Guidelines for Increasing the Adoption of Cloud Computing within SMEs

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Abstract — **This document is part of a larger effort meant to define a set of guidelines useful for the fast adoption of cloud computing and social media technologies within small and medium enterprises (SMEs) in European Union. The topic under scrutiny is how SMEs should approach and what they should do when embracing these new technologies, and also what to know about their potential impact on the SMEs businesses.**

Keywords: SME, guidelines, cloud computing.

I. Introduction

Cloud computing is not a new technology, but rather a natural evolution of efficient using and combining several modern technologies. Computing power, data storage and internetworking resources have all been put into a novel context and consequently, transformed into services (either separately or taken together). The paradigm in cloud computing is based on an old commercial approach – on-demand pay per use – in which you better rent a service for a specific period of time instead of buying the support infrastructure (utilities included), building a solution and administering it all by yourself. The cloud service providers (CSPs) promise reliable and configurable resources, made available promptly to consumers with a minimum effort and involvement on their behalf.

Small and medium enterprises (SMEs) are – as everyone else is – interested in reducing costs, and remaining competitive. Also, green computing is getting momentum and SMEs are targeting the issue too. Cloud computing is able to offer solutions to these aspects obviously for a price; the pay per use approach encourages a responsible behavior and maximum efficiency for what concerns consumption of resources and energy. In order to decide whether to pay that price and go all the way through, SMEs need guidance and knowledge of what are the best practices when approaching cloud computing technologies. This paper is about a work in progress on this topic emphasizing the importance of cloud computing for SMEs and the necessity to provide SMEs decision makers with guidelines and best practices.

II. Motivation

SMEs are socially and economically important, since they represent 99% of all enterprises in the EU, employ more than 90 million people, and contribute to entrepreneurship and innovation [1], [2]. In Germany alone, there are about 3.2 million SMEs, most of them regionally anchored. Significant international, social and economic changes like globalization, market competition, technological innovation, the European Union enlargement, and particularly, the last financial crises affect the situation of SMEs; they need innovative and sustainable approaches to survive and be competitive. But most of European SMEs have shortage of financial resources and of skilled staff, no sustainable ICT (Information and Communication Technologies) strategies, have difficulties with the management of missing knowledge, and a low transfer of knowledge to improve the effectiveness of their work tasks, have not enough knowledge of policies of communication and cooperation in research and production. SME staff is often frustrated of constantly missing out on critical internal information due to complicated existing collaboration tools requiring users a lot of work to search out information necessary to their daily work tasks and other needs [3], [4].

Last developments in cloud computing and a most structured approach to social media in the work place can change this situation. The managers can select employees to form individual teams for given business activities, the teams can work together with a greater efficiency, and employees can seek expert advice across departments, share, and download updated documents. The real-time collaboration supported by the new approach of cloud computing and social media enables individuals and teams to reduce the time previously wasted searching through inboxes or in file servers for important documents or content. Two studies carried out in Germany (within the European-funded projects ReadiSME – http://www.readisme.com, and NetKnowing 2.0 – http://www.netknowing.com) show that about 70% of SMEs use standard software what is an advantage because most services offered by CSPs are standard.

But in connection with Software as a Service (SaaS – see also section III) [5], the results of the studies show that 30% of ICT sector SMEs use SaaS, 75% of SMEs from other sectors did not have plans for using SaaS till the end of 2011.

Some causes that are often mentioned are that in many SMEs, particularly small ones, there is only one decision maker, there are security problems of outsourcing (85%), there is a lack of trust in what concerns the CSP (75%), there are concerns related to the integration of SaaS with the existing ICT in the company (30%), there is no support for large bandwidth Internet connectivity in the company

(81.2%), there are no precise rules in the company about the issue of social media and social networks.

European Network and Information Security Agency (ENISA) is also conducting a security risk assessment of cloud computing technologies aimed at giving advice to SME's on the most important risks in adopting cloud computing technologies, as well as ways to address those risks. The timeframe of the survey was prolonged from 2010 to 2012 and will investigate in deep the actual needs, requirements and expectations of the SMEs for cloud computing services. Up to now the ENISA survey [1] (published and updated regularly) focused on topics such as the driving forces towards adopting the cloud, the size and the geo-location of the company, the cloud models, types, and services of potential interest, the possible use of multiple CSPs, the recovery options in case of disasters and incidents, and obviously the main concerns facing such a paradigm shift.

III. CLOUD COMPUTING SERVICES FOR SMEs

In literature, there are clearly delimited three main classes of cloud computing services. Additionally, there exist other newly-defined classes that appeared as variants or reinterpretations of the main classes. Therefore, we have Infrastructure as a Service (IaaS), Platform as a Service (PaaS), Software as a Service (SaaS). All these services are available remotely via some communication channel and will require a payment for use (even though there are some free services available, especially in what concerns e-mail and social media web-based applications).

The first service made available by most CSPs was IaaS. In practice, it is a complete virtual machine running a specific operating system. For SMEs the suspicion regarding the multi-tenancy/sharing of resources is alleviated since the level of control and the possibility to define perimeters of resources among tenants is easier to achieve with this class of service. As said, the fundamental unit in IaaS is the virtual machine that is in most cases a server. A CSP may provide depending on the specific business of a customer four subclasses of IaaS: *vendor-managed private cloud*, *dedicated hosting*, *hybrid hosting*, and *cloud hosting*.

In a vendor-managed private cloud, the client rents a number of physical servers placed in the same area of the data center so that they are as separate as possible with other hardware and internetworking. This IaaS configuration is the most expensive but also it is considered the most secure. The flexibility and scalability of the solution are poor therefore an SME should be able to estimate and know in advance the needed infrastructure. All changes up the scale are slow and require interaction and timely scheduling with the CSP. This scenario works best for large enterprises building their own data centers and not for SMEs.

Dedicated hosting is for clients requiring one or more physical servers anywhere within a data center, available on-demand. In this service configuration, even though the hardware and internetworking is mixed with other servers from the data center, a particular SME will not share its rented servers with any other tenant in the CSP cloud. This is less expensive than the previous configuration and is both scalable and flexible as long as the CSP provisioning of resources is well handled for the peak periods.

An intermediate service configuration between the two above is hybrid hosting. With it, a client pays for a mix of costly physical servers (they may be occasionally required to be located in the same perimeter within the CSP's data center) and some inexpensive virtual server instances. The sensitive data and the applications of the SME run on the physical servers, while the rest of the data is stored in the virtual servers. The solution is flexible and dynamically scalable when it comes to renting more virtual server instances during peak hours. Physical servers may be rented but only if the customer accepted them to be anywhere within the CSP's data center.

The last IaaS configuration is what everyone expected from the cloud, technical and environmental efficiency. Lots of virtual server instances available on-demand with a high degree of scalability and flexibility in use, and at a very low price. The reverse of the medal is that a customer shares all the hardware and internetworking resources with the other tenants. A security and privacy perimeter can be achieved only at virtual server instance. It is the best commercial offer for SMEs and start-ups. SMEs may want to consider it since they do not have the capital and (perhaps, they are not willing to invest in) the know-how for the hardware-software infrastructure and management. Start-up companies find themselves in a happy scenario with the cloud since this could be a perfect business incubator at a very low initial investment cost.

PaaS is the second class of services in which SMEs may acquire only the specific platform they need. It is an extension of the IaaS to accommodate the middleware and to improve the performance in using it. It may be for example a web development platform containing the web/application server, the integrated development environment, the associated database and all additional utilities for development and testing. The tenants are sharing a large part of the middleware, and the CSPs can no longer distinguish some clear perimeters among them. Problems typically appear when the middleware is not as robust as expected or the shared databases are not well configured. The downside of this happening is that one customer may influence negatively the quality of the PaaS observed by the others.

Many European-based SMEs and start-up companies in the field of IT development and research may be interested in renting such highly customized platforms at acceptable low costs. Highly interested could be for example start-up firms working to deliver mobile applications for the extremely crowded market of smart mobile devices. They could then use this cloud service and produce and eventually sell their own on-line SaaS applications. Careful attention should be paid by the SMEs to service level agreements (SLA), to protection mechanisms enabled by the CSP for its tenants, and to business continuity (BCP) and disaster recovery plans (DRP).

SaaS is the third main class of services, and with it CSPs offer SMEs the possibility of acquiring on-demand usage-time for different types of software services. This includes a wide range of applications: office tools, graphic utilities, data

storage facilities, etc. SaaS is dynamically scalable, device independent (giving no access to the hardware for the tenant) and most of the applications are collaborative, allowing thus multiple users to share documents and work on them concurrently. Adding social media services through SaaS can only enhance this collaboration. The most common problems with this type of service are generated by the authentication mechanism, the management of authentication credentials by end users, the access control, the lack of securely tunneled communications, or intrinsic faults with the web applications used.

A. Advantages

They can be summarized in remote accessibility, flexibility, scalability, security, and environmentally friendly. Flexibility and scalability means that SMEs will only pay and use the resources they need and for the time they need them. CSP promise that provisioning and de-provisioning of resources will be transparent and easy to handle. Then, accessibility means that the business of the SME is no longer restricted to a particular location. Actually, for certain areas of business this is even more beneficial for the employees could work remotely and thus telecommuting and contributing to green computing. Most internal company servers use only approximately 30% of their capacity while in a large cloud data center the percentage of utilization goes up to circa 80% [8]. On a European scale this means that energy and consequently, carbon footprint reductions can be made. Furthermore, recent research in the field of microprocessors (e.g. Intel Atom, AMD Geode, VIA C7, etc.) proves that cloud computing users may use lower-power computers that are performing sufficiently to run cloud applications, thus cutting down the electricity bills and individual carbon emission footprints. Security as strange as it may sound has now a better chance to be well implemented (right from the start) than in any previous computing approach. In fact, Security as a Service is gaining momentum since it may represent a worldwide implementation of security standards, frameworks and regulations that will eventually minimize the existing security implementation differences or absence.

B. Concerns and challenges

First concern for SMEs is raised by the multi-tenancy property of the cloud. As we have seen, there are ways to counter this concern by acquiring only particular configurations of IaaS. Then, there is the performance and quality of the services offered by the CSP. On this issue, SMEs adopting the cloud into their business should carefully elaborate on the SLAs signed with the CSP. Another security concern is that users with administrative privileges on the side of the CSP might take an unauthorized look at their data. Procedures, frameworks, agreements and audits may facilitate a reasonable level of trust between SMEs and CSP. Associated with this last point are also de-provisioning of data and the way in which data are handled when SMEs are leaving the cloud plus the data geo-location. Data geo-location might create legal and compliance problems for SMEs when the CSP is not clear about where they have their

facilities. A *Buy European* approach would settle in a positive manner this issue in tandem with a stimulus offered to CSPs to have their installations on EU territory only [9].

IV. CLOUD ADOPTION RECOMMENDATIONS FOR SMEs

In what follows we will try to delineate some of the major areas of interest for SMEs when approaching the cloud. This set of cloud adoption guidelines that will be devised for European SMEs are based on the Security Guidance of CSA (Cloud Security Alliance) [10], ENISA cloud analyses, and Jericho Forum commandments [11], and will further elaborate on other areas of interest for SMEs. The cited documents are broad and thorough analyses of the subject. We believe that SMEs in particular would be better supported and encouraged to take advantage of the cloud if there were some specific documents containing the best practices and the guidelines for adopting the cloud into their business. Furthermore, standards, frameworks, benchmarks and regulations at EU level would help refining these guidelines and perhaps, they will also benefit from the ideas contained in these guidelines. CSA contributions in what concerns cloud security and privacy (Trusted Cloud initiative, Cloud Control Matrix, and Certification of Cloud Security Knowledge) are giving hints that this is the direction to be followed.

European SMEs are small in number of people employed (up to a maximum of 250 persons). It goes without saying that they would primarily invest their capital in improving their business process (production, services, etc.) and they do not always have the know-how to manage in-house the IT support infrastructure. In fact, ENISA found out that European SMEs are interested first of all in avoiding capital expenditure in hardware, software, IT support, information security (68.1% of the respondents). On the second place were the scalability and flexibility of required IT resources (63.9%), and on the third position were business continuity and disaster recovery capabilities (52.8%). ENISA survey proved that the highest percentage of SMEs willing to move into

The SMEs decision makers must understand well and fast what differences exist among different cloud computing solutions available on the market, what their costs are, what the security and privacy impacts are, and how their availability and acquisition may add value to their particular business. Decision factors must also decide what really matters for the SME business from a data security and privacy stand point and if there are any guarantees from the CSP to ensure data security and privacy (if possible, cryptography should be ubiquitous in the cloud or negotiated when performance reasons demand so, such that all data at rest or in transit be encrypted). This preliminary analysis must be performed just before initiating any other step. A related questionnaire for the decision makers would greatly simplify putting the things in context and providing some quick analytical results.

Certifications and benchmarking of the various CSPs would also be helpful. CSP transparency and openness for external auditing of their internal processes is also a sign of trust and a great control mechanism for SMEs. Auditing

preserves the level of trust of customers, and SMEs should investigate negotiate and pay attention to the terms agreed in contracts and SLAs concerning audit, monitoring, event log reviews, physical inspection of the CSP facilities, etc.

Special attention will be paid within the guidelines also to the legal and compliance implications of moving into the cloud for the SMEs. Proposals must be drafted towards a set of common practices to be followed when signing contracts and accepting SLAs. Awareness and dissemination instruments (social media) will be used to publish and bring into discussion the findings and real-case SME cloud migration scenarios. Cloud migration must be investigated not only at the first adoption of the paradigm, but also for cases when an SME decides to switch and move from one CSP to another. This investigation has legal, financial (on short and long terms) and technical implications related to deleting the data from the former cloud. Third trusted party audits and confidentiality agreements must be enforced.

ENISA found out that SMEs are mainly concerned with confidentiality of the corporate data, privacy, integrity and availability of services and data. It is important that SMEs rest assured by the CSP that their data will be private, available, and untouched. SMEs will have to answer themselves if they are ready to plan and enforce business continuity in cooperation with the CSP. Incident response and disaster recovery are related topics for which both CSPs and SMEs will have to agree upon and put in practice. A collection of best practices related to these topics will be shared among SMEs.

V. CONCLUSIONS AND FUTURE WORK

It is expected that the European SMEs will lead the global economic trend of adopting cloud computing paradigm within their daily businesses. EU Commission should further investigate through ENISA the need for a clear legislation in the field of cloud computing as a public utility of the following decade. Thus, a European Network of Clouds can be built upon, and also, participating third party CSPs could certify their services on various levels of compliance with that EU cloud legislation. This would encourage SMEs since trust is the base for economic development and creating new opportunities.

We strongly believe that the cloud adoption by SMEs could be further accelerated by establishing at least a set of guidelines including some recommendations and a book of good practices at European level. In our research, we have not found anything similar so far.

Our next effort is thus aimed to developing a short practical guide for using cloud computing and social media within European SMEs and to discuss these guidelines by conducting focused interviews with all the partners from the NetKnowing 2.0 project. A second step will be to disseminate these guidelines at European level also by using the social media-based platform developed within the same project and to organize moderated forums for discussing (and further improving) the guidelines and other issues concerning this topic. Last step is trying to apply the results and findings in SMEs from project partner countries and to

identify specific areas of organizational improvements both within European-based CSPs and SMEs consuming the cloud-based services.

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