Accounting and Management Information Systems
Vol. 10, No. 4, pp. 516–534, 2011

ENTERPRISE 2.0 – IS THE MARKET READY?

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ABSTRACT

Enterprise 2.0 family technologies have growing popularity, the cloud computing market is growing rapidly and, as a consequence, companies of all sizes start to evaluate the potential fit. The use of "Software as a Service", "Platform as a Service" and "Infrastructure as a Service" has been evolving during the past years and has become increasingly popular. As its computing viability and benefits are legitimized, the adoption rate is rapidly increasing. The most popular business model in the abovementioned family is by far "Software as a Service" (also called SaaS), which is a software distribution model assuming the software applications are hosted and maintained by the vendor or the distributor, and user access is granted exclusively by means of the Internet. Based on both literature review and action research, the paper at hand is a synthesis for the results of an empirical study performed during the last two years among Romanian and foreign companies, in order to outline and provide an objective and unbiased answer to the question: "Is the market ready for these technologies or did they come too soon?". The paper is a part of a larger research performed by the author in the field of Enterprise 2.0 technologies.

Enterprise 2.0, Software as a Service, Platform as a Service, Infrastructure as a Service, Empirical study

INTRODUCTION

As the *Enterprise 2.0* family of technologies is evolving and facing ever-growing adoption, we can also observe the development of some next-generation business models for the purchase and use of business software applications, business platform and business infrastructure components. The "flagship" of these new models is, by far, "*Software as a Service*", usually abbreviated *SaaS*, which has evolved to be a quite common practice for *Enterprise 2.0* – specific software distribution (Menken, 2008).

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As semantic technologies penetrate and consolidate the modern organizations business processes, the traditional "sales" of business IT architectural layers (software, platform, infrastructure) give up in front of the new business models, as the consumers become aware of the simplicity and the efficiency of this new practice (Fan *et. al.*, 2009). Based on a recent empirical study performed by the author, the paper at hand is an attempt to figure out whether this "movement" towards cloud computing is the advent of a new era in business IT, or just a fragile "wave" of interest for a novelty.

1. RESEARCH METHODOLOGY

This attempt is part of a larger research performed by the author in the field of organizational memory and *Enterprise 2.0* technologies, and also continues a previous doctoral research in the field of computer-assisted financial audit tools and techniques, whose final results were publicly defended in order to be validated by both the scientific and academic community. The main goal of the aforementioned research was the identification of some new areas of applicability for the modern knowledge-based information technologies in the field of financial audit.

When possible, a direct identification of the practitioners' expectations was attempted by means of direct interviews and also by means of the empirical study questionnaire. The questions for the empirical study were carefully designed so as to get unbiased, objective answers. The members of the target group were encouraged to add their own observations regarding the questionnaire. Validation of the research conclusions was performed by means of an informal discussion with some "real life practitioners", members of some companies which performed or are in the process of performing the shift to *Enterprise 2.0*. In case some other author's opinion was enclosed in the paper, whether in exact quotation or synthetic form, a complete mention of the source identification information was made. Some of the data in the paper is based on the results of some previous market research studies that were credited accordingly.

The author has over seven years of previous experience in the research area, and also a series of previous research results (published articles, conference attendances and doctoral research). By defending the research results at the proceedings of such a prominent scientific conference, attended by both scholars and practitioners bearing some interest in the research area, the author attempts to get further validation of his opinions, both confirmation and rejection of the aforementioned opinions' scientific and practical importance being welcome.

2. OLD vs. NEW IN GETTING BUSINESS SOFTWARE

Traditionally, software applications are regarded as products, or as assets, both for the producer and the consumer. They are usually bought by the consumer, which may be considered the owner of a copy of the program (Cusumano, 2004). The customer pays a license fee which renders him the right to install and use the software application in

a certain hardware configuration and for a certain number of users. In most of the cases, the software may be used for an unlimited time period, but on a single machine. The consumer might also pay a periodic fee, usually 5 to 25% of the initial price for update, maintenance and technical support services. From the accounting point of view, software applications are "capitalized", which means they are to be presented as an asset in the buyer's financial statements (Iod, 2002), and suffer depreciation based on their acquisition value and presumed lifespan.

The "standard" model of software as a product has been adopted mainly due to the tremendous success of some software producing companies like *Microsoft, Oracle* or *SAP*, which were proud to report the huge profits obtained. But aside from the "success stories", the situation is very similar to the music industry, being almost exclusively based on "hits" or "breakthroughs", which are extremely advertised software applications being of great interest for the large public (Haines, 2008). However, the software products which are not regarded as "hits" by the market and the general public usually get much smaller profits, and their producers are almost always on a narrow line between profit and loss. Moreover, the top software producers almost never adopt the open standards which allow for free data transfer among applications. "Sealing" the applications, limiting the user's choice to a few proprietary formats and avoiding any possibility of converting documents to the formats of the direct competitors were always "features" of the top software producers, despite the major drawback they represent for the consumers and the final users. Once a company has become a customer, its possibilities to migrate to a cheaper or better product were drastically reduced (Gannod *et. al.*, 2005).

Even if the aforementioned analysis reveals a series of important benefits, using software as a product is also marked by a set of major issues. In most cases, the software application is downloaded from the vendor's website, and installation and setup are the exclusive task of the customer. As a consequence, the software application has to be prepared to run in heterogeneous, unstable or unforeseen environments (Pohl *et. al.*, 2005). The software application is usually installed across the customer's network, on hardware configurations and operating systems installed and configured by the customer. At least in theory, the software application has to be able to face any challenge in terms of configuration and operate in any environment, with any set of parameters. According to the author's, reaching this goal is extremely expensive for the application's developer.

The second major drawback software developers have to face is the "cross-platform" support for their software, or the support for multiple operating systems. When a software developer intends to get a significant market share for its product, it has to develop a few separate versions of the software, one for each major operating system (*Windows, Linux, MacOs, Unix*). The more than significant differences among the aforementioned operating systems render just a small part of the application source code usable in all the versions, the development of four or five almost different

applications (one for each operating system) being required in most of the cases. The negative impact on the software developer is obvious in this situation. A large quantity of time and human resources, which otherwise might be used for adding new features to the application, is used instead to test the software on different operating systems, on different operating systems' versions, or on different hardware configurations (Haines, 2008).

The drawbacks often affect the consumer, too. In most cases the cost of installation, setup and configuration for the purchased software applications are significantly larger than the purchase cost *per se*. Each organization has its own network, having many features and idiosyncrasies and, by consequence, aspects as the network topology or hardware incompatibilities have to be foreseen, taken into account and dealt with. Even for the most popular applications, which usually are thoroughly tested and adequately documented, the system or the network administrators take major risks for each setup and update of the software.

As a result of the aforementioned drawbacks, both software application developers and their customers are eager to adopt a new model for the development and the distribution of such applications, usually known as "*Software as a Service*" and abbreviated *SaaS*. Even if the model is around for a few years, being far from a total novelty, the difference resides in its recent success registered as a consequence of the high compatibility with the *Enterprise 2.0* family of technologies (Blokdijk, 2008). The *SaaS* success during last few years is tightly interconnected with the advent and the rise of the *Web 2.0* technologies. As network connection and Internet access are ubiquitous, the business model behind the new approach may be accessible for the vast majority of software consumers. Web applications have reached a maturity level allowing on-line users to get the same experience and facilities as from traditional, off-line applications (Heydarnoori *et. al.*, 2006). In the author's opinion, a comparison of the Web-based e-mail management suites (like *Gmail*) with traditional e-mail client applications as *Microsoft Outlook*, or a comparison of the traditional *Microsoft Office* suite with the *Google Docs* on-line suite may be enlightening.

Cloud computing applications are faster, simpler and cheaper to use, as there is no involvement of capital requirement for servers or storage and operational expenses for running a large data center (Buyya *et. al.*, 2011). Cloud industry is growing quickly and vendors are investing significant amounts of money to develop solutions-as-a-service, suggesting they believe in the success of this technology as an alternative to traditional IT solutions. A very large scale study, performed by *Gartner Inc*. (Krautheim, 2009), the world's leading information technology research and advisory company, revealed that for the 2008-2013 time interval, an impressive growth of the *Enterprise 2.0* and cloud computing market is predicted, from 9.1 to 26.6 billion $. In order to get a better view of the facts, the *Compound Annual Growth Rate* (or *CAGR*) was chosen to be computed. The compound annual growth rate is calculated by taking the n^{th} root of the total percentage growth rate, where n is the number of years in the

period being considered. Taking into account that the estimated growth is not considered to be linear (or constant), the *CAGR* allows for results comparison, both intra-industry and cross-industry. The following formula was applied (Formula 1):

Formula 1. **The Compound Annual Growth Rate**

$$CAGR = \left(\frac{Ending\ Value}{Beginning\ Value}\right)^{\left(\frac{1}{Nr.of\ years}\right)} - 1$$

(*Source:* Grundfest, 1990:350)

A value of 24% is computed for the *CAGR*, based on the aforementioned formula. In the author's opinion, the growth rate has a definitely large value, which renders the *Enterprise 2.0* as a mature, settled set of technologies. A ten billion dollar market, having almost 25% growth per year does not appear based on an experiment or a single "pioneer" company. A company moving from *SaaP* to *SaaS* becomes more and more a trend follower than a trend setter.

According to the author, the general support or interest for *SaaS*, which is clearly observed for the majority of the corporate software consumers resides in the rapid adoption of the *SaaS* business model by the small companies in the fields or industries requiring many complex (and often overwhelmingly complex) software applications. Using software as a service was mostly attractive because it allowed to small companies having a minimal IT department (or having no IT department at all) to use software application otherwise out of reach due to installation, configuration and maintenance issues not manageable in the absence of a well-staffed IT department. A large multinational company almost always affords to assemble a team of professionals in order to properly install, configure and manage networks or large-scale software applications, but a small company almost never can afford such costs.

In our opinion, the second major benefit of software as a service is that the customer is allowed to pay only for what he really needs. The vast majority of corporate business software applications come with a fixed minimal cost of the hardware, installation and configuration efforts involved, usually computed for a large-scale department. Even if the department dimensions are significantly smaller, the cost is much less elastic and does not fall back accordingly. As a result, small companies are often forced to support cost levels similar to the ones of the large companies. Using *SaaS* allows the customers to significantly reduce the aforementioned costs, as they usually are charged based on the amount of time, storage space or application resources used. Even if the advantages are obvious, it is not to expect that all companies will unconditionally (or blindly) move to the new technology, without a shadow of a doubt. Thus, one question of main importance, included in the aforesaid empirical study, requested the members of the target group to state their key buying (or not buying) criteria. Four main criteria were provided (cost, scalability, expertise and

operational stability), and the respondents were encouraged to provide their own criteria, if not in the list. The weight of each main criterion in the answers received is stated in Table 1:

Table 1. **The weight of each main criterion**

CRITERION	***WEIGHT***
Cost	80.2%
Operational stability	74.6%
Scalability	32.9%
Expertise	25.8%

In the author's opinion, the results may be explained as follows:

- ***Cost*** – the size of the expense implied by moving to *Enterprise 2.0* is still the most important of the criteria. As the switch to *SaaS* is mainly taken into account by small or medium sized organizations, unable to afford large IT departments, this kind of companies was the main target of the questionnaire. Even if moving from *SaaP* to *SaaS* is attractive due to the small IT costs on the long term, the immediate costs of the process are still an important concern for the potential customers. In a previous paper (Mangiuc, 2010), the author provided a model and a set of results in the field of computing *ROI* (*Return on Investment*) for an *Enterprise 2.0* implementation.
- ***Operational stability*** – most of the managers are concerned about the impact of the "movement" on the organization's current activity. Small companies usually fight a lot for their market share and, due to the fierce competition; a temporary shutdown of their services is usually out of question. In this case, it is the duty of the "cloud mover", or the service provider to develop and present a strategy allowing the customer's transition to *Enterprise 2.0* without compromising its operational stability. And with a 74.6% rate of concern, building such strategy will be no easy task.
- ***Scalability*** – most of the respondents do not regard scalability as an important concern, and this is mainly due to the aggressive advertising campaign of the "cloud movers", which claim that adopting software as a service usually comes with unlimited scalability at almost no cost. Even if this is mostly true, the collateral scalability costs have to be taken into account. For example, if a new branch office of the company is opened, the cost of the extra software access required by the software provider is usually small, but the costs of the underlying hardware and network communications infrastructure may not be as small as the amount paid to access the software applications from within the new location.
- ***Expertise*** – the lack of expertise in migrating to the cloud seems not to be an important concern for the customers, as they regard this kind of expertise mostly as an additional service provided by the migration assistant or by the *Enterprise 2.0* services provider. In most customers' opinion, the migration

expertise is to be bought from the provider, not gathered by the customer itself (Buyya and Bubendorfer, 2009).

In addition to the four aforesaid criteria, the respondents also provided the following additional buying criteria (presented in the reverse order, by number of occurrences):

- ***Security-related services (81%)*** – according to the survey results, security seems to be a top priority for the potential customers, and usually, the first questions asked by a company before moving to cloud are all about security issues. Even if customers who admit that their own information systems have serious security issues are quite hard to convince about the secured environment of the cloud-based services. In the author's opinion, this behavior is mainly due to the fear of the unknown, and if improperly handled, it may become a real deal breaker, even more important than cost. The provider of the *Enterprise 2.0* services usually has to explain in great detail the security measures related to the following procedures:
  - Protection of data during transit and in storage (obfuscation, cloud-specific storage etc.);
  - Encryption and decryption algorithms (strength, implementation);
  - Disaster recovery policies (backup systems, disaster recovery plans etc.);
  - Restricted access, intrusion protection and firewall services;
  - Security documentation and certifications;
  - Data security procedures related to the termination of service.

  Tightly related to the security issues are the legal issues of the cloud-based business model. Most of the potential customers are very interested in the legal jurisdiction and framework applicable for each potential contract they will agree on, as well as the legal authority that is able to decide in case of litigation.
- ***Service and support (73%)*** – most customers look at moving to cloud and using *Enterprise 2.0* as a milestone of their business activity and are very concerned about the support they will get to successfully accomplish the process. As most providers claim 24/7 availability for their services, most customers also expect 24/7 technical support, at least in the first stages of the transition. Most of the respondents required full time support for their employees, as the final users of the service, not particularly for the IT department and staff. In the author's opinion, most of the potential customers feel like their business processes will be somehow "outsourced", or look at moving to cloud computing as a "leap of faith" (Walsh, 2009), so as full time service and support are fundamental prerequisites for the success of the migration.
- ***Flexibility (73%)*** – a large part of the respondents were concerned about the ability of the provider to integrate and manage hybrid environments, which will allow the customer company to leverage their cloud services while also augmenting their internal IT capabilities. Large heterogeneous environments are frequently due to a large number of legacy systems, to previous evolution

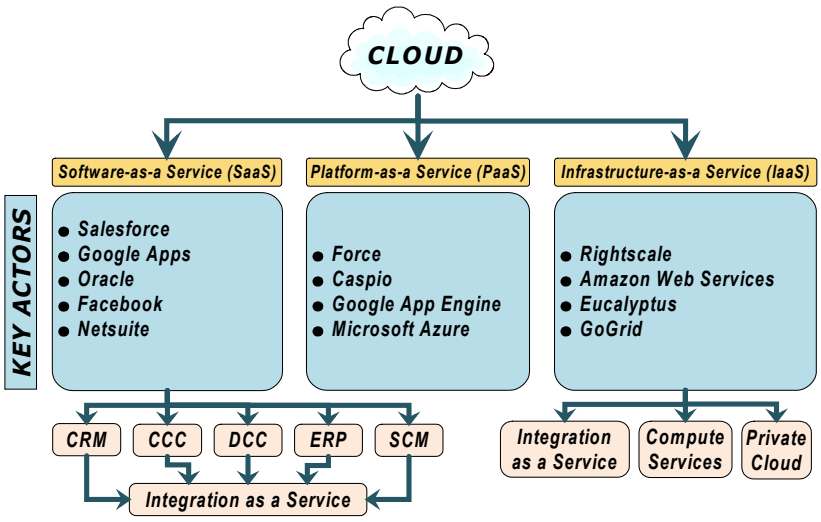
attempts, or to previous failed or successful cost-cutting attempts. However, *Enterprise 2.0* services providers always advertise the "universality" of the cloud computing, as well as the "full availability" of the provided applications and services, for computers which have "only a Web browser installed". As a result, most customers expect almost unlimited flexibility, and also assume their entire IT infrastructure will be fully functional in the cloud.

- ***Performance (72%)*** – since the advent of Web applications and Internet-based computing, some voices complained about the "performance gap" between desktop applications and their on-line counterparts (Youseff *et. al.*, 2008). For almost a decade, Web applications were regarded as a palliative, incomplete way of replacing traditional desktop applications. Even if broadband Internet and the huge technological advances made the border between desktop and Web more and more hollow, some traditionalist customers still fear about a performance decrease when moving from traditional to cloud-specific computing techniques. When analyzing the current offer of cloud computing solutions, we may discover that the fear is not completely ill-founded. Most potential customers should assess the cloud provider's capabilities at the sub-segment level (i.e. *CRM, SCM*, and *ERP*) due to large differences in the sub-segments maturity and performance.
- ***Availability (72%)*** – most cloud services providers show off a lot about the 24/7 availability of their services and, consequently, even a minor stop of the service (a few minutes) is regarded as a small disaster. For example, if Google document management or e-mail services become unavailable, even for a few seconds, the media makes a lot of hype on the subject. If this happens for a provider whose services are mostly free of charge, it is obvious that unavailability of a paid service will be very harshly sanctioned by the customers. Some of the respondents even asked about the existence of contractual clauses and compensations for the service unavailability periods.
- ***Issue resolution (68%)*** – some of the potential customers feel that the general phone-based or Internet-based support is not enough for such an important choice like migration to the cloud and, consequently, ask for direct assistance in issue resolution. On the other hand, most of the *Enterprise 2.0* services providers are quite reluctant to provide direct support, especially when it implies sending own employees to the customer's location. Moreover, the location of the provider may be in a different country, or even on a different continent than the location of the customer. In order to fill this gap, a new kind of business raised during the last years, offering "cloud moving services". Having a strong contractual basis with both the service provider and the customer, the cloud mover company offers to assist the customer as an external consultant, compensating for the provider's lack of ability to provide direct support.
- ***The billing model (67%)*** – migrating to cloud-based services implies, for most companies, a re-design of their perspective of IT costs. Switching from

local to cloud usually leads to important savings on server hardware, software licensing, infrastructure maintenance and administration labor costs. Even if the main reason to embrace *Enterprise 2.0* is a significant decrease of the IT-related costs, some customers may be suspicious at first when facing the cloud-specific billing models. One main advantage of the cloud is the ability of the customer to pay only for usage. This model applies for all the layers of *Enterprise 2.0* (*SaaS, IaaS, PaaS*). Even if the information that customers "will only pay for what they use" is ubiquitous, there is no uniform unit yet. The service provider may charge based on the Internet bandwidth used, the storage space employed, or the *instance-hour* for each provided service (the service provided for one hour to one computer of the customer).

- ***Years of experience and customer portfolio (66%)*** – even if the cloud is still very "young" among the IT-specific approaches, some of the main players on the market (like *Google, Oracle or Microsoft*) may already claim to have significant experience with moving customers from local to cloud-based services. A large number of respondents admitted that in case of an eventual migration, they would more likely choose a "big" name in the field (like the three abovementioned companies), than a newcomer, even if the latter has a much better offer in terms of costs and support policy. Some of the respondents even admitted that having the leaders of their industry or branch in his customer portfolio may be the best reference an *Enterprise 2.0* services provider can get.
- ***Quality of the applications hosted in the cloud (42%)*** – the cloud computing is new, but still old enough to be prone to competition. As presented in figure 1, there are multiple offerings for each family and sub-segment of the cloud-based set of services.

Figure 1. **Cloud computing families and sub-segments**



When analyzing the potential cloud computing solutions, companies should assess each cloud provider's capabilities at the sub-segment level (i.e. *CRM, SCM, ERP*), due to large differences in the sub-segments maturity. For each sub-segment, a set of representative players have to be selected based on their offer, individual maturity, and the role they play within their sub-segment. The current landscape of the cloud services offer is a mix of new and recent niche players competing with more established software and hardware vendors. The providers have to be compared based on the following criteria (at least):

- Domain of activity;
- Date of first cloud release;
- Year-on-year growth (for example, 2009 to 2010);
- Key differentiators;
- A sample of key clients;
- A sample of key partnerships;

- ***Business process services (23%)*** – in some cases, migration to cloud computing may have a greater effect than usual on the structure and dynamic of a company business processes. Consequently, the potential customer may consider that the re-engineering of the affected business processes is a part of the *Enterprise 2.0* implementation process, leaving this task for the cloud service provider. The provider, on the other hand, has seldom enough knowledge of the customer's position and business model details to provide valid advice in re-modeling the business process. In the author's opinion, this is another situation where the expertise of a *cloud mover* or a consultant company would make a significant difference.
- ***The exit plan (11%)*** – due to business consciousness (or just distrust), a small group of respondents considered that a valid exit plan should be part of the deal. Most of the expressed concerns were about data security after the cloud-based service use is discontinued, and also about a proper service cancelation procedure in case of a switch to a new provider, which should be able to access and copy business data from the old one. The question also applies for the situation of a return to the software and business model that the customer had before moving to the cloud. Another issue brought into discussion was the provider's treatment of sensible business data in the case of a late or overdue payment for the service.

The analysis of the aforementioned criteria reveals that even if most of the potential customers are rather interested in a migration to the cloud, they would agree to take this step only after getting reasonable assurance about the safety and the sustainability of the approach. As a result, the author considers that the main players on the *Enterprise 2.0* market need a "change of tone" in their advertising campaigns, with less emphasis on marketing promises and more answers to the key "fears" of the potential customer.

Despite all the aforesaid advantages, we consider the *SaaS* model not to be a universal solution for all the corporate business software issues. According to some of the quoted authors (Heydarnoori *et. al.*, 2006; Blokdijk, 2008), the new model will never replace the traditional model entirely, but will provide an increasingly better alternative to the software as a product. We also consider there are a set of major issues and a set of business areas where *SaaS* has less of a chance to succeed. According to the author, most of the issues originate from the fact that the customer is required to have extremely strong confidence in the software service provider. In some situations, granting such confidence to an outsider may be considered as a proof of irresponsibility and may even compromise business continuity. For example:

- A large multinational company producing candy and chocolate products should never let a software provider store and manage the secret manufacturing recipes for the products.
- A government agency processing secret or confidential information should never let an external service supplier manage its data sets.
- A healthcare institution taking the confidentiality of their patients' medical history very seriously, should not hand the management of the medical history data to an outside service provider.
- A bank should never let a service provider manage all the customers' financial information and even perform transactions on behalf of the customers.

Some other aspects here are open for interpretation. For example, the issue of the legal framework applicable in such contexts: to what extent has a Romanian company using applications hosted on Cayman Islands servers to comply with the local and the remote legal framework (Hall & Frey, 2007).

All the aforesaid issues diminish as the distributors of such applications provide solutions for the privacy, security and trust-related problems. Even though, the list of questionable practices remains open. For example, the *SaaS* model does not provide the means for the service consumer to locally store his own data. The customer's data are stored in the application provider's data center, placing the Internet between the customer and the provider. Consequently, any malfunction of the application provider's system or the customer's *Internet Service Provider* (*ISP*) renders the application unusable for the customer. Moreover, a malfunction of the application provider's system renders the application unusable for *all* its customers, which may be hundreds, thousands or millions of people or companies. The advantage of a centralized application management is the significant cost decrease, but the "dark side" of the matter is that any malfunction affects everybody. In the author's opinion, a *SaaS* offer can easily become the victim of its own success if inadequately managed. A rapid increase in the number of customers not followed by the necessary increases in bandwidth, security systems, backup systems and staff may throw into chaos an otherwise successful project. Obviously, the "software as a product" model is also prone to disasters, but the malfunction only affects a customer or a small group of

customers, not everybody in the same time. Even if the customer's IT team is able to get involved swiftly in case of a malfunction, its expertise level in debugging the application is significantly lower than the application developer's.

As a *SaaS* application provider, the merely existence of the company and business process depends on the provided application's availability. The large providers of *SaaS* (like *Google*) are always bragging about the "24/7" availability of their applications and, by consequence, any malfunction, even a partial or limited one, is severely penalized by the media and also by the customers. The above is true even for the free applications, but in the case of commercial ones, a serious malfunction may irreversibly damage the image of the provider. On the other hand, investing in security and backup may be somehow appealing for a *SaaS* provider, as the benefits of the investment are simultaneously "delivered" to all its customers.

The landscape of the Software-as-a-Service market is divided today into a few main sub-segments:

- ***Customer Relationship Management (CRM)*** – The "on demand" *CRM* market is one of the most mature sub-segments in the *SaaS* market. The first players arrived on the market in early 2000 and, since then, the market has grown towards maturity. According to analysts (Walters and Newton, 2010), the *CRM* "on demand" market will generate more than 2 billion *USD* in 2011 and will represent more than 20% of the entire *CRM* market.
- ***Enterprise Resource Planning (ERP)*** – *ERP* defines a broad area of sub-categories, from human resources to financial management. Today, most of the *SaaS ERP* customers are midsized companies. Large corporations are still confronted with limitations due to the complexity of their needs preventing them from entirely embracing cloud *ERP* solutions.
- ***Supply Chain Management (SCM)*** – Supply chain management applications are those that allow companies to improve externally oriented processes, to manage selected portions of their supply chains, and to control their supplier base.
- ***Content, Communication and Collaboration (CCC)*** – The content, communication and collaboration market varies in the maturity of its sub-segments. Adoption rates range from a high use of *SaaS* (where 60% of all e-learning solutions are *SaaS*-based) to medium (10% of e-mail) and low adoption (only 2% of enterprise content management systems run on *SaaS*).
- ***Digital Content Creation (DCC)*** – *SaaS* currently represents a small part of the digital content creation market. This market relies, more than others, on customer decisions; consequently, as the consumer's appetite for digital video (*Youtube, MySpace*...) shows tremendous growth and online image editing software versions (e.g. *Adobe Photoshop Online, Picasa*, etc.) are appearing, many evolution directions are ahead for digital imaging and video.

3. FURTHER DEVELOPMENT OF THE *SAAS* MODEL – *INFRASTRUCTURE AND PLATFORM AS A SERVICE*

The interest for cloud computing in the infrastructure market has grown substantially during the last five years, and so have the investments (Ashta & Patel, 2010). Several infrastructure services have been re-labeled and this causes confusion between the various offerings. From *outsourcing*, the market has already moved to *infrastructure utility* and, as cloud computing grows, infrastructure utility is becoming *Infrastructure-as-a-Service* (*IaaS*). Today, public cloud infrastructure is not yet able to provide a complete offering to companies and therefore the market is growing slowly, being still based on the early hybrid cloud models. The main areas of interest for this market are considered to be:

- ***Backup & storage services*** – In the online backup and storage services market, price competition is high, forcing providers to keep costs low to maintain profitability. Consequently, the providers are looking to gain their benefits from economies of scale.
- ***Compute services*** – The key added value offered by compute providers is elastic computing power, which can transparently cater to the organization's fluctuating needs. Currently, on demand compute services is at an early stage.
- ***Private cloud computing*** – A private cloud environment is a solution that enables companies to centralize their IT resources instead of working with separate environments. The advantages for companies include the ability to access a pool of resources that offers the flexibility and scalability to handle fluctuating demands, and cost savings through "on demand" provisioning of virtualized resources.

As a result, the idea of providing technology "by request" is no longer limited to software applications, but is also extending to some other areas, as the infrastructure or the hardware system. The term "*Infrastructure as a Service*" (or *IaaS*) is used far less than *SaaS*, but is becoming a more and more important component of the *Enterprise 2.0* family of technologies. For example, the *Amazon* company, worldwide renowned for its virtual store and generally considered the largest book seller in the world, started to provide *IaaS* services, the most successful one being *S3* (short for *Simple Storage Service*). The service allows companies to rent data storage capacity, paying only for the occupied space. Even if the service, in its essence, is a very simple one, it allowed for the development of a whole suite of third-party applications aimed at access and data management, the very low prices asked forcing to a general decrease in the price of the Internet-based data storage services (AWS, 2009). The *S3* service may be used as a back-end for any software application (traditional or Web-based), its major strong points being scalability and extreme flexibility. A consumer of the *S3* service in need of a significant and immediate increase of the *S3* storage space does not have to do anything to get it, but use as many data storage space is needed, a subsequent payment being performed, depending on the subscription terms.

There is no need a to add and configure new drives or storage units, and there is no need to contact *Amazon* in order to ask for a supplement, the whole process being implicit, when the new files of the customer are saved on the provider's storage servers. So, the customer gets instantaneous and smooth scalability for the infrastructure provided as a service.

A second member of the same family of services, is *EC2* (short for *Elastic Computing Cloud*), consisting in a set of virtual machines which may be rented by the customers. The virtual machines are usually based on open-source software (*Linux*, *Apache*, *MySQL*, *PHP*) and are able to instantaneously scale up or down, depending on the customer's needs for the server. This service also had a price so low, that a general decrease in the price of the hosting services occurred. As the customers only pay for what they use, there is no minimum price (AWS, 2009).

Although having generated considerable interest, *Platform as a Service* is still an early-stage market. The software development platform providers have broadened their scope to enable multi-tenant development and by leveraging their presence in the *SaaS* market, are bringing these platforms to the market as *PaaS* solutions.

Another technology having a solid contribution for the success of the *SaaS* model is *virtualization*, which is the abstraction and the re-partitioning of the existing hardware resources (Battle & Benson, 2008). The procedure provides an increased application independence of the hardware configuration, allowing processes or operating systems to execute in total isolation. A virtual machine is a "guest" operating system which executes over a "host" operating system, and the technique releases the guest operating system from dealing directly with the hardware components. According to the author, the main advantages of virtualization are:

- ***Server consolidation*** – more physical servers are "concentrated" in a much more powerful virtual server, with a significant decrease in the cost of the processing unit.
- ***Server partitioning with resource limitation*** – allows for a physical server to be "broken" in a set of virtual servers, and also for a very detailed limitation of the resources each virtual server (or *partition*) is allowed to use.
- ***Application sandboxing*** – provides a security and isolation mechanism for an application or operating system, allowing it to execute completely separate from the other applications and operating systems sharing the same physical resources.
- ***Management of the development and testing platforms*** – allows for the easy simulation of the different execution environments, a useful tool for software applications development and testing.
- ***Rollout, rollback and patching*** – allows simplifying the application update process, by means of the update rollout and updating rollback, both at the application and the operating system level.

The use of the virtual machines significantly increased the efficiency of server resources management, allowing for a significant decrease in the total amount of hardware that needs to be deployed, installed, configured and maintained. Some *Internet Service Providers* (*ISP*'s) employed virtualization in order to simultaneously execute different operating system instances on the same physical machine. The instances are then offered to the customers as *Virtual Private Servers* (or *VPS*). Five years ago, the *ISP* had to buy, install and configure a physical server for each customer in need of a server hosting, rendering the server hosting process very expensive, even prohibitive for the small companies which did not need the whole power of a physical server.

Platform-as-a-Service (or *PaaS*) is a set of web-based services that provide all the facilities required to support the complete life cycle of building and delivering web applications and services, where the user is typically within the software developing organization. Most *PaaS* systems are hosted, Web-based application-development platforms, providing end-to-end or, in some cases, partial environments for developing full applicative programs online. They handle tasks from editing code to debugging, deployment, runtime, and management. In *PaaS*, the system's provider makes most of the choices that determine how the application infrastructure operates, such as the type of operating system used, the APIs, the programming language, and the management capabilities. Users build their applications with the provider's on-demand tools and collaborative development environment. Despite its high technological interest, *PaaS* adoption is slow to take off because the *PaaS* solutions are relatively new and still lack standards.

PaaS remains an early-stage market with revenue of around 50 million USD, which represents approximately 1.5% of the total application development market. Despite the massive investments vendors such as *Microsoft, Google* and *Salesforce* performed in *PaaS* technologies, the *PaaS* market remains immature and most vendors still have proprietary and differing programming standards. As a result of its high technological interest, and also because *SaaS* is growing sharply, the *PaaS* market will experience a high growth in the coming five years (estimated to be around 50% of the present value) and reach 400 million *USD* in 2013 (10% of the total application development market) (Lawton, 2008). In the next years the confidence in the *PaaS* model is expected to grow, so more organizations will build their applications in *PaaS* environments. Organizations will be encouraged to experiment the *PaaS* development, taking advantage of the familiarity and previous experience they have with their *SaaS* solutions.

4. MAIN RISKS IN ADOPTING *ENTERPRISE 2.0*

Another key set of questions included in the aforesaid empirical study tried to identify the main risks that members of the target group consider to assume in the eventuality of an *Enterprise 2.0* implementation. As the question was open-ended, a lot of

different answers were received, so the author re-arranged the answers by grouping them into fewer categories (based on similarity or resemblance). In the descending order of occurrence, the main risks in adopting cloud-related technologies were stated as follows:

- ***The loss of governance*** – moving to the cloud forces the customer to accept the control of the service provider on a quite large number of important issues and areas of the own business process. This loss of control is widely perceived as a very large potential security breach and it may be the main reason customers tend to choose service providers having a frontrunner position on the market, or, at least, a very good and well established reputation.
- ***The lock-in*** – most potential customers feel there is currently little on offer in the way of tools, procedures or standard data formats or services interfaces that could guarantee data, application and service portability. This can make it difficult for the customer to migrate from one provider to another or to migrate data and services back to an in-house IT environment.
- ***Compliance risks*** – some of the respondents stated that part of their investment in achieving certification (e.g. to an industry standard or to a set of regulatory requirements) may be put at risk by migration to the cloud. In most cases, the compliance test process will require the cloud-based services providers to produce evidence of their own compliance with the relevant requirements, and, in some cases, even to permit audit by the cloud customer. In a few situations, even the use of a public cloud-based infrastructure implies that certain kinds of compliance cannot be achieved.
- ***Data protection*** – as previously stated, cloud computing poses several data protection risks for both cloud customers and providers. In some cases, it may be difficult for the cloud customer to effectively check the data handling practices of the cloud services provider. On the other hand, some cloud providers do offer exhaustive information on their data handling practices. Some also offer certification summaries on their data processing and data security activities, and fully describe the data controls they have in place.
- ***Management interface compromise*** – the customer-usable management interfaces of a public cloud services provider are accessible through the Internet and, consequently, mediate access to larger sets of resources (than traditional hosting providers), posing an increased risk, especially when combined with remote access and Web browser vulnerabilities.
- ***Insecure or incomplete data deletion*** – when a request to delete a cloud resource is made, as with most operating systems, this may not result in true wiping of the data. Associated with the use of multiple tenancies, and the reuse of hardware resources, this may represent a higher risk to the customer than using dedicated hardware.
- ***Malicious insider*** – while usually less likely, the damage which may be caused by malicious insiders is often far greater. Cloud architectures

necessitate certain roles which are extremely high-risk. Examples include the cloud services provider's system administrators and managed security service providers.

- ***Isolation failure*** – multi-tenancy and shared resources are defining characteristics of cloud computing. This risk category covers the failure of mechanisms separating storage, memory, routing, and even reputation between different tenants.

In the author's opinion, most of the aforementioned risks are basically security concerns due to the migration from one business model to another. Most of the risks also have counterparts in the traditional, software-as-a-product model and are far from being cloud-specific. It is obvious that potential customers need in-detail knowledge of the security system that the cloud-services provider offers, but they also need to re-assess the own security systems, in order to perform a fair comparison.

DISCUSSION AND CONCLUSIONS

The *Enterprise 2.0* technologies have led to the advent and development of new business models for the IT-specific needs of an organization. *Software-as-a-Service* (*SaaS*), *Infrastructure-as-a-Service* (*IaaS*) and *Platform-as-a-Service* (*PaaS*) are just the first "wave" of such models facilitating the access of small and medium organizations to advanced IT-management tools traditionally reserved for the very large companies. Based on the results of an empirical study, the paper is an attempt to identify the general attitude of the potential customers towards moving to cloud computing, and also, the key orientation criteria for the aforementioned group. As revealed by the results of the survey, most of the potential customers are generally eager to implement cloud-based technologies in their organizations, but only as a result of a well-thought and detailed migration strategy. The initial key buying criteria provided in the survey were completed with a few more by the respondents, demonstrating a precautious and mature attitude towards going through a process which small companies usually cannot afford to fail. Employing *SaaS* implies a series of major changes in the way software applications are licensed and used. Many challenges arise, both for the software services providers and for the software consumers, but *SaaS* is able to provide both sides the benefits of a new and efficient software distribution model. The main benefits for the consumers usually reside in the decrease of the infrastructure expenses and immediate access to the latest version of the software applications they use. As for the software developers, they are able to get improved feed-back from the users of their applications, leading to a general decrease in the development costs and, as a result, an increase in the profit margin of their product. Moreover, the *SaaS* model is not the only successful initiative of this kind. Due to the almost unlimited possibilities offered by the virtualization process, infrastructure also becomes a service, significantly decreasing installation and maintenance costs for the hardware systems and the network (infrastructure management costs). The *SaaS* market is the most successful segment of the *Enterprise*

2.0 family, and its success leverages the growth of the *IaaS* and *PaaS* markets, which are still in early stages, but with tremendous potential for the next five years. The respondents identified a set of major risks in adopting cloud-based technologies, and the identified risks may be regarded as key improvement areas for the cloud-based services providers.

The adoption of the new software distribution model will not happen overnight, but will become a gradual process, having a variable growth rate, but, according to the author, the first companies to discover the benefits of the new model, and the companies willing to adapt in order to get the benefits, will gather significant competitive advantages from the adoption of the model.

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