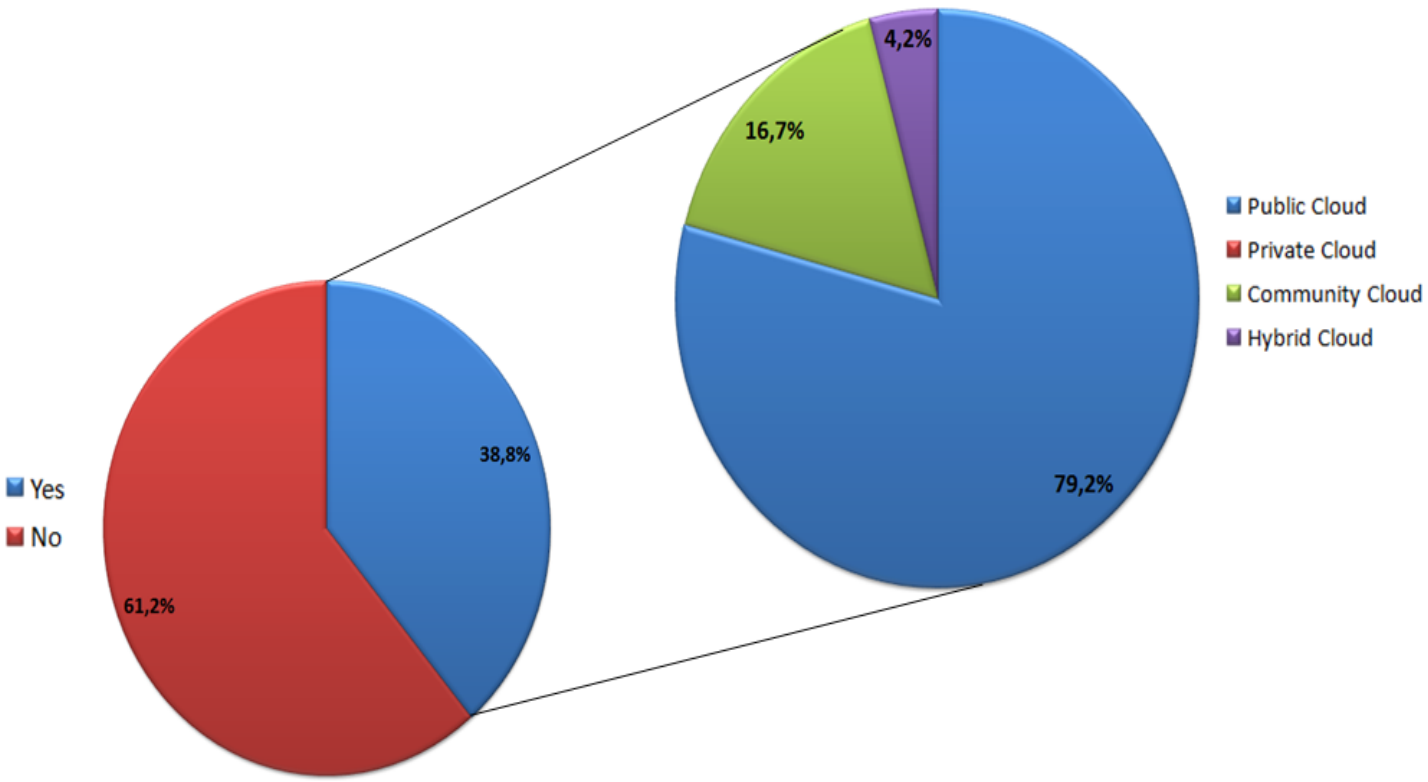
Figure 9 – The use of different Service Model in the future by the Portuguese SMEs



From the graphs above one can conclude that just 34.7% of the Portuguese SMEs think in the future to use and explore another Service Model. Nonetheless, from those 34.7% the most relevant Service Model to explore in the future is the SaaS and PaaS models. These results confirm the expectation of the expert Carlos Lourenço, who believes that PaaS will be definitely a bet for the future of the Portuguese SMEs. The increase in the SaaS model, could be explained by the incredible increase of SaaS applications in the last years [Barnatt, 2010]. According to Christopher Barnatt [Barnatt, 2010] in the future the majority of the software applications will be delivery though the internet as a Cloud Computing model.

The Graph below illustrates the results concerning the Deployment models:

Figure 10 - The use of different Deployment Models in the future by the Portuguese SMEs



Once again, the majority of the Portuguese SMEs do not expect to change for another Deployment model, only 38.8% of the Portuguese expect to try another Deployment model. This tendency to increase the use of the Public and the Hybrid model is in line with the opinion of our experts but also of some authors from the Literature [Barnatt, 2010; Sosisnsky, 2010; Rhoton, 2011], who believe that with the increasing knowledge of this technology, issues as safe and privacy will lose some importance.

The use of Cloud Computing in the SMEs' value chain

Another objective of this work is to understand in which areas of the SMEs' value chain is Cloud Computing being explored. In addition, it is also tested if in the near future there are any significant changes to the areas currently using Cloud Computing services.

The table below shows the responses of the SMEs to the questions 20 and 21, where there were listed several applications characteristics for the several areas of the Porter Value chain [Porter, 1998]

Table 16 – Characteristics of the Cloud Computing services used by the Portuguese SMEs

Characteristics of the Cloud Computing services used by the SMEs			
Currently (Question Q20)	**%**	**Expected to be used in the Future** (Question Q21)	**%**
Tools for on-demand budgeting, forecasting and reporting solutions. All components of planning, financial statements, consolidating metrics and automated tools	**12.16%**	Tools for on-demand budgeting, forecasting and reporting solutions. All components of planning, financial statements, consolidating metrics and automated tools	2,27%
Web-based applications to document consistent implement standard operating procedures	10.14%	**Web-based applications to document consistent implement standard operating procedures**	**13.64%**
Applications that facilitate the allocation of tasks among several employees. Tools to collect data on the number of hours that employees work, they are working and how they work: via web, phone and / or mobile devices	4.05%	Applications that facilitate the allocation of tasks among several employees. Tools to collect data on the number of hours that employees work, they are working and how they work: via web, phone and / or mobile devices	6.82%
Applications for payment of wages Web-based, time calculations of workers allocated to each project and attendance of employees	1.35%	Applications for payment of wages Web-based, time calculations of workers allocated to each project and attendance of employees	9.09%
Management Tools for product innovation. Applications of R & D crowdsourcing and other collaboration applications and participation in the creation of new products / services	8.11%	**Management Tools for product innovation. Applications of R & D crowdsourcing and other collaboration applications and participation in the creation of new products / services**	**15.91%**
Applications to facilitate the purchase of raw materials and tools for implementing the concepts of consumer-controlled logistics. Tools to predict the optimal amounts required to be ordered. Applications of POC (Purchase Order Control)	1.35%	Applications to facilitate the purchase of raw materials and tools for implementing the concepts of consumer-controlled logistics. Tools to predict the optimal amounts required to be ordered. Applications of POC (Purchase Order Control)	4.55%
Solutions for order management, stock management and inventory, synchronization of demand / supply, logistics processes. Applications to reduce the cost of direct materials, enhance quality and security of supply, reduce cycle time, improve operational efficiency and increase flexibility	0.68%	Solutions for order management, stock management and inventory, synchronization of demand / supply, logistics processes. Applications to reduce the cost of direct materials, enhance quality and security of supply, reduce cycle time, improve operational efficiency and increase flexibility	4.55%
Software systems to measure performance of the production system. Tools for better access to operational data, allowing managers to make better decisions and continuously improve production processes	0.68%	Software systems to measure performance of the production system. Tools for better access to operational data, allowing managers to make better decisions and continuously improve production processes	4.55%
Sophisticated applications of route optimization, through better monitoring in real time and better planning of routes. Applications to improve the planning process of replenishment, order processing, construction, load transportation and fleet management. Tools for collaboration between stakeholders in the logistics process	0.68%	Sophisticated applications of route optimization, through better monitoring in real time and better planning of routes. Applications to improve the planning process of replenishment, order processing, construction, load transportation and fleet management. Tools for collaboration between stakeholders in the logistics process	2.27%
Application for management of sales data and processes online. Tools for processing of data about customers and their records - available on any device. Marketing applications for organizing and managing events, campaigns of new products / services	10.14%	**Application for management of sales data and processes online. Tools for processing of data about customers and their records - available on any device. Marketing applications for organizing and managing events, campaigns of new products / services**	**18.18%**
Tools for collaboration between teams of sales and marketing teams	7.43%	Tools for collaboration between teams of sales and marketing teams	6.825
Applications to storage the backups of the companies	**25.68%**	Applications to storage the backups of the companies	0%
Applications to storage support data of the company	**12.16%**	Applications to storage support data of the company	0%
Applications to improve customer support. Tools and applications for call centre, support the delivery and replacement of products, claims administration and customer support tools	5.41%	Applications to improve customer support. Tools and applications for call centre, support the delivery and replacement of products, claims administration and customer support tools	11.36%

It is important to mention that it was asked if in the future these SMEs were thinking of using services and applications with different characteristics and objectives from the ones they are currently using. 40.4% of the SMEs said they will, and this way, the results can be found in the right column of the table above. As each line of the table above correspond to a service characteristics, which is then linked to a specific area of the value chain, is possible to understand in which areas of the value chain are the Portuguese SMEs using currently and in the future Cloud Computing applications. Based on that information the following graphs are presented:

Figure 11 – The use of Cloud Computing services in the SMEs' value chain currently

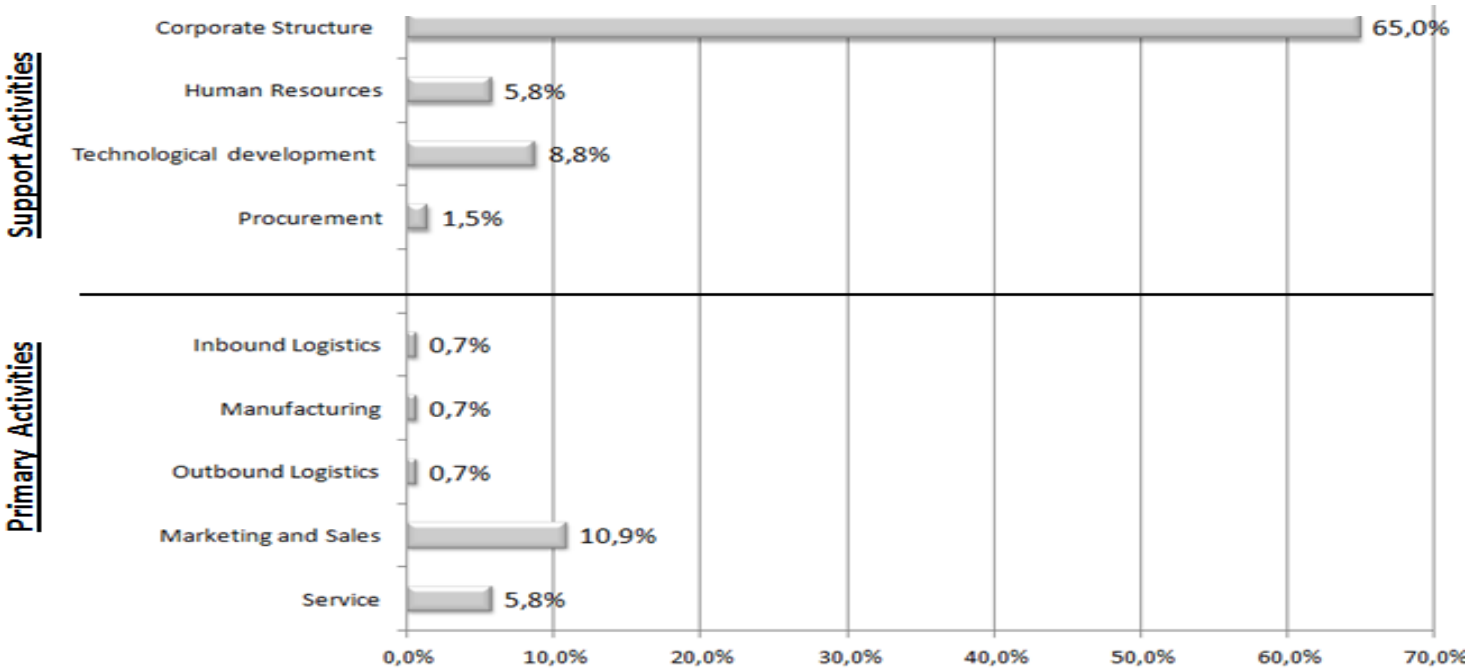
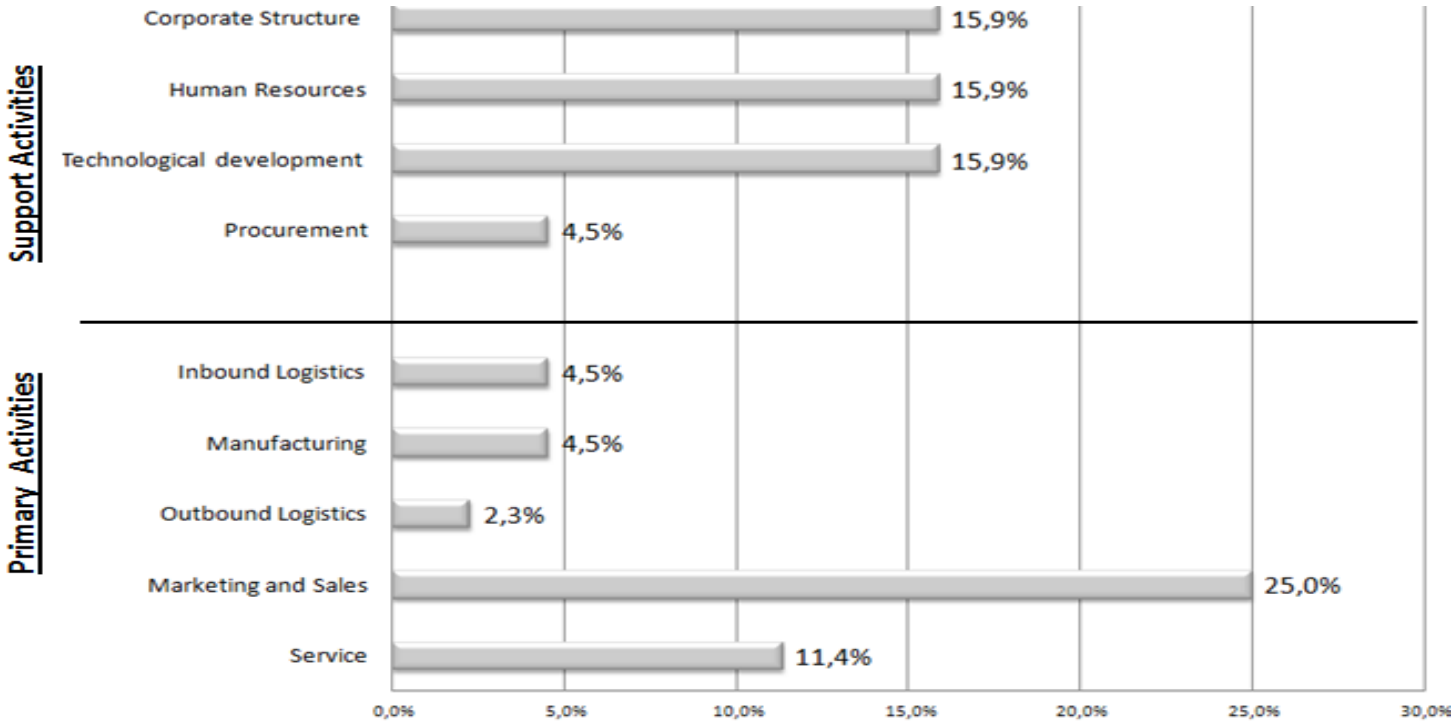


Figure 12 – The use of Cloud Computing services in the SMEs' value chain in the future



It is possible to conclude by the graphs above that Cloud Computing services are being used by Portuguese SMEs still in more support activities rather than primary activities. Nevertheless, and by the results from the on-line questionnaire is expected that this situation in the future will start to change, becoming a more balanced situation.

Finally, and to conclude the analysis and discussion of the results, this work also aims to verify if the Portuguese SMEs are using more end-to-end applications or in contraire are using more specific applications, for different areas and objectives. Taking into account the results from the on-line survey, around 70% of the SMEs are using specific application rather than an integrative, end-to-end application.

4.3 Influence of the SMEs characteristics control variables

As mentioned before, the SMEs characteristics control variables chosen have been the SMEs' Dimension, its Economic CAE, its turnover and the investment in IT. The dimensions that have been chonsen to test are:

- The utilization of Cloud Computing Services
- Reasons and fears behind the adoption of Cloud Computing services
- Service and Deployment Models used by the SMEs
- The utilization of SLAs

Crosstab 1 – Dimension of the SMEs

In order to understand if there is some association which could be consider as statistically significant between the Dimension of the SMEs and the Variables above defined, it has been used the chi-square test. This has been the test chosen since it allows to test "the influence or impact that a subject's value on one variable has on the same subject's value for a second variable" [Mehta and Patel, 1996]. According to the p Values and to the analysis made which can be found in the appendix 7, the only association related to the Dimension of the SMEs which can be considered as statistically significant is the association between the Dimension of the SMEs and the *fears behind the adoption of Cloud Computing services*.

When analyzing the crosstab graph between *the Dimension of the SMEs* and the *Fears the SMEs had before adopting Cloud Computing* services, one may conclude that the security issue is much more present on the companies with lower dimensions, whereas with larger companies the main concern was related with the potential lock-in of the vendor.

Although not considered as statistically significant in the appendix 7, it is possible to see the crosstabs between the other variables and the Dimension of the SMEs. For example it possible to verify that from our sample the SMEs with *10 – 50 employees* use more Community Cloud than the Private (which has been considered as the most used Deployment model in the sample), or that from the sample there is not a single company with *1 – 9 employees* which use SLAs.

To sum up, one may conclude that the Dimension of the SMEs do not has direct association with the utilization of Cloud Computing, with the reasons behind the adoption, nor with the Service and Deployment Models used or the utilization of SLAs.

Crosstab 2 – Economic Sector of the SMEs

Once again, and with the objective of understanding if there is some association which could be consider as statistically significant between the Economic CAE of the SMEs and the Variables defined, it has been applied the chi-square. According to the results of the chi-square, which can be seen in the appendix 8, the only association that can be considered as statistically significant is the association between the economic CAE of the SMEs and the utilization of Cloud Computing services. It can be seen by the graph 8 in the appendix 8 that the economic CAE has some direct influence on the utilization or not of Cloud Computing services. For example, all the ICT SMEs use Cloud Computing whereas SMEs from for instance from mining or fishing there is not a single company that uses this technology.

Even though the other variables, trough the chi-square test, have not been considered as statistically significant, trough the basic crosstabs we can drawn some conclusions about the SMEs of our sample. For example when looking to the graph 11 in the appendix 8 is possible to verify that the PaaS service model is only used by the companies of the ICT (Information and Communication technology) economic sector or that the SMEs from this CAE are the only ones which have more companies using SLAs then SMEs not using.

Crosstab 3 – Turnover of the SMEs

After applying the chi-square test no association between the turnover of the SMEs and the other dimensions could be consider as statistically significant, the results of the p Values can be found in the appendix 9. Consequently, one can conclude there is no direct influence of the SMEs turnover on the utilization of Cloud Computing services, or their reasons and fears behind the adoption of this technology. Additionally, it is also possible to state that cannot be

proofed a relation between a SMEs' turnover and the Service and Deployment models used by these companies nor the utilization of SLAs.

Crosstab 4 - Annual percentage invested in ICT (Information Communication and Techonology)

Finally, the last crosstab strives to understand if there is any statistically significant association between the annual percentage invested in ICT and the other dimensions. According to the chi-square test there is a statistically significant association between the annual percentages invested in ICT in two dimensions: the utilization of Cloud Computing services and the utilization of SLAs.

From the graph 14 in the appendix 10 is possible to conclude that the more is the annual investment in ICT the more is the utilization of Cloud Computing services by the Portuguese SMEs. A similar conclusion can be taken regarding the use of SLAs, meaning, the higher the investment in ICT the more is the utilization of the Service Level Agreements.

Although according to the chi-square the other variables do not have an association statistically significant regarding the annual percentage invested in ICT, some facts can be point out concerning our sample of SMEs. For example only the SMEs with a percentage of investment in ICT superior to 5% use PaaS as a Service model. Another interesting fact of the sample is that when the percentages of investment in ICT increase, the reasons for the adoption of Cloud Computing begin to change, for example the reason *Expected Cost Savings* starts to lose importance.

4.4 – Chapter Conclusion

In this chapter the results from the on-line questionnaire have been analyzed and discussed in light of the knowledge model created, taking into account the knowledge from the literature and the experts' insights and experience. The discussion of the results of this chapter permitted taking important and relevant data which allowed coming to the main conclusions of this work.

The next chapter presents those main conclusions and the answer to the Research Question of this work, as well as future suggestion future work around the topic of Cloud Computing. In addition, some limitations of this dissertation are also put forward.

V. CONCLUSION

5.1 Main Conclusions – Hypothesis and Research Questions

After the analysis and discussion of the results of the on-line questionnaire, the main conclusions are presented. Trough these main conclusions the hypothesis are tested in order to answer to the Research Questions of this work.

Concerning the characteristics of Cloud Computing and taking into account the main ones defined in our model by the literature and by the experts, the managers of the Portuguese SMEs are aware that Cloud Computing is a *model in which software, processing power, storage capacity, data backups, development tools, and other services are provided as a set of services over the Internet* (table 17, section 4.2.2) and they are also aware of its *Service Models* (table 17, section 4.2.2). Nonetheless, these managers in relation to cloud Computing main characteristics tend to focus much on the need of *an internet connection* (table 17, section 4.2.2), rather than on the *pay-per-use model* or on the *Deployment models*, the other main characteristics defined by the literature and the experts (table 2, section 3.3.1).

When it comes to the main advantages of Cloud Computing, the managers of the Portuguese SMEs are completely aware of the main advantages defined in the model (table 4, section 3.3.1): *Reduction of IT costs* and *Flexible payment model* (table 17, section 4.2.2). However, the managers of the Portuguese SMEs are not so aware of the potentialities of Cloud Computing (table 17, section 4.2.2) regarding the ability to *fosters innovation* and its *speed of implementation*, consider also as main advantages in our model (table 4, section 3.3.1). The managers of the SMEs prefer to highlight the possibility to *access the cloud anywhere* and from *any device* (table 17, section 4.2.2).

In relation to the potential risks of Cloud Computing, the managers of the SMEs point out as main drawbacks the *security and privacy issue* and the *vendor lock-in* (table 17, section 4.2.2), which are in line with some of the potential risks defined as principal in our model (table 6, section 3.3.1). However, potential risks as the *difficult of migration between Cloud Computing vendors* and the important *absence of SLAs* are not seen as main issues to the SMEs managers (table 17, section 4.2.2), conversely to the literature and the experts, which consider them as very important risks to take into account (table 6, section 3.3.1). The managers of the Portuguese SMEs prefer to draw attention to the *need of a fast and robust internet connection* (table 17, section 4.2.2).

The analysis of these results is directly related with the first Research Hypothesis. Consequently, the hypothesis ***H1 - Portuguese SMEs managers are aware of Cloud Computing main characteristics, advantages and drawbacks*** can be validated. Although the Portuguese SMEs still lack some knowledge of the most important characteristics, advantages and risks, these companies know the majority of the principal features of this technology. The validation of this hypothesis is directly related to the first Research Question:

1. **Are the managers of the Portuguese SMEs aware of CC main characteristics, advantages and potential risks?**

This way one may conclude that the **managers of the SMEs are aware of the majority of the most important characteristics, advantages and potential risks of Cloud Computing**.

Regarding the use of proper SLAs only around 33% of the Portuguese SMEs affirm they use *SLAs*, being the most relevant information present in those contracts the *downtimes and interruptions of the Cloud Computing vendor* (table 20, section 4.2.3). Concerning the *KPIs*, only 20% state their companies have them, being the most common the *indicators of QoS* (table 20, section 4.2.3). This way, the hypothesis ***H2.a – Portuguese SMEs managers have proper SLAs and some KPI concerning Cloud Computing services*** cannot be proven as truth by the results of our survey. From the results of the survey made to the Portuguese SMEs is possible to conclude that the majority of the Portuguese SMEs managers still do not use SLAs and KPIs. From the sample 67% of the mangers of the SMEs do not use SLAs and 80% do not use KPIs.

In addition, from the Portuguese SMEs from the sample, around 27% declared they do not use any of the procedures to overcome or reduce the potential risks (table 19, section 4.2.3). Moreover, from those companies that use one or more of those procedures, the most relevant one has been the specific *Cloud Computing policy for their own companies* so they could guarantee a better and safer access to the cloud (table 20, section 4.2.3). Only 17.89% of the companies have what is considered by authors as Mark Williams [Williams, 2010] the most important procedure to reduce potential risks: an established appropriate and enforceable SLAs or other contract (table 20, section 4.2.3). Therefore the hypothesis ***H2.b –The Portuguese SMEs managers are aware and use some of the procedures to overcome some potential risks of Cloud Computing*** cannot be proven as truth by the results of the survey made. One may conclude by the results of the on-line questionnaire that the managers of the

Portuguese SMEs are still not using all the risk management practices regarding Cloud Computing which are available to them.

Taking into the analysis of the two hypothesis mentioned above, it is possible to conclude that the hypothesis ***H2. Portuguese SMEs managers are prepared to manage Cloud Computing services*** according to the model defined (section 3.3.2), also cannot be validated**.** Besides, a good knowledge of the concept of Cloud Computing is also important the use of SLAs, KPIs and the use of some of the procedures to overcome potential risks.

These tree hypotheses (H2, H2.a and H2.b) are linked to the following Research Question:

2. **How are the managers of the Portuguese SMEs managing Cloud Computing?**

Consequently, one can conclude that although the managers of the Portuguese have a fairly good knowledge of Cloud Computing main characteristics, advantages and potential risks, **these managers are still not mature and prepare to manage Cloud Computing when it comes to the utilization of SLAs, KPIs or the use of some procedures to overcome potential risks**.

In relation to the way the Portuguese SMEs are using Cloud Computing technology, the Service Model most used currently is the *IaaS* (51.76%), followed by the *SaaS* with 37.65% (Figure 7, section 4.2.3). Concerning the deployment model and taking into account the results of the questionnaire, the most used solution is the Private one with 40.82%, followed by the *hybrid* 36.73% (Figure 8, section 4.2.3). This way the hypothesis **H3 - *Currently, the service model more used by the Portuguese SMEs in their value chains is the IaaS and the deployment model used most is the private*** can be validated.

Concerning, the future use of Service and Deployment models, most of the companies do not expect or think to use a different cloud solution in the future. In relation to the Service Models used, 65.3% of the SMEs do not think in adopting other solutions in the near future (Figure 9, section 4.2.3). Nonetheless, from those companies that expect to embrace another Service model the most relevant is the SaaS with 52.9% (Figure 9, section 4.2.3). In relation to the Deployment models 61.2% of the SMEs do not expect to adopt other solution in the near future (Figure 10, section 4.2.3). But from those which expect the Public Cloud is the one more appealing with 79.2% (Figure 10, section 4.2.3). Consequently, the hypothesis ***H3.a – In the future, the majority of the SMEs will continue to use the same service Model and Deployment model they are currently using*** can be validated.

Regarding the use of Cloud Computing in the SMEs' value chain, currently the Portuguese SMEs are using Cloud Computing mainly in their support activities (Figure 11, section 4.2.3). Nevertheless, in the near future it is expected that the Portuguese SMEs start to use Cloud Computing applications more frequently in their primary activities (Figure 12, section 4.2.3). The first part of the hypothesis ***H3.b –The Portuguese SMEs do not use and their managers are also not thinking of using, in the near future, Cloud Computing services in their value chain Primary activities*** can be validated**.** Nevertheless, the second part of the hypothesis is not validated since it is expected an increase in the importance of the use of this technology in the SMEs primary activities.

Finally, according to the analysis of the results it is verified that around 70% of the Portuguese SMEs use single and specific application rather than end-to-end applications. This way, the hypothesis ***H3.c – The Portuguese SMEs use more single and specific applications rather than integrative/end-to-end applications*** can be validated.

As already mentioned in the section 3.4 these four hypotheses (H3, H3.a, H3.b and H3.c) are directed linked to the final Research Question:

3. **How are the Portuguese SMEs using Cloud Computing services regarding Service Models, Deployment Models and its application on their value chain?**

Bearing in mind the results of the hypotheses above analyzed (H3, H3.a, H3.b and H3.c) several conclusions can be drawn. One may conclude that the **Portuguese SMEs use more the IaaS Service Model** and **the majority do not think of use another model in the future**; the **most used Deployment model is the Private** and that the **majority do not think of use another solution in the future**; **few Portuguese SMEs use Cloud Computing in their Primary activities currently** but in **the future it is expected an increase in the usage of this technology in the primary activities**; and finally that the **Portuguese SMEs use specific applications of Cloud Computing** rather than end-to-end applications.

This way, one could conclude it is still a long way to go regarding the utilization of this technology by the Portuguese SMEs. Taking into account the increasing importance of Cloud Computing [Rhoton, 2011] It is crucial that in the next years, occur not only an increase in the usage of Cloud Computing services by the Portuguese SMEs but also that these companies become more aware of its potentialities and know how to take the best of this technology

since according to this dissertation several SMEs are not still aware of all the benefits of this technology.

5.2 Dissertation limitations

The main limitation of this work is related to the difficult of having different perspectives within each organization. This means that as the large majority of the questionnaires were sent via email, the questionnaire has been answered by a single manager of the company, rather than having different inputs and points of view of the other managers of a company.

5.3 Future Research

As highlighted by this work and the several studies mentioned in the Literature Review, Cloud Computing is without a shred of doubt, one of the next big technological trends for the following years. Therefore, there is room for several other studies and researches on this paradigm. Future studies could focus also on the relation between the Portuguese SMEs and the utilization of Cloud Computing but this time focusing in specific economic sectors. Moreover and bearing in mind one of the limitations of this work it would create important value added if future works focus their Research Model on the feedback and points of views of more than one manager of a company. This way, it would be possible to have different perspectives of the paradigm of Cloud Computing within each company.

Furthermore, it would be interesting to repeat this study and the questionnaire to evaluate the evolution of the data and the results. Finally and taking into account the results from this work, future studies could be also interesting focusing on ways to increase the use of Cloud Computing services by SMEs.

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Appendix 1: SaaS main providers and applications

SaaS Types	SaaS Applications	Main Characteristics
SaaS E-Mail	Gmail	Gmail is a free, advertising-supported email service provided by the well known company Google [Barnatt, 2010]. The messages never leave the cloud. The e-email software used to write and read the message is also never installed on either user's PC [Barnatt, 2010]. Gmail integrates other type of SaaS applications as Google Wave, Google Buzz and Gmail chat [Rhoton, 2011].
	YAHOO! MAIL	Yahoo! Mail is a free e-mail service offered by the American search engine company Yahoo! [Barnatt, 2010]. In early 2008, Yahoo! started offering unlimited mail storage to its users, in response to the increase in competition in the free-web mail market segment. The messages never leave the cloud. The e-email software used to write and read the message is also never installed on either user's PC [Barnatt, 2010].
	Windows Live Hotmail	Hotmail (also known as Microsoft Hotmail and Windows Live Hotmail), is a free web-based email service operated by Microsoft as part of Windows Live. The messages never leave the cloud. The e-email software used to write and read the message is also never installed on either user's PC [Barnatt, 2010]. Hotmail features unlimited storage and integration with Microsoft's instant messaging (Messenger), calendar (Hotmail Calendar), file hosting service (SkyDrive) and contacts platform. According to comScore (August 2010) Windows Live Hotmail is the world's largest web-based email service with 364 million members, followed by Gmail and Yahoo! Mail.

SaaS Types	SaaS Applications	Main Characteristics
Office SaaS	Google Docs	Google Docs is the world's most popular online office applications and is from the Google [Barnatt, 2010]. The suite consists of a word processor, spreadsheet and power point applications (similar to Microsoft office but without so may functionalities) [Sosinsky, 2011]. Google Docs is a very collaborative tool [Carr, 2009].
	Google Apps	Google Apps is a service from Google providing independently customizable versions of several Google products. It features several Web applications with similar functionality to traditional office suites, including Gmail, Google Groups, Google Calendar, Google Talk, Google Docs and Google Sites. [Sosinsky, 2011].
	ZOHO Work. Online	The economist has described Zoho as "the most comprehensive suite of web-based programs for small business" [Barnatt, 2010].The Zoho Office Suite is a Web-based online office suite containing word processing, spreadsheets, presentations, databases, wikis, customer relationship management (CRM), project management, invoicing and other applications developed by ZOHO Corporation [Carr, 2009].
	ACROBAT.COM	It includes the original service – Acrobat.com – as well as Adobe CreatePDF, Adobe ExportPDF, Adobe EchoSign, Adobe FormsCentral, and Adobe SendNow. Users access each of the services through their web browser [Barnatt, 2010].
	Office Web Apps	Microsoft Office Web Apps is a web-based version of the Microsoft Office productivity suite. It includes the web-based versions of Microsoft Word, Microsoft Excel, Microsoft PowerPoint, and Microsoft OneNote. The web applications allow users to access their documents directly from the cloud as well as share files and collaborate with other users online [Rhoton, 2011].
	slideRocket	SlideRocket is a SaaS that offers an on-line presentation package. SlideRocket can include full-motion video and integrate live data from for example Google Docs [Barnatt, 2010].

SaaS Types	SaaS Applications	Main Characteristics
SaaS Photo and Video	Photoshop Express	Adobe Photoshop Express is a Flash-based image editing web application from Adobe used to directly edit photos on blogs and social networking sites, so that users do not have to download or upload images [Barnatt, 2010].
	pixlr	Pixlr is considered my many as the favorite online image editor. An image could be created from scratch, opened from a local drive or uploaded from anywhere through the cloud [Barnatt, 2010].
	FotoFlexer	FotoFlexer is an online digital photo editing service. It attempts to bring professional grade photo editing suites online for those without access to professionals or expensive software such as Photoshop [Barnatt, 2010].

SaaS Types	SaaS Applications	Main Characteristics
SaaS Desktops	Startforce	StartForce provides a windows-like desktop loaded with a word processor, spreadsheet, presentation packages and other applications [Barnatt, 2010]. It is possible to try the software for free, without registration [Barnatt, 2010].
	eyeos	EyeOS is an open source web desktop which acts as a platform for web applications written using the eyeOS Toolkit. It includes a Desktop environment with 67 applications and system utilities [Barnatt, 2010].
	farm	The IT Farm is a paid service which is almost like running a cloud-based copy of the Windows. IT Farm is a paid service. [Barnatt, 2010].

SaaS Types	SaaS Applications	Main Characteristics
SaaS Business Applications	Zoho Creator	Already nearly 400.00 people have adopted Zoho Creator which allows custom database applications to be built online. [Carr, 2009]. Zoho creator has a free plan that allows one or two users to create up to three databases, after that it a paid service [Barnatt, 2010].
	Salesforce	The Salesforce CRM-powered customer portal provides customers the ability to track their own cases 24 hours a day, includes a social networking plug-in that enables the user to join the conversation about their company on social networking websites, provides analytical tools and other services including email services, chatting tools, Google search, and access to customers' entitlement and contracts [Rhoton, 2011].
	ADP Employease	Employease provides Human Resource information systems that allows companies to run applications to help companies with the payroll and other administrative issues, this system provides an online service solution for both managers and employees [Barnatt, 2010].
	clarizen Projects Made Real	Clarizen is a web based (SaaS) collaborative work and project management solution. Clarizen combines work management and team collaboration with real-time business execution in a cloud-based application [Barnatt, 2010].
	NETSUITE	NetSuite's cloud business management system including ERP / accounting, order management / inventory, CRM, professional services automation (PSA), and Ecommerce [Rhoton, 2011]. Netsuite already has customers across a wide range of industries [Rhoton, 2011].
	webex weboffice	Webex is a suite of online collaboration tools, and it helps mainly people who want to hold virtual meetings by using phone conferencing, shared documents and shared desktops [Barnatt, 2010].

SaaS Types	SaaS Applications	Main Characteristics
SaaS online Storage	Dropbox	Dropbox is a Web-based file hosting service operated by Dropbox, Inc. that uses networked storage to enable users to store and share files and folders with others across the Internet using file synchronization [Barnatt, 2010].
	box	Box is an online file sharing and Cloud content management service for enterprise companies. The company provides 5GB of free storage [Barnatt, 2010].
	Microsoft SkyDrive	SkyDrive (also called Microsoft SkyDrive or Windows Live SkyDrive) is a free-of-charge file hosting service that allows users to upload files to a cloud storage and then access them from the web. It is part of Windows Live range of online services and allows users to keep the files private, share them with contacts, or make the files public [Rhoton, 2011].

Appendix 2: Brief resume of the most important and quoted PaaS providers and applications

PaaS Types	PaaS Applications	Main Characteristics
Most quoted PaaS	Google App Engine	Google App Engine is a platform as a service (PaaS) cloud computing platform for developing and hosting web applications in Google data centers. Applications are sandboxed and run across multiple servers. App Engine offers automatic scaling for web applications—as the number of requests increases for an application, App Engine automatically allocates more resources for the web application to handle the additional demand [Rhoton, 2011].
	force.com platform as a service	Force.com is a cloud computing platform as a service system from Salesforce.com, which developers use to build multi tenant applications hosted on their servers as a service [Rhoton, 2011]. Force.com has even decided to allow anyone to build and run their first application for free up to 100 users [Barnatt, 2010].
	Windows Azure	Microsoft Windows Azure Platform is a Microsoft cloud computing platform used to build, host and scale web applications through Microsoft data centers [Rhoton, 2011]. As other PaaS offerings Azure may be internal or external to a business, and either private or public [Sosinsky, 2011]

Appendix 3: Brief resume of the most important and quoted IaaS providers

IaaS Types	IaaS Applications	Main Characteristics
Most quoted PaaS	amazon web services	Amazon Web Services (AWS) is a collection of remote computing services (also called web services) that together make up a cloud computing platform, offered over the Internet by Amazon.com. The most central and well-known of these services are Amazon EC2 and Amazon S3 [Sosinsky, 2011]. S3 allows customers to store data on Amazon Cloud's infrastructure and EC2 allows computer processing power to be purchased on demand on an hourly basis [Sosinsky, 2011].
	GOGRID	GoGrid Cloud Storage is a file-level backup service for Windows and Linux cloud servers running in the GoGrid cloud. Windows and Linux cloud servers mount the storage using a secure private network and common transfer protocols to move data and to and from the Cloud Storage device [Rhoton, 2011].
	rackspace	The Rackspace Cloud is an infrastructure and platform provider with three primary offerings: Cloud Servers, Cloud Files and Cloud Sites [Rhoton, 2011].

Appendix 4: Interview made to the experts of Cloud Computing

This interview has been made through personal interviews in some cases and others have been made through email or via Skype. The pool of experts is formed by six experts that are identified as following:

- Abel Aguiar (AA)
- Orlindo Santos (OS)
- Eduardo Fitas (EF)
- Pedro Lopes (PL)
- Carlos Lourenço (CL)
- Jorge Sousa (JS)

Interview about Cloud Computing and its use by Portuguese SME

The main objective of the thesis is to understand to what extent are the Portuguese SMEs using Cloud Computing services and if its managers are mature and prepare to embrace this technology. Thank you very much for you availability and contribution to this study.

1. **In your opinion, do you think that Portuguese SMEs know and are aware of cloud computing services?**

AA - The knowledge of cloud services by SMEs in Portugal is, in my opinion, highly variable taking into account the size, sector and the company specific technological maturity, however, I consider that on average it is reduced in terms of actual knowledge of the Cloud Computing Services offer and average in terms of awareness of the concept. Larger firms with 50-100 employees and / or in areas of major technological weight, such as information systems or finance, the companies will have higher percentages of knowledge than for example micro-enterprises in the automotive repair industry or food retail. Nonetheless and independent of the type of company, if a managers wants to use Cloud Computing services it is better he or she knows what this technology is all about.

OS – Yes. At least has being registered an improvement on the SMEs awareness concerning Cloud Computing. But it would be important the knowledge the managers have would go behind the basic knowledge of the characteristics. The managers should be aware of the main advantages and how to take the best of them.

CL - The movement of the market indicates that cloud computing is here to stay and is no going back. There are still questions about what is cloud computing and its relation to the sale

of software as a service (SaaS). Typically the two technologies are associated, as a complement to another. According to a recent study[19] (Feb 2012), at the request of Microsoft, by the consultancy company Vanson Bourne to several SMEs across Europe, including Portugal. The Portuguese small and medium entrepreneurs are optimistic for the next biennium 2012-2013 about the role that the cloud computing model will assume in the economic recovery and the possibility to increase the levels of productivity of the SMEs at national level.

The same study conclude that relative to Portuguese SMEs when the managers were asked about what is cloud computing, 22% said to be related to the services used at home and in the personal sphere (hotmail, messenger, photo sharing, windows live, photo gallery), 36% reported to be related to the rental service of computing housed on the web, while 14% have referred they have heard but do not know what it means and 29% report never having heard about the concept.

Honestly, and given the size, origin and type of business of our SMEs (by definition we are talking about companies with fewer than 250 employees and turnover lower than 50M €), I think that ICT was not in their major concern of their managers, hence the proliferation of small data centers, if we may call them so.

However given the nature of the anti-investment of Cloud Computing services, eventually they arise in the radar of the Portuguese SME, as a convenient and easy solution to adopt. In conclusion, I believe that small and medium enterprises will be, at this time of crisis, much more interested and alert to adoptions of cloud computing services over the next three years. Many of them will opt for local providers, but are not sufficiently knowledgeable of the underlying concepts of this technology.

EF - A small portion which is an actual user of this technology knows and is aware of the Cloud Computing services. For the majority which is not user or a user which is not very informed the Cloud Computing concept is almost unknown. For a manager that who wants to use Cloud Computing, a fairly good knowledge of the concept is crucial to the success and the implementation of this paradigm.

PL - In general I think Portuguese SMEs begin to know and be familiar with the concept, at least in its most basic forms of IaaS and SaaS models that are perhaps more immediate applicability to the reality of our companies.

[19] http://www.microsoft.com/portugal/presspass/SalasdeIV.aspx?ID=184

JS - I think there is a lack of deep understanding of this paradigm. Many organizations only associated Cloud Computing to a data center that is in a remote place (in the "cloud") by going through an Internet connection. In my thesis ("Cloud Computing – Evaluation of ROI. A case of the Higher education institutions in Portugal), 43 higher education institutions questioned, only 8 reported that effectively utilize the services of this paradigm. However, over 50% said they use services of external email (gmail) and online office tools (Google Docs) at their institutions. These kinds of programs / tools are part of Cloud Computing, particular the SaaS layer. Therefore, we can conclude that many institutions are using Cloud Computing having no idea what this paradigm actually is. Following the same reasoning is very important that all the managers, independent if they are managing a SMEs or a larger company, have a basic knowledge of Cloud Computing.

2. Taking into account your perception of the market, would you say that Portuguese SMEs are already using Cloud Computing services?

AA - In my perception there are already some SMEs which are using cloud computing services. Nonetheless, I believe that there will be some which use Cloud Computing services without knowing they are already using cloud services, particularly in terms of email and portals. To fully understand the concept of Cloud Computing, the managers should know not only the basic characteristics but also the benefits, so they could take the best from this technology. Following the same reasoning the managers should also, of course, know Cloud Computing potential risks.

OS - Yes, mainly in SaaS, in a public environment. In the SME segment has been observed a strong receptivity to services on cloud computing model in the areas of web presence and collaboration (email, space for housing sites, tools for collaborative information sharing), room for storage of information (storage and backup) and servers in the Internet environment (public cloud).

CL - Honestly, only a small part of SMEs and restricted to parts of the services available. There are several factors contributing to that, already mentioned above, along with an offer that is only now beginning to mature, and become credible.

EF - Very few and certainly not in the proportion to the benefits that Cloud Computing services could provide.

PL - I would say that they are taking the first steps in using it, almost as a way to test the concept so that in the future could be applied more broadly, now with more security and

confidence. After all, there are still many myths around security, reliability and confidentiality of data, which gradually have been demystified leading to a wider adoption by SMEs particularly in infrastructure components and collaborative platforms. In respect to the core systems I would say that there is still an important way to go, but it is a matter of time.

JS – Taking into account the previous answer I say yes, stating again that many SMES still do not have this knowledge.

3. **What types of Cloud Computing service models (SaaS, PaaS and IaaS) you consider the Portuguese SMEs use the most? Which of the three types of services you consider the Portuguese SMEs can benefit the most?**

AA - In terms of IaaS, I think the most used services are Storage and Back-up and, in respect of PaaS and SaaS, I would say collaboration services including email and web hosting. In terms of services that would be most beneficial for the Portuguese SMEs I believe services of collaboration, CRM and Web Hosting in terms of SaaS / PaaS and Storage, Backup and servers in terms of IaaS. In terms of deployment model, the most used type is still the Private Cloud since there are still a lot of concerns about security and privacy issues. Nevertheless, with the increasing use and knowledge of the Cloud Computing concept, I believe the Public Cloud will be the most used type of Deployment model.

OS – The most used service models I would say that it is the SaaS. The type of service SaaS allows SMEs to switch to a set of application software (usually it was characterized by high investment levels associated with the licensing model in a traditional setting – contraire to the Cloud Computing Model) that allowed a strong impact on productivity and efficiency levels. In addition to these benefits, the use of IaaS services also leverage a strong competitive advantage by reducing IT costs, since it provides access to a set of IT resources constantly updated, as SMEs do not need the initial investment, benefiting from a model called pay-per-use.

CL – Currently, I think IaaS and SaaS are the most used. Having said this I believe PaaS will be a bet for the future. Benefits can arise from all of them, but it is my belief that the IaaS and SaaS are more directly linked to reduction of Investments (Capex) and therefore will be more easily adopted and a justification for SMEs which are particularly adept to reduce investment costs (lack of funding) and exploitation.

EF – SaaS for basic needs (mail, web presence) and IaaS, are the ones which seems to me the most obvious use. I believe that SaaS could be a way of providing levers of productivity and

competitiveness to companies that do not have technological solutions for business support (SMEs who are not exposed to this technology) and IaaS an immediate and without risk way of reducing costs and gain flexibility and quality. PaaS services seem to me very interesting for some niches, especially SMEs which are characterized by the provision of services to third parties or that want to differentiate by technological innovation

PL – Clearly IaaS and PaaS. I would say that SMEs might benefit from all these models. In my view the SaaS model is very interesting from the point of view of flexibility and capabilities available. It is, however, one that requires a greater level of maturity and level of trust between the parties involved.

JS – In my opinion, the most used are IaaS and SaaS. SaaS concerning e-mails and other applications from external suppliers as for example Skype or Google Docs and other tools with similar functionality. IaaS in order to reduce material costs with data center, in particular by consolidation of servers using virtualization. Therefore, it allows reducing energy costs for power and releasing equipment space on the data center. Regarding the second part of the question, I think any kind of service is beneficial. The fact that with Cloud Computing we pay only for what we use is quite advantageous for SMEs that are not normally provided with the needed capital to expand their business, so Cloud Computing solutions present themselves as a very viable solution.

Regarding the Deployment models, today I think the most used type is the Private Cloud due to some suspicion that stills exists regarding this technology. However, in my opinion, in the near future the SMEs will opt for a hybrid solution, benefiting more of the Cloud Computing paradigm.

4. **In the table below is a summary of the main characteristics of Cloud Computing mentioned by several authors. From these characteristics indicate what you consider as the most important ones a manager of an SME should know?**

The table with these results was already presented in the chapter 3.3. It is the table number 1.

5. **Do you consider there is other important characteristic of cloud computing not mentioned in the table above? If so, please describe it briefly**

None of the experts mentioned other characteristics.

6. **In the table below is a summary of the main advantages of Cloud Computing mentioned by several authors. From these benefits which of them you consider as the most important a manager of an SME should know?**

The table with these results was already presented in the chapter 3.3. It is the table number 2.

7. **Do you consider there is other important advantage of cloud computing not mentioned in the table above? If so, please describe it briefly**

AA - Self provisioning, ie the ability/possibility the client has to terminate the use or provision of the Cloud Computing services through customer portals provided by the Cloud Computing company.

The other experts have not mentioned other advantages.

8. **In the table below is a summary of the main risks of Cloud Computing mentioned by several authors. From these risks which of them you consider as the most important a manager of an SME should know?**

The table with these results was already presented in the chapter 3.3. It is the table number 3.

9. **Do you consider there is other important risk of cloud computing not mentioned in the table above? If so, please describe it briefly**

CL – The dificulty in some applications to create a customer differentiation, for example it is not easy to offer a different service to a premium client and another one to ordinary customer for instance in an application as email.

The other experts have not mentioned other risks.

10. **In addition to the basic understanding of the main features, advantages and potential risks of cloud computing, which characteristics do you consider the managers and SMEs themselves must have so we can consider they are prepared to adopt cloud computing services?**

AA - I believe that firstly the SMEs have to be aware of their own current needs in terms of future IT. This theme is not evident and obvious, and ultimately leads to decision-making with some foundational consequences on cost and impact on relevant business and non-fulfillment of expectations. Having cleared the requirements in terms of IT, SMEs should consider what kind of service levels is required and how they compare with the current "service levels". SMEs should know if the Cloud Computing services are provided by a third party or internally managed. This point is critical to provide a comparison with a baseline actually comparable. In

addition, it is important that the SMEs have some tools to measure and control the performance of the service provided by the Cloud companies as well as some SLAs.

It is also critical to realize what kind of elements can be differentiators for the SMEs business or not, typically SaaS models are stiffer / less customizable but at the same time are more robust solutions. Understand where I have to differentiate and how these levers are served on cloud model is critical.

OS - It is important an assessment of the current applications, their requirements (both in terms of IT, such as network traffic) and its usage model in the company, as well as its impact on existing business processes. These are the main parameters of analysis in developing a migration plan for cloud, identifying the areas that Cloud Computing enhances the operational efficiency and an exponential maximum cost reduction.

CL – The SMEs will have to be prepared, I do not think given the current economic climate, there are great alternatives for these companies to keep pace with changes in its business, and consequently their IS without resorting to this offer. In conclusion, the SMEs are not prepared but will be quickly, because they have no great alternatives. Therefore it is very important that the companies are aware of the potential risks of Cloud Computing and know some of the procedures to safeguard and overcome them.

EF – The Portuguese SMEs should indeed seek competitive advantages for their business and review the concept of risk / benefit in adopting new operating models and new technologies. In the current context of reduced CAPEX and OPEX and absolute need for competitiveness gains by SMEs, Cloud Computing services can offer a way (or in some cases the only way) to achieve these objectives. In addition, the companies should be able to "audit" somehow the Cloud Computing providers so they can be compensate in case they do not fulfil the performance levels agreed in the contract. SLAs can be a way to "deal" with this problem as well as internal KPIs so the companies can compare with the performance levels the Cloud provider states to have.

PL – I think in general the national SMEs are prepared or at least awake to the subject. I believe the actual economic context will dictate a cloud adoption of the term. Increasingly, managers are pressured to reduce their CAPEX and OPEX and the use of cloud model can be an important lever in that direction. Nevertheless, they must have a deep knowledge of the concept, the right procedures to take the best of Cloud Computing benefits and be aware of the potential risks and how they could avoid or defend from them. In addition, what in my

opinion reveals also a deep knowledge and maturity on the use of this technology is a proper SLAs, since still is one of the major risks of this technology.

JS – The Portuguese SMEs should have a real knowledge of what this paradigm really is. Conduct a study on the advantages and disadvantages of having a traditional solution and have a cloud solution in order to determine which case fits best the company. And it is also important that the managers are not only aware of the potential but also know how to deal with them. Cloud Computing may not be beneficial for all companies. These companies need to have the cost control mechanisms which can often analyze the viability of choosing a cloud platform. I also think that companies wishing to implement a private cloud solution must take into account the possibility of hiring specialized personnel to deal with this type of highly virtualized environment.

Appendix 5: Cobit Maturity Attribute Table

	Awareness and Communication	Policies, Plans and Procedures	Tools and Automation	Skills and Expertise	Responsibility and Accountability	Goal Setting and Measurement
1	Recognition of the need for the process is emerging. There is sporadic communication of the issues.	There are *ad hoc* approaches to processes and practices. The process and policies are undefined.	Some tools may exist; usage is based on standard desktop tools. There is no planned approach to the tool usage.	Skills required for the process are not identified. A training plan does not exist and no formal training occurs.	There is no definition of accountability and responsibility. People take ownership of issues based on their own initiative on a reactive basis.	Goals are not clear and no measurement takes place.
2	There is awareness of the need to act. Management communicates the overall issues.	Similar and common processes emerge, but are largely intuitive because of individual expertise. Some aspects of the process are repeatable because of individual expertise, and some documentation and informal understanding of policy and procedures may exist.	Common approaches to use of tools exist but are based on solutions developed by key individuals. Vendor tools may have been acquired, but are probably not applied correctly, and may even be shelfware.	Minimum skill requirements are identified for critical areas. Training is provided in response to needs, rather than on the basis of an agreed plan, and informal training on the job occurs.	An individual assumes his/her responsibility and is usually held accountable, even if this is not formally agreed. There is confusion about responsibility when problems occur, and a culture of blame tends to exist.	Some goal setting occurs; some financial measures are established but are known only by senior management. There is inconsistent monitoring in isolated areas.
3	There is understanding of the need to act. Management is more formal and structured in its communication.	Usage of good practices emerges. The process, policies and procedures are defined and documented for all key activities.	A plan has been defined for use and standardisation of tools to automate the process. Tools are being used for their basic purposes, but may not all be in accordance with the agreed plan, and may not be integrated with one another.	Skill requirements are defined and documented for all areas. A formal training plan has been developed, but formal training is still based on individual initiatives.	Process responsibility and accountability are defined and process owners have been identified. The process owner is unlikely to have the full authority to exercise the responsibilities.	Some effectiveness goals and measures are set, but are not communicated, and there is a clear link to business goals. Measurement processes emerge, but are not consistently applied. IT balanced scorecard ideas are being adopted, as is occasional intuitive application of root cause analysis.
4	There is understanding of the full requirements. Mature communication techniques are applied and standard communication tools are in use.	The process is sound and complete; internal best practices are applied. All aspects of the process are documented and repeatable. Policies have been approved and signed off on by management. Standards for developing and maintaining the processes and procedures are adopted and followed.	Tools are implemented according to a standardised plan, and some have been integrated with other related tools. Tools are being used in main areas to automate management of the process and monitor critical activities and controls.	Skill requirements are routinely updated for all areas, proficiency is ensured for all critical areas, and certification is encouraged. Mature training techniques are applied according to the training plan, and knowledge sharing is encouraged. All internal domain experts are involved, and the effectiveness of the training plan is assessed.	Process responsibility and accountability are accepted and working in a way that enables a process owner to fully discharge his/her responsibilities. A reward culture is in place that motivates positive action.	Efficiency and effectiveness are measured and communicated and linked to business goals and the IT strategic plan. The IT balanced scorecard is implemented in some areas with exceptions noted by management and root cause analysis is being standardised. Continuous improvement is emerging.
5	There is advanced, forward-looking understanding of requirements. Proactive communication of issues based on trends exists, mature communication techniques are applied, and integrated communication tools are in use.	External best practices and standards are applied. Process documentation is evolved to automated workflows. Processes, policies and procedures are standardised and integrated to enable end-to-end management and improvement.	Standardised tool sets are used across the enterprise. Tools are fully integrated with other related tools to enable end-to-end support of the processes. Tools are being used to support improvement of the process and automatically detect control exceptions.	The organisation formally encourages continuous improvement of skills, based on clearly defined personal and organisational goals. Training and education support external best practices and use of leading-edge concepts and techniques. Knowledge sharing is an enterprise culture, and knowledge-based systems are being deployed. External experts and industry leaders are used for guidance.	Process owners are empowered to make decisions and take action. The acceptance of responsibility has been cascaded down throughout the organisation in a consistent fashion.	There is an integrated performance measurement system linking IT performance to business goals by global application of the IT balanced scorecard. Exceptions are globally and consistently noted by management and root cause analysis is applied. Continuous improvement is a way of life.

Appendix 6: Questionnaire to the Portuguese SMEs

1. **What is the dimension of the company you represent?**
    a. 1-9 employees
    b. 10-50 employees
    c. 50-250 employees
    d. More than de 250 employees

2. **In which of the following CAE does your company fit?**

    a. Fishing and aquaculture
    b. Mining and quarrying
    c. Manufacturing
    d. Electricity
    e. Water
    f. Construction
    g. Trade/Commerce
    h. Transportation and storage
    i. Hotels and restaurants
    j. Information and Communication Technology
    k. Real estate
    l. Consultancy activities
    m. Administrative Activities
    n. Education
    o. Human health activities
    p. Artistic Activities
    q. Other service activities
    r. Other

3. **What is the turnover / budget of your company?**
    a. Less than 2 million
    b. Between 2 and 10 million euros
    c. Between 10 to 50 million euros
    d. More than 50 million

4. **What percentage, compared to the total budget is invested annually in ICTs?**
    a. Less than 1%
    b. Between 1% to 5%
    c. Between 5% to 15%
    d. More than 15%

5. **How many employees whose duties are related to areas of ICT?**
    a. None
    b. Between 1-5
    c. Between 5-10
    d. Between 10-20
    e. Greater than 20

6. **Who assumes the maintenance of infrastructure and ICT services?**
    a. An external organization
    b. Employees of their own company
    c. Both situations
    d. The company does not have ICT services (email, website, computers, data centers, etc.)

7. **Even if you do not know exactly what it is, have you ever heard of the term of Cloud Computing?**
    a. Yes
    b. No

8. **Does your company use cloud computing services?**
    a. Yes
    b. Not
    c. Do not know

9. **From the IT services mentioned below indicate those that your company uses?**
    a. Email hosted on the web (like Gmail or Hotmail)
    b. Web-hosting
    c. Instant messaging and chat
    d. Collaboration tools such as Google Docs or crowdsourcing platforms
    e. Online office tools (Google Docs, Office and other web apps)
    f. Applications of online storage (Dropbox, Box, Microsfot SkyDrive)
    g. Management applications, web-based HR and SAP
    h. CRM applications based on web such as SalesForce
    i. Business Intelligence Applications hosted on the web
    j. ERP - integrated management systems on the web. With systems of finance, accounting, human resources, production, marketing, sales, purchasing, transaction processing system, information systems for management, decision support systems, etc..
    k. Tools for creating, testing and implementation of web applications
    l. None of the above
    m. Other. Indicate the IT service below

If selected the interviewee in the question 8 selected b) or c) the questionnaire ends here.

10. **From the following features which of them would you consider as main characteristics of Cloud Computing?**
    a. It is a model in which software, processing power, storage capacity, data backups, development tools, and others are provided as a set of services over the Internet
    b. To benefit from Cloud Computing services the company necessarily requires an internet connection
    c. A company and its employees can access the cloud from any device (computer, tablet or mobile)
    d. A company can contract cloud services without having to directly contact the service provider of Cloud Computing
    e. Different companies may share the same Cloud
    f. A company can increase or decrease the cloud services according to their needs at a precise moment
    g. In a model of Cloud Computing the company pays the service to the Cloud Computing provider on what the company actually use/consume. A model known as pay-per-use.
    h. The models of cloud computing services are the most common: SaaS (Software as a Service), PaaS (Platform as a Service) and IaaS (Infrastructure as a Service)
    i. The Cloud Computing Deployment models most common are Public, Private, Community and the Hybrid.
    j. None

11. **From the following advantages which would you consider as the most relevant of Cloud Computing?**
    a. Flexible payment model
    b. Reduction of IT costs (hardware, software, maintenance and IT staff)

c. Faster and easier to update software and applications
d. Increased reliability of the network company
e. There are no compatibility issues of operating systems
f. Can encourage innovation in the enterprise applications for example through collaboration and crowdsourcing platforms
g. Possibility of employees access the Cloud and work in any device and anywhere they are (as long as they have internet access)
h. Speed of implementation. The company may have access to new applications in hours or days)
i. Possibility of reducing transport costs
j. Cloud applications are considered user-friendly
k. Improving the competitiveness of the company. Allows the company access to innovative applications that without Cloud Computing could not.
l. Allow the company to remain competitive as the future new generation application will worked in the Cloud.
m. Enable companies to be Green. Insofar as they can reduce energy costs and reduce CO2.
n. None

12. **From the following risks which would you associate with Cloud Computing concept?**

a. The need for a fast and robust Internet
b. Possible decrease of security and privacy of sensitive company data
c. Possibility of non-compliance of some legal requirements. For example the need for some data to be in the territory from which the company has its headquarters
d. Possibility that there are fails in the availability and / or reliable on the access to enterprise data. Possibility of downtime even with reputed companies in the panorama of Cloud Computing.
e. Lack of robust SLAs that allow compensation for firms not satisfied with the service provided by the Cloud Computing vendor.
f. Lack of audit to the firms providing services of Cloud Computing
g. Difficulties in the transition between Cloud Computing service providers
h. Little control in the services / products sold by the companies of Cloud Computing
i. Too much dependence on the Cloud Computing provider that can generate a problem of lock-in. This problem of lock-in is also linked to the difficulty of transition between Cloud providers.
j. None

13. **What were the reasons that led to the adoption of the architecture and technologies of Cloud Computing?**
a. Expected cost savings
b. Expected to improve the expected rate of return on investment (ROI)
c. Support improvements to business processes
d. Use of business models appealing to the customer
e. Facilitate the implementation and delivery of new services
f. Flexible sharing of resources
g. None of the above

14. **What were the biggest fears in the adoption of Cloud Computing?**
a. High costs
b. Security Issues
c. "Lock-in" information in a single service provider
d. Lack of control over resources
e. Inability to audit and assess performance measures

f. Interoperability between service providers
g. Dependence of the company / institution in a foreign service provider
h. Legal Constraints
i. Others. Indicate which:

15. **In order to "control" or reduce some of the potential risks inherent in using cloud computing services indicate which procedures your company uses:**
    a. The company updates its SLA with its ISP and develop an appropriate business continuity plan to ensure continued access to the infrastructure network and Internet access.
    b. The company sets a policy of using Cloud Computing specific to the company in order to ensure a more secure access to Cloud (eg related to user names and passwords needed to enter the enterprise applications or for example through a constantly updated antivirus and firewall)
    c. The company shall establish an appropriate and enforceable (legal and logistically) SLAs and other contracts with the provider of Cloud Computing, which must include corrective measures and penalties related to non-fulfillment of minimum services established in the agreements. These contracts and SLAs should be inspected by a team of IT professionals and legal scholars.
    d. The company has a process for selecting providers of cloud computing rigorous, using a careful selection and approval process. If possible, the company should select a provider that uses cloud computing standards generally established to ensure an easier transition to another vendor at its discretion.
    e. Contracts for Cloud Computing that can somehow cross borders should be examined by legal counsel with expertise in international law
    f. The company must ensure that the supplier of cloud computing services is audited by third parties.

16. **From the Cloud Computing Service models which does your company use?**
    a. Complete business applications provided over the internet - (SaaS)
    b. A software environment where an employee of the company can create, test and deploy web applications - (PaaS)
    c. Rental hardware for data storage and backups - (IaaS)
    d. None of the above

17. **Do you think in the future your company will use another Service Model?**
    a. No
    b. Yes
        i. SaaS
        ii. PaaS
        iii. IaaS

18. **Which of these solutions does your company use?**
    a. The company hires virtual data centers as needed, not knowing the exact location where this is - Cloud Public
    b. The company rents actually a physical part of a data center which is dedicated entirely to the customer who pays for this service - Private Cloud.
    c. Several companies share the same cloud having similar objectives, rules and concerns- Cloud Community
    d. Combination of Mixed Public and Private Cloud - Cloud Hybrid

19. **Do you think in the future your company may use another solution of Deployment Model?**
    a. No
    b. Yes
        i. Public Cloud
        ii. Private Cloud
        iii. Hybrid Cloud

iv. Cloud Community

20. **From the Cloud Computing services that your company uses indicate from the characteristics below which best assimilate to the characteristics of Cloud Computing Services used in your organization**
    a. Tools for on-demand budgeting, forecasting and reporting solutions. All components of planning, financial statements, consolidating metrics and automated tools
    b. Web-based applications to document consistent implement standard operating procedures.
    c. Applications that facilitate the allocation of tasks among several employees. Tools to collect data on the number of hours that employees work, they are working and how they work: via web, phone and / or mobile devices.
    d. Applications for payment of wages Web-based, time calculations of workers allocated to each project and attendance of employees
    e. Management Tools for product innovation. Applications of R & D crowdsourcing and other collaboration applications and participation in the creation of new products / services.
    f. Applications to facilitate the purchase of raw materials and tools for implementing the concepts of consumer-controlled logistics. Tools to predict the optimal amounts required to be ordered. Applications of POC (Purchase Order Control)
    g. Solutions for order management, stock management and inventory, synchronization of demand / supply, logistics processes. Applications to reduce the cost of direct materials, enhance quality and security of supply, reduce cycle time, improve operational efficiency and increase flexibility.
    h. Software systems to measure performance of the production system. Tools for better access to operational data, allowing managers to make better decisions and continuously improve production processes.
    i. Sophisticated applications of route optimization, through better monitoring in real time and better planning of routes.
    j. Applications to improve the planning process of replenishment, order processing, construction, load transportation and fleet management. Tools for collaboration between stakeholders in the logistics process
    k. Application for management of sales data and processes online. Tools for processing of data about customers and their records - available on any device. Marketing applications for organizing and managing events, campaigns of new products / services.
    l. Tools for collaboration between teams of sales and marketing teams.
    m. Applications to storage the backups of the companies
    n. Applications to storage support data of the company
    o. Applications to improve customer support. Tools and applications for call center, support the delivery and replacement of products, claims administration and customer support tools.

21. **Indicate whether your company in the future is considering purchasing Cloud Computing services with the characteristics listed below.**
    a. No
    b. Yes. Indicate from the list below which:
        i. Tools for on-demand budgeting, forecasting and reporting solutions. All components of planning, financial statements, consolidating metrics and automated tools
        ii. Web-based applications to document consistent implement standard operating procedures.
        iii. Applications that facilitate the allocation of tasks among several employees. Tools to collect data on the number of hours that employees work, they are working and how they work: via web, phone and / or mobile devices.
        iv. Applications for payment of wages Web-based, time calculations of workers allocated to each project and attendance of employees

v. Management Tools for product innovation. Applications of R & D crowdsourcing and other collaboration applications and participation in the creation of new products / services.
vi. Applications to facilitate the purchase of raw materials and tools for implementing the concepts of consumer-controlled logistics. Tools to predict the optimal amounts required to be ordered. Applications of POC (Purchase Order Control)
vii. Solutions for order management, stock management and inventory, synchronization of demand / supply, logistics processes. Applications to reduce the cost of direct materials, enhance quality and security of supply, reduce cycle time, improve operational efficiency and increase flexibility.
viii. Software systems to measure performance of the production system. Tools for better access to operational data, allowing managers to make better decisions and continuously improve production processes.
ix. Sophisticated applications of route optimization, through better monitoring in real time and better planning of routes.
x. Applications to improve the planning process of replenishment, order processing, construction, load transportation and fleet management. Tools for collaboration between stakeholders in the logistics process
xi. Application for management of sales data and processes online. Tools for processing of data about customers and their records - available on any device. Marketing applications for organizing and managing events, campaigns of new products / services.
xii. Tools for collaboration between teams of sales and marketing teams.
xiii. Applications to improve customer support. Tools and applications for call center, support the delivery and replacement of products, claims administration and customer support tools.

22. **The Applications / tools of Cloud Computing that your company use are:**
    a. Integrated - the same application provides services to various areas of your business. For example an application of ERP (Enterprise Resource Planning) services covering CRM, Sales, Operations, Accounting, among others.
    b. Specifies - specific applications for each business area. For example a specific application for marketing and other separate for accounting

23. **Does your company have some kind of SLAs with the Cloud Computing service provider?**
    a. Yes
    b. No
    c. Do not know

24. **If your company has an SLA or a similar contract indicate from the following information and terms which are present on those contracts:**
    a. Your company knows who has control over the organization's data
    b. The company is aware if any other company can have access to your data or if the company has contracted service provider that can outsource to third parties the security of your data.
    c. Specified in the contract what happens to back up of your data if the supplier of the services or your company closes.
    d. Your company is aware of the security of the Cloud Computing provider and knows how this security is audited.
    e. If the company knows how to report service problems and in case of prolonged inactivity of the service if there is alternative ways to access data / enterprise applications.
    f. The company knows the downtime and interruptions and how these are measured.
    g. The company is aware of the delay time to restart or switch to a virtual server fails.
    h. The company is aware of the key metrics QoS (Quality of Service) used by the supplier of the service of Cloud Computing.

25. **Does your company have some sort of KPI (Key Performance Indicators) that allows to evaluate and measure the service provided by Cloud Computing vendor?**
    a. No
    b. Yes, Which type:
        i. Performance indicators to measure and monitor the possible length of downtime and disruption of the cloud services.
        ii. Performance Indicators to assess the speed and flexibility with which the supplier of the Cloud Computing service allocates resources if there is an overload or if there is a fault in a server
        iii. Indicators of QoS (Quality of Services) in order to compare internal data provided by Cloud Computing provider

Appendix 7 – Crosstabs of the Dimension of the SMEs

The statistics processes and conclusions were all based on the book from Isabel Reis [Reis, 2008] and on the article from Cyrus R. Mehta and Nitin R. Patel about the utilization and interpretation of SPSS outputs [Mehta and Patel, 1996].

Therefore and in order to understand if there is any association between the Dimension of the SMEs and the Variables we want to test, it was first defined the hypothesis. Below is an example of what has been made for the first variable (Cloud Computing utilization):

Null Hypothesis: Cloud Computing utilization and the Dimension of the SMEs are independent.
Alternative Hypothesis: Cloud Computing utilization and the Dimension of the SMEs are not independent

If Asymp. Sig. (2-sided) de Pearson Chi-Square ≤ 0,05[20] => Reject Null Hypothesis
If Asymp. Sig. (2-sided) de Pearson Chi-Square > 0,05 => Not Reject Alternative Hypothesis

As in this example the Sig. (2-sided) de Pearson Chi-Square is equal to 0.602, we have that:

If 0.602 ≤ 0,05 => Reject Null Hypothesis
If 0.602 > 0,05 => Not Reject Null Hypothesis

This way, one may conclude that the association between the Dimension of the SMEs and the utilization of Cloud Computing is not statistically significant. Consequently, and taking into account our sample is possible to conclude that the Dimension of the SMEs do not have a direct relation or influence if the SMEs are using or not Cloud Computing services.

In the table below are the other Dimensions we want to test and its correspondent p Value[21] and conclusions:

[20] It has been used a Confidence Interval of 95%
[21] In order to calculate the p Values it was used the SPSS and the QuestionPro

Table 30 - Dimension SMEs and p Value variables

Dimensions to test	p Value	Hypothesis Conclusions
CC utilization	0.602	**Null Hypothesis:** Variables are independent
Reasons behind the adoption	0.954	**Null Hypothesis:** Variables are independent
Fears behind the adoption	0.038	**Alternative Hypothesis:** Variables are not independent
Service Models	0.735	**Null Hypothesis:** Variables are independent
Deployment Models	0.811	**Null Hypothesis:** Variables are independent
Use of SLAs	0.169	**Null Hypothesis:** Variables are independent

It is also important to state the sample size requirement for the chi-square test of independence has been satisfied for all the variables [Mehta and Patel, 1996], meaning:

- No cell has an expected frequency less than 5
- All the minimum expected count are superior to 1

Figure 20 – Dimension SMEs vs CC's utilization

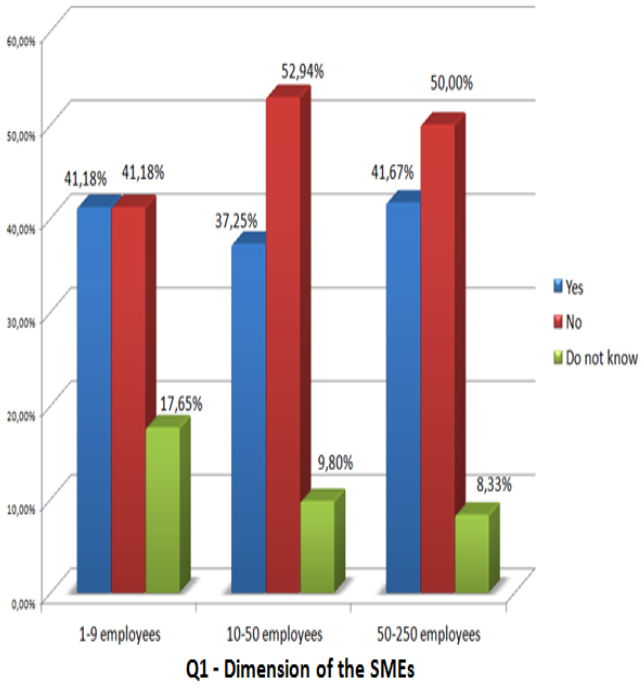


Figure 19- Dimension SMEs vs Reasons of the CC's adoption

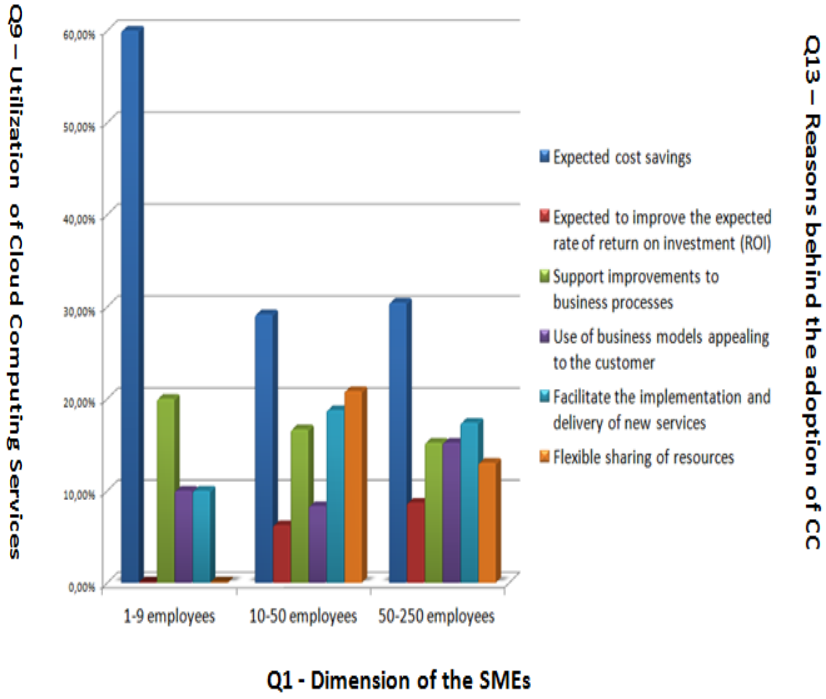


Figure 22 – Dimension SMEs vs Biggest fears of adoption

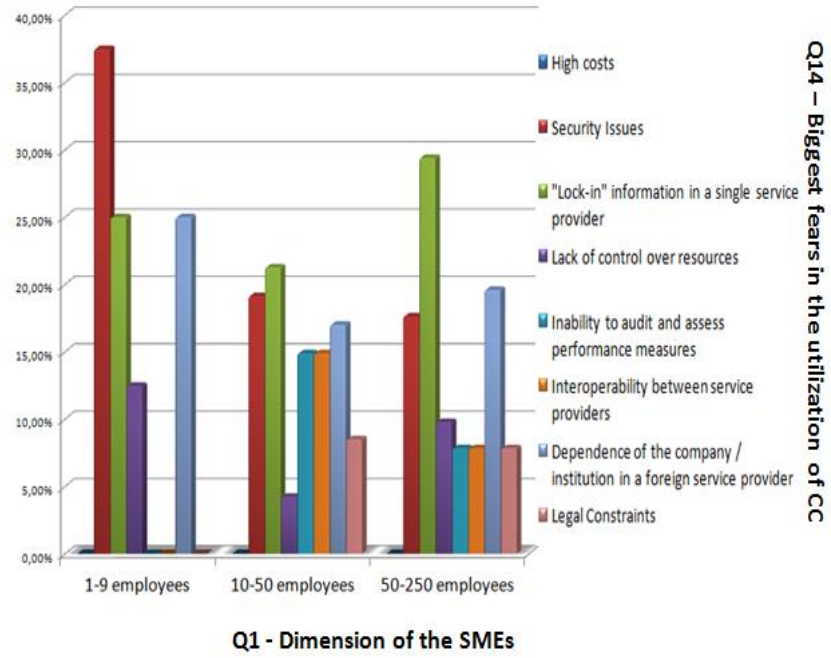


Figure 21 – Dimension SMEs vs Service Model

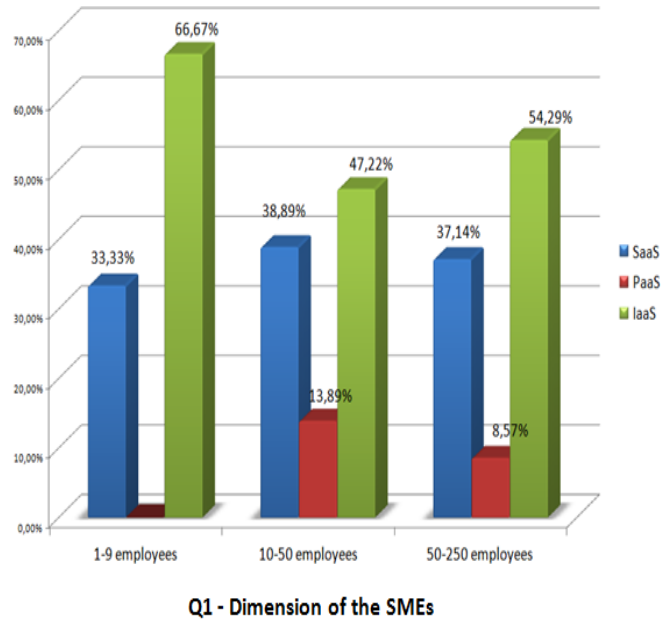


Figure 24 – SMEs' Dimension vs Deployment Models

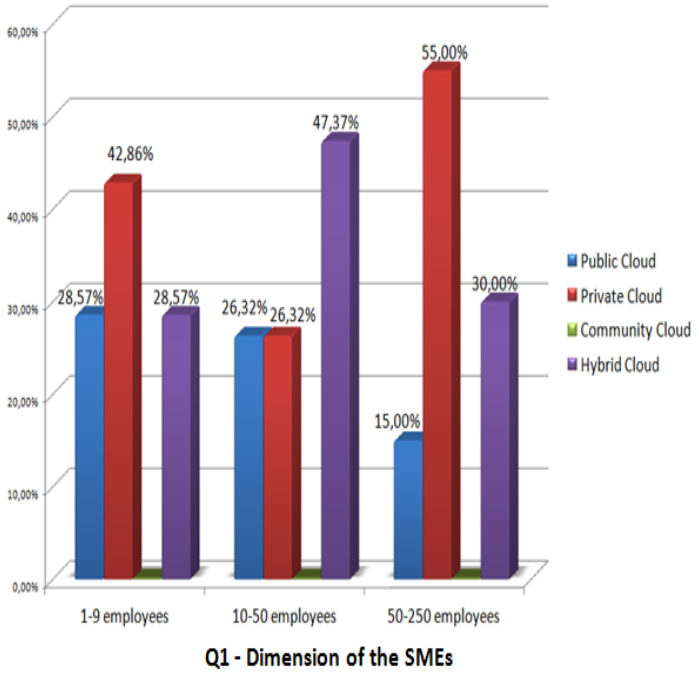
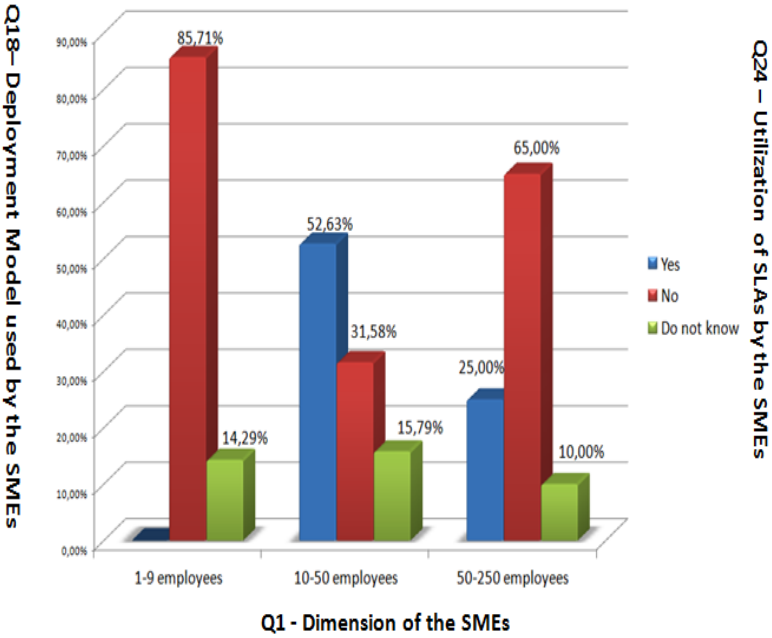


Figure 23 – SMEs Dimension vs SLAs' utilization



Appendix 8 – Crosstabs of the economic CAE of the SMEs

The sample size requirement for the chi-square test of independence has been satisfied for all the variables

Table 31 - Economic CAE of the SMEs and p Value variables

Dimensions to test	p Values	Hypothesis conclusions
CC utilization	0.002	**Alternative Hypothesis:** Variables are not independent
Reasons behind the adoption	0.99	**Null Hypothesis:** variables are independent.
Fears behind the adoption	0.999	**Null Hypothesis:** variables are independent.
Service Models	0.99	**Null Hypothesis:** variables are independent.
Deployment Models	0.99	**Null Hypothesis:** variables are independent.
Use SLAs	0.374	**Null Hypothesis:** variables are independent.

Figure 26 – CAE of the SMEs VS CC's utilization

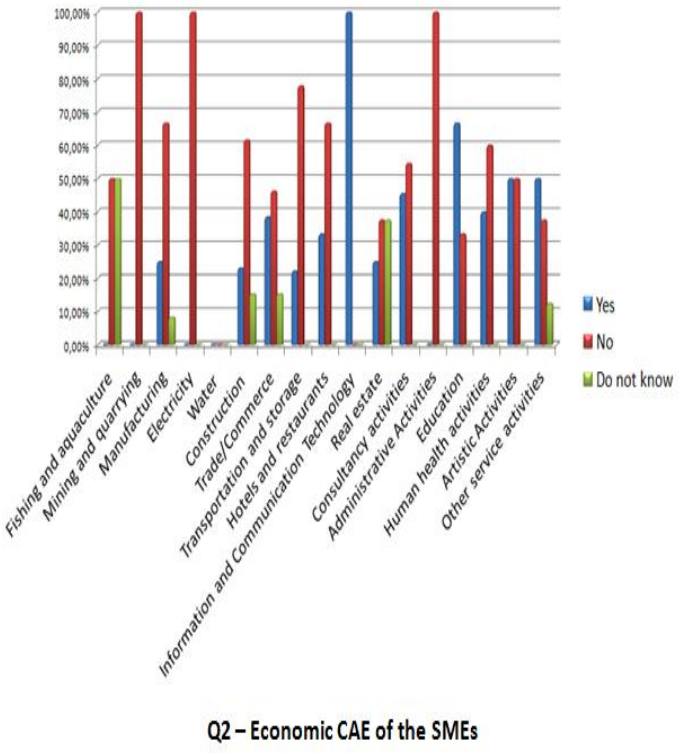


Figure 25 – CAE of the SMEs vs Reasons behind CC's adoption

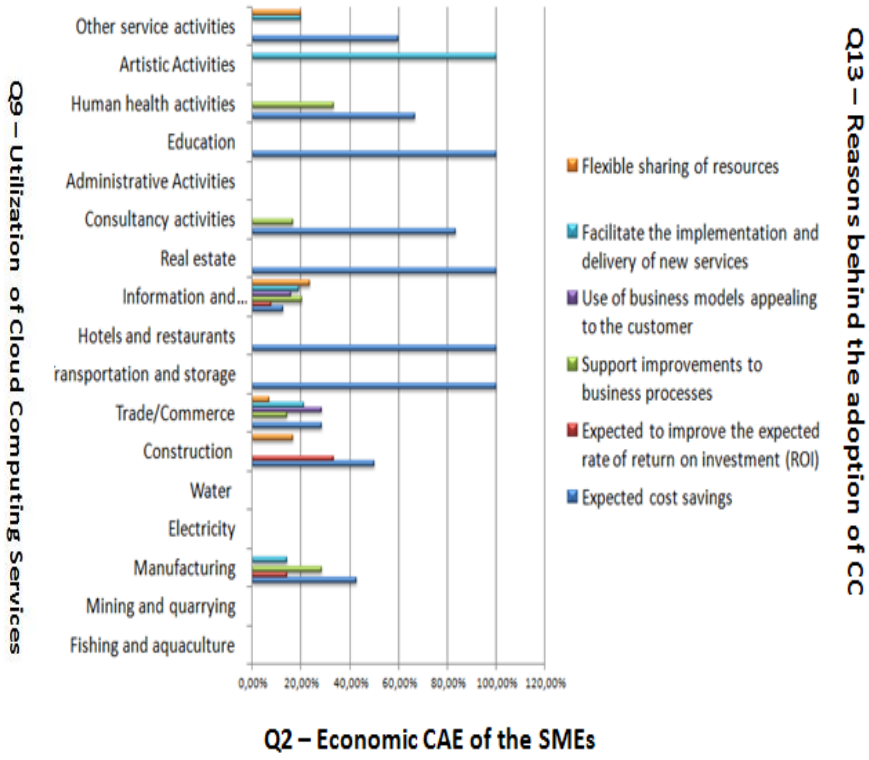


Figure 27 – CAE of the SMEs vs Fears of the adoption of CC

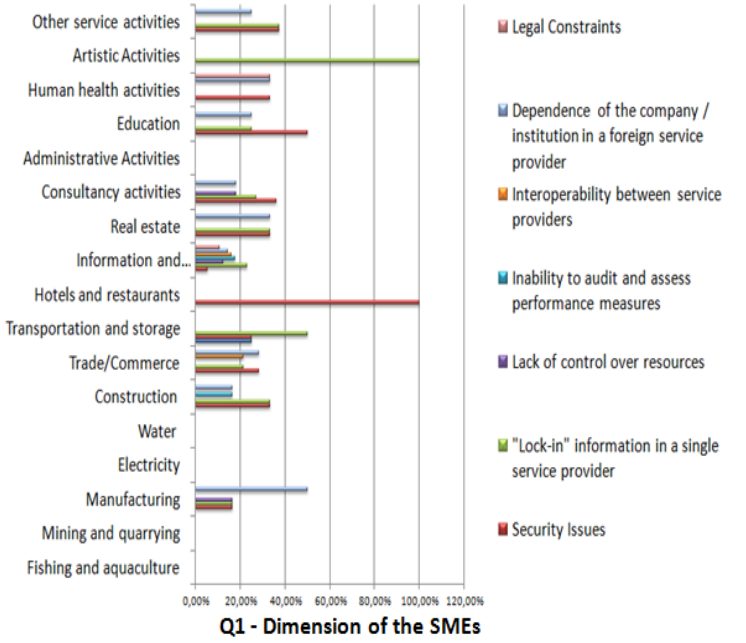


Figure 28 – CAE of the SMEs vs Service Models

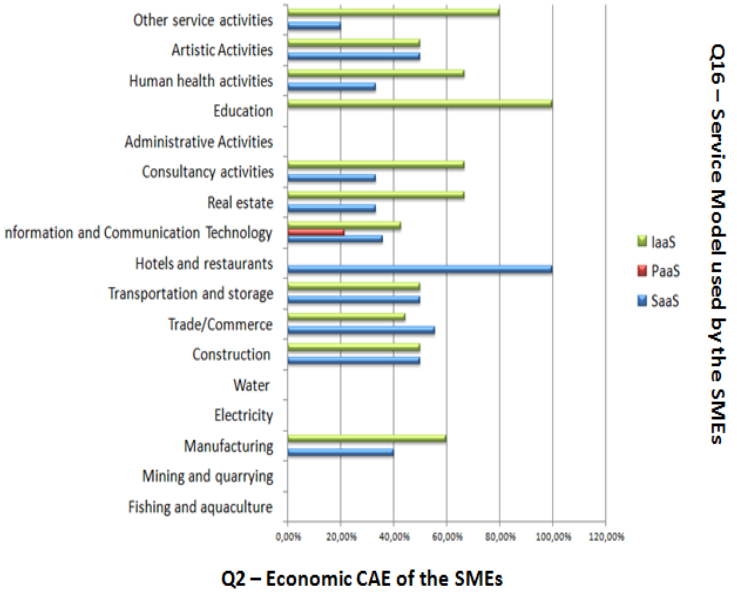


Figure 30 – CAE of the SMEs vs Deployment Models

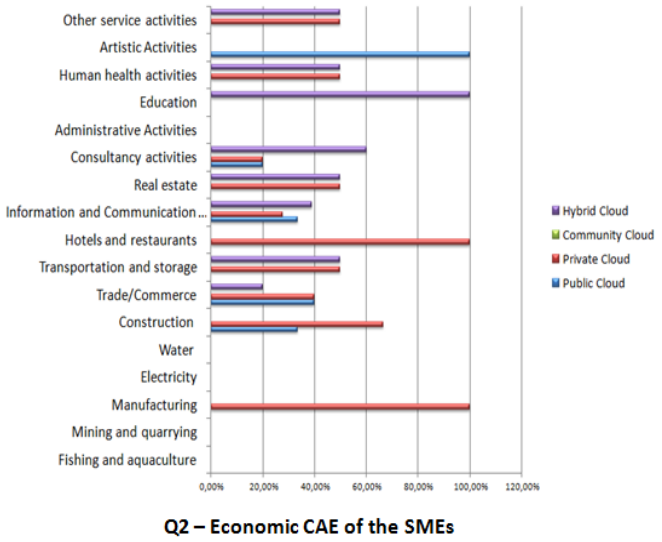
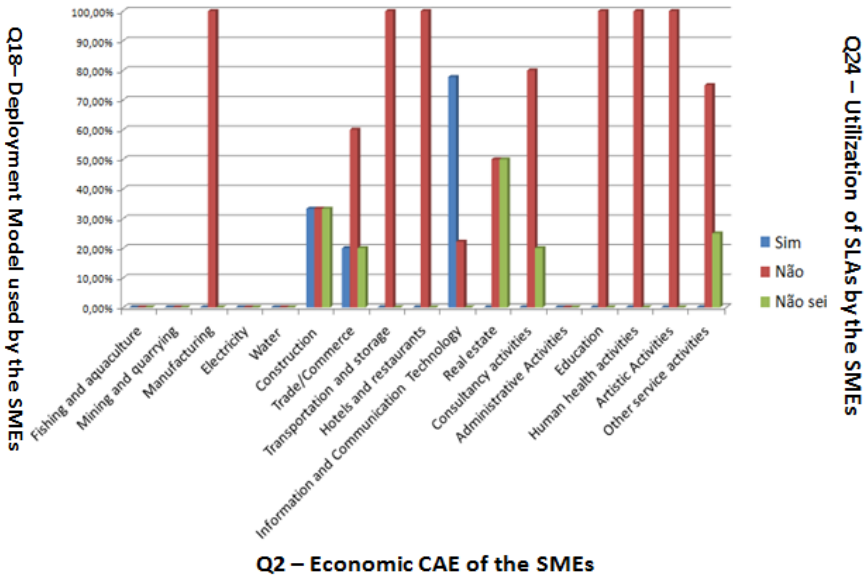


Figure 29 – CAE of the SMEs vs Use of SLAs



Appendix 9 – Crosstabs of the SMEs' turnover

The sample size requirement for the chi-square test of independence has been satisfied for all the variables

Dimensions to test	p Values	Hypothesis conclusions
CC utilization	0.439	**Null Hypothesis**: variables are independent.
Reasons behind the adoption	0.99	**Null Hypothesis**: variables are independent.
Fears behind the adoption	0.99	**Null Hypothesis**: variables are independent.
Service Models	0.97	**Null Hypothesis**: variables are independent.
Deployment Models	0.98	**Null Hypothesis**: variables are independent.
Use SLAs	0.99	**Null Hypothesis**: variables are independent.

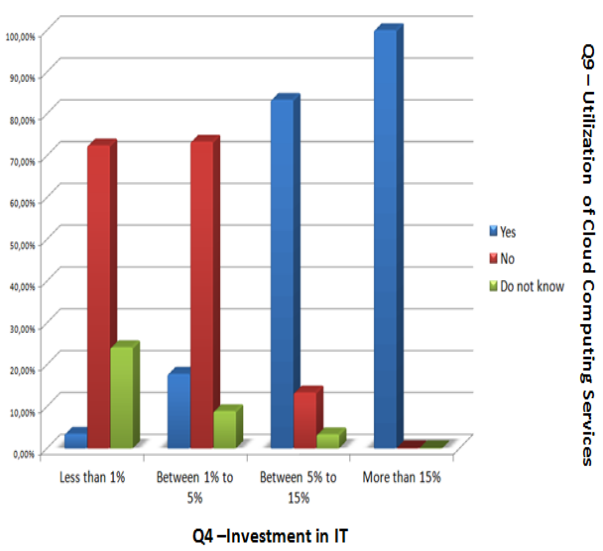
Appendix 10 – Crosstab % Invested in ICT

The sample size requirement for the chi-square test of independence has been satisfied for all the variables

Dimensions to test	p Values	Hypothesis conclusions
CC utilization	0.001	**Alternative Hypothesis:** variables are not independent.
Reasons behind the adoption	0.99	**Null Hypothesis:** variables are independent.
Fears behind the adoption	0.184	**Null Hypothesis:** variables are independent.
Service Models	0.267	**Null Hypothesis:** variables are independent.
Deployment Models	0.303	**Null Hypothesis:** variables are independent.
Use SLAs	0.002	**Alternative Hypothesis:** variables are not independent.

Figure 31 - %invested in ICT vs Reasons behind the adoption of CC

Figure 32 - %invested in ICT vs Utilization of CC



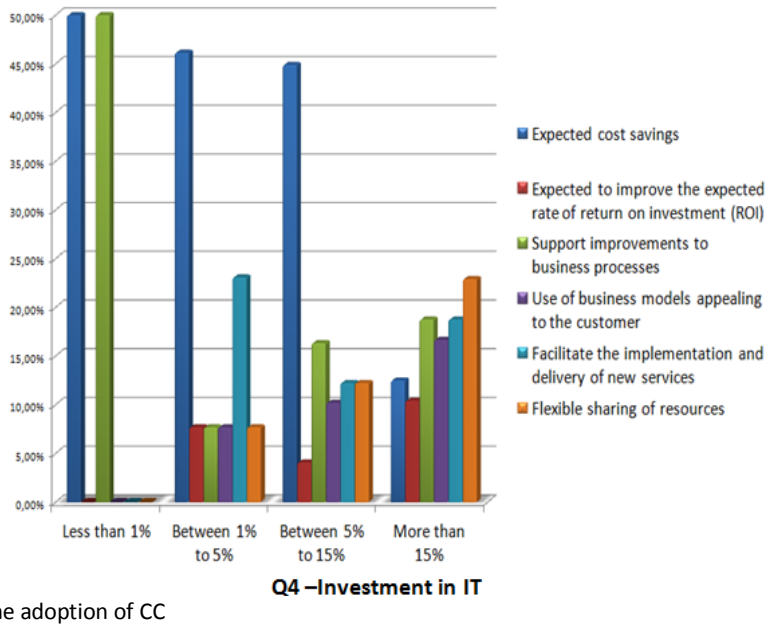


Figure 33 - % invested in ICT vs Fears behind the adoption of CC

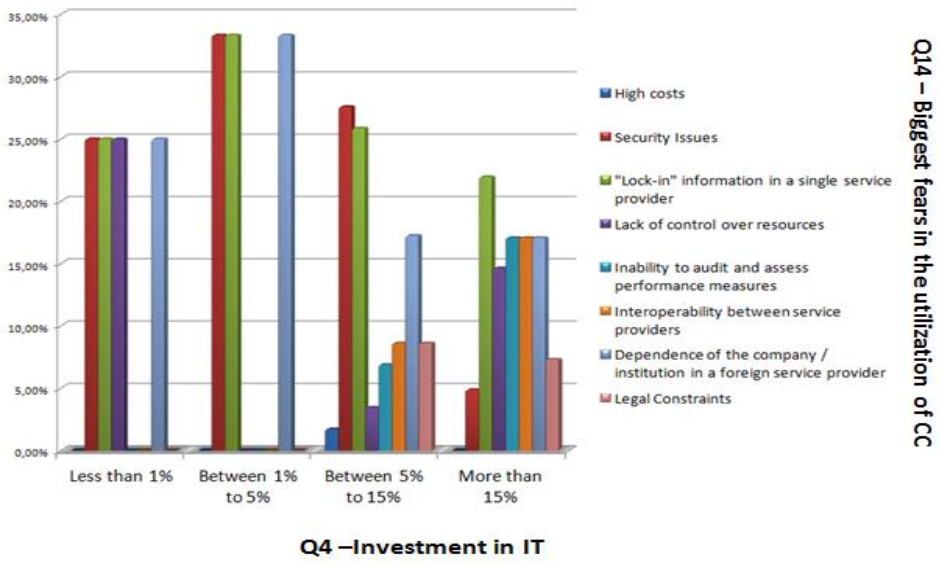


Figure 35 - %invested in ICT vs Service Models

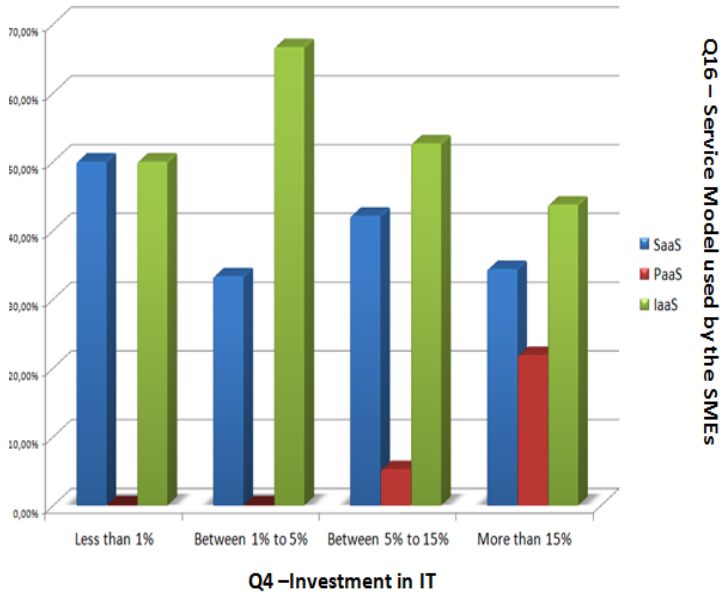


Figure 34 - %invested in ICT vs Deployment models

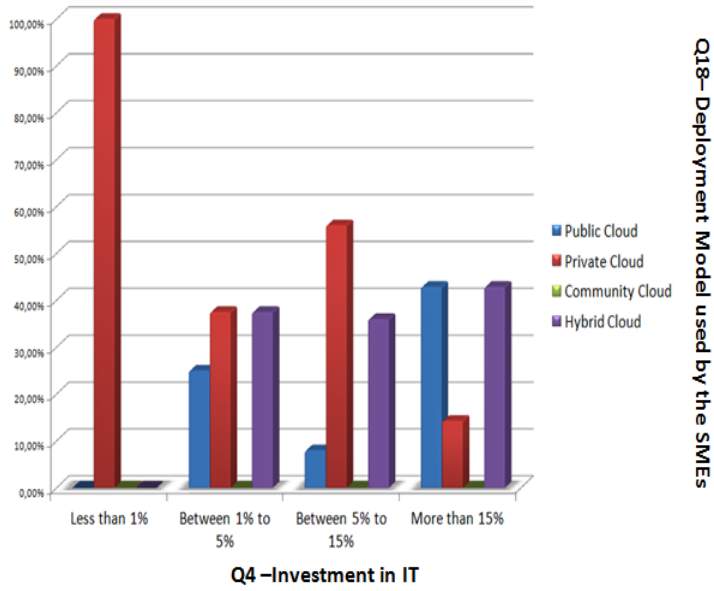


Figure 36 - %invested in ICT vs utilization of SLAs