Characteristics of the Cloud Computing Model as a Disruptive Innovation

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Abstract

The increasing complexity and management costs of enterprise information technology forces organizations to find improved ways of fulfilling their computing needs. Cloud Computing model evolved as a new means of delivering and consuming information technology services in organizations. While the new model confers greater flexibility and increased agility, and enables innovation in enterprises, its adoption raises important challenges to business leaders and demands a new mindset. As data and information make ever more relevant contribution to organizational performance, there is a lot of anxiety among managers when it comes to entrusting other companies with providing and operating technological infrastructure, computing platform, and business applications - assets that have been long perceived as critical to business success.

Cloud Computing model is often described as a disruptive innovation. The extensive adoption of Cloud Computing model determines significant changes in most of the industries, as they create, commercialize, and/or consume information technology services. The paper reviews the characteristics of disruptive technological innovations, as described by Professor Clayton Christensen, and associates those with Cloud Computing characteristics and impact on established companies and industries. The authors, revealing a rather subtle nature of Cloud Computing penetration, explain the relatively slow pace of adoption that is indicated by current trend analysis. Even though it may be less booming than some previous technological disruptions, the new computing paradigm has a pervasive character and will eventually replace the traditional computing model.

Keywords *Cloud Computing, Disruptive innovation, Management, Information technology*

JEL classification: M10, M13, M19

Introduction

Information technology, right from its debut as a facilitator of organizational activity, consistently bewildered the enterprise management. Mastering the digital technology usually requires special training and a certain technical inclination which rarely concurs with the business ingenuity. Either rudimentary or advanced, the

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enterprise information technology was never easy to mold to the business needs and it was difficult to manage so that the expected benefits are achieved.

Currently, despite the fact that information technology becomes increasingly more sophisticated and capable, the cost and complexity in configuring, managing and servicing the computing systems are constantly increasing (Vasilakos et.al, 2010). A development that caused a dramatic increase in the complexity and sophistication of managing enterprise IT has been the occurrence of server sprawl. Server sprawl - *a situation in which multiple servers were being under-utilized while they took up more space and consumed more resources than it was justified by the workload* (Rouse, 2008) – led to accelerated energy consumption and boosting costs of operating computing technology. As a consequence, a series of data center consolidation strategies have been developed with strong emphasis on the adoption of virtualization technologies (Cătinean and Cândea, 2009).

The IT modernization and the consolidation of datacenters become once more organizational imperatives. Besides server sprawl another phenomenon, of a more subtle nature, affects organizations: data and information overload. While server sprawl leads to underutilization of equipment, thus being related to the *technological* component of IT, the second problem refers to the *information* component of IT and affects the information processing and storing capacity. The current solution for solving the latter shows the characteristics of disruptive innovation.

The introduction of the Cloud Computing model brings in a completely new approach to managing the enterprise information technology. Cloud Computing is a major trend in information technology and constitutes a complex concept. It is not based on a single technological breakthrough, rather on the combination of several technologies, among which Internet and virtualization stand out. McAfee (2011a) believes that Cloud Computing revolutionizes the way computing power is generated and consumed and suggests that Cloud is the next pervasive model of consuming information technology in organizations, which will eventually replace the traditional one.

Gartner defines Cloud Computing as *a style of computing in which scalable and elastic IT-enabled capabilities are delivered as a service using Internet technologies* (Gartner, 2013a). The institute perceives Cloud Computing as a disruptive phenomenon, potentially improving the responsiveness of the IT organizations more than ever before. Cloud Computing promises economic advantages, but more importantly, it improves the competitive strength of the organizations by augmenting organizational speed, enhancing agility, providing flexibility and practically infinite elasticity. At the same time, Cloud Computing constitutes an innovation enabler in a time when innovation seems to be the most valued competitive asset.

Assessing the emerging disruptive technologies, McKinsey Global Institute concludes that Cloud Computing has the potential to disrupt entire business models, making way to new organizational approaches that are asset-light, highly mobile, and flexible. The report describes Cloud Computing's primary and secondary potential impacts on businesses, society, and economies (Manyika et al., 2013).

Primary impacts:

- Changes patterns of consumption - Consumers will likely continue to benefit as new Cloud-enabled applications and services emerge and reduce the need to install and maintain local applications.
- Creates opportunities for entrepreneurs - Small enterprises and entrepreneurs could be able to use the agility provided by Cloud technology to level the playing field with larger rivals.
- Creates new products and services - Providers of public Cloud services could see new competition from both large technology companies and their current enterprise customers, who could decide to develop their own Cloud capabilities.
- Drives economic growth or productivity - Enterprises that take advantage of public or private Cloud models could potentially see productivity gains and enjoy increased flexibility.

Secondary impacts:

- Shifts surplus from producers to consumers - As Bain and Company points out Cloud Computing represents a fundamental shift in value from providers back to customers. The traditional offering of most incumbent providers is designed to accommodate peak capacity. In contrast with that, Cloud Computing charges customers only for what they use, while the value of unused capacity is redistributed back to customers.
- Poses new regulatory and legal challenges - As Cloud Computing capabilities are progressing to enabling Internet-based delivery of all the enterprise applications and IT services, policy makers are finding themselves under pressure to update laws relating to data ownership and privacy.

1. Cloud Computing Service Models

Three service models of Cloud Computing are predominant. They are referred to as Software as a Service (SaaS), Platform as a Service (PaaS), and Infrastructure as a Service (IaaS). The early implementations of Software as a Service started in the mid-1990s when, thanks to the Web and the browsing applications, some companies were able to offer email services online. Before the availability of web-based email, this type of communication could be achieved exclusively by having a mail server and specific applications. Most of the companies still prefer using private email services, primarily for security reasons. No less true is that owning and maintaining a mail server is not generally among the costlier services for a company, although that depends on the number of users and the service level. However, it is important to keep in mind that most of the on–premise IT services and systems currently used in an enterprise are expensive. Another example that illustrates a common Cloud Computing application is given by the ability to transfer files using web-based services. Before the availability of web-based file sharing services, the operation also required an ftp server, as well as buying and installing specific client software.

Although it was the first service model on the market, Software as a Service (SaaS) solutions offer the highest level of service in the Cloud Computing model, in that the SaaS provider manages the entire supporting infrastructure and all the computing components: networking, storage, server, virtualization, O/S, middleware, runtime, data and application (Lau, 2011). Software as a Service (SaaS) solutions went from providing specific applications like email and file sharing services to offering complex enterprise systems and applications such as Enterprise Resource Management (ERP), Supply Chain Management (SCM) and Customer Relationship Management (CRM).

When dealing with Platform as a Service (PaaS) service model, the enterprise keeps its data and applications locally managed, while the Cloud Computing provider takes care of the rest of the components.

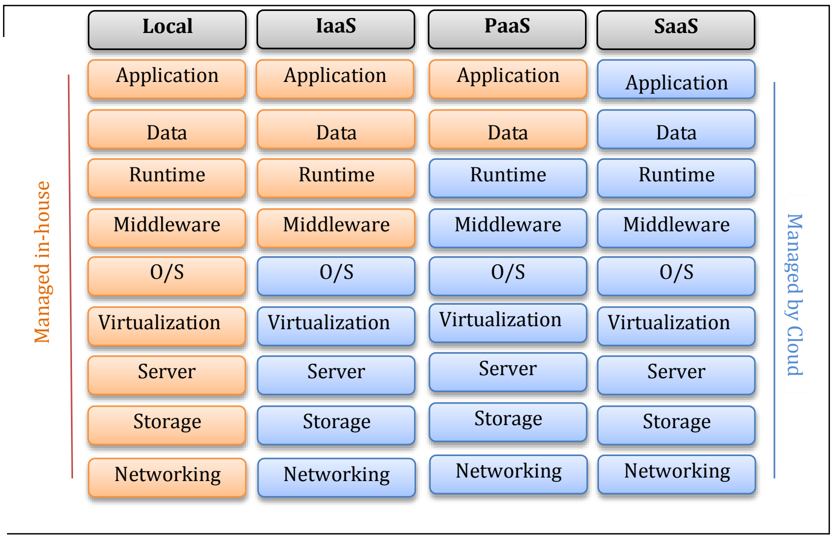

Figure 1 Cloud Computing Service Models (Lau, 2011)

Further on, when the company acquires its infrastructure from Infrastructure as a Service (IaaS) providers, while four of the components are left to be managed on the premises of the organization: middleware, runtime, data and applications.

There are many patterns or categories of IT services in the context of Cloud Computing that can be used to meet the needs of the enterprise architecture. Some solve specific problems, such as Security-as-a-Service (SeaaS) or Testing-as-a-Service (TaaS), and others provide complete platforms, such as Platform-as-a-Service (PaaS) or Infrastructure-as-a-Service (IaaS). The categories of service are: storage, database, information, process, application, platform, integration, security, management/governance, testing, and infrastructure. What Linthicum (2010) calls "fine-grained services" include: storage, database, information, process, integration, security, management/governance, and testing. The "coarse-grained services" refer to application (SaaS), platform (PaaS), and infrastructure (IaaS). One coarse-grained Cloud Computing service can be made up of many fine-grained resources. For example, a single Platform-as-a-Service (PaaS) provider could offer storage, database, process, security, and testing services.

Table 1 Fine grained service models (source: HBP, 2011)

Type of Cloud Service	Description
Storage as a Service	The storage exists physically in the Cloud and is allocated to locally used application. Logically, it is a local storage resource.
Database as a Service	The Cloud-hosted database is shared with other users and it functions logically as a local database resource for any application that requires database content
Information as a Service	Provides access to any type of information hosted in the Cloud through interface such as application program interface (API)
Process as a Service	Creates business process computing support by Cloud resources such as services or data, hosted in one or multiple Clouds
Integration as a Service	Delivers complete integration of required IT resources, including application interface, disparate data resources and generates control flow
Security as a Service	Core security services are deployed through Cloud security components
Management/governance as a Service	Manages on-demand Cloud services and enforces company policies associated with services and data
Testing as a Service	Enables testing of local and Cloud based applications (e.g., Cloud based applications, websites, internal enterprise software) using services and software that are housed in the Cloud.

2. Cloud Computing Deployment Models

According to NIST (National Institute of Standards and Technology, U.S. Department of Commerce), there are four deployment models for Cloud Computing (Mell and Grance, 2011):

- Private Cloud – refers to Cloud infrastructure that is provided for the exclusive use of an enterprise. It may be owned, managed, and operated either by the organization or a third party and it may be functioning on premises or outside the organization. It provides all the benefits of the public Cloud, but within a private network and a secure computing environment (Murphy, 2013).
- Community Cloud – in which the Cloud infrastructure is provided for use by a community of consumer organizations that share common utilization needs. They have a common mission, the same security requirements, or policy and compliance considerations. Just like the private Cloud, the community Cloud can

be owned and managed by the organizations in the community or by third parties, and its location is independent of the community premises.

- Public Cloud – the Cloud infrastructure addresses the open use by individual consumers and enterprises. The public Clouds may be owned, managed and operated by private companies, academic organizations or governments and they reside on the premises of the Cloud provider.
- Hybrid Cloud – the Cloud infrastructure is a combination of private, community or public Clouds, which remain distinct entities, but are bound together by standardized or proprietary technology that enables data and application portability.

Although NIST specifies that the "private Cloud" may be owned, managed and operated by a third party and may be based outside an organization's premises, many articles in the literature on "private Clouds" refer just to on premise private Clouds - the ones managed and operated by the internal IT organization –thus making abstraction of the externally-hosted private Clouds - provided and managed by an external provider - and yet designated for the exclusive use of the client enterprise. Differentiating the on premise private Cloud, also known as "internal Cloud" from the traditional IT model could sometimes be confusing. In both cases, the company owns the data centers and invests in infrastructure management. The difference consists mainly in the design of the infrastructure and the way applications are used. The internal Cloud model establishes self-service access for its users and enables the sharing of resources among users (e.g., different business units and individual employees) in a way that simplifies infrastructure planning and the management of computer resources. The internal Cloud provides a more standardized process than traditional IT services, but is often limited in size and scalability by comparison with externally hosted Clouds.

Numerous studies indicate that due to data security and privacy concerns, the private Cloud – either internal or externally hosted – remains for the time being the preferred deployment model for enterprises, especially in the case of the large ones. However, it is generally expected that public Cloud share would continue to grow as the security and regulation concerns are increasingly addressed. Given the current stage of development of public Cloud Computing, large organizations are using the model for portions of their IT environment, not necessarily for their whole IT services (IDG, 2013). They might deploy data storage, some applications and part of the infrastructure using the Cloud Computing model. Public Cloud is more appealing to small and medium size enterprises, especially for start-ups, as it offers the best and most viable solution to growth by providing increasing computing power at a cost advantage. Complex and traditionally very expensive information systems become increasingly accessible to SMEs by the deployment of Cloud Computing solutions.

3. Why Cloud Computing is a Disruptive Technological Innovation

The disruptive potential of the Cloud Computing model is often stressed in presentations and articles on the subject. To better understand what constitutes a disruption in a business environment and what the characteristics of a disrupting innovation are, we examined the work of Clayton Christensen, the Harvard Business School professor who introduced the term “disruptive” in the business literature. The research conducted by Christensen (2000) on the disk drive industry, hydraulic excavators and other sectors, led to a set of conclusions related to the nature of technological innovations. The author identifies two types of technological innovations, each with a distinct impact on the competition basis, with different implications on enterprises, especially on the successful incumbents of the disrupted industry. These are:

- Sustaining innovations – those that improve the performance of established products, along the dimensions of performance that mainstream customers in major markets have historically valued. They can be discontinuous in character or incremental;
- Disruptive innovations – which bring to market different value propositions than those available previously. They are discontinuous in nature.

The author shows that a key characteristic of a disruptive technology is that “it heralds a change in the basis of competition”. Both the sustainable and disruptive innovations introduce new products or product architectures that eventually would replace those commercialized before.

Disruptive innovations generally consist of off–the–shelf components put together in a product or service that is simpler than prior solutions. They transform a fundamental technological problem in an industry, from one that had been complicated previously, requiring high expertise for designing and providing the products or services, into something simple, that people with much less technical skills can perform well. At their introduction, disruptive innovations typically yield lower performance then the products existing on the market. At the beginning, they seem to make no sense for the successful established companies. The set of performance metrics used for disruptive technological innovations is different from that used for established technological products. For example, in the traditional excavating market, the functionality of the mechanical excavators was measured by the extension distance and bucket capacity. Due to sustained improvements, the bucket capacity reached to about 5 cubic yards. The first hydraulic excavators had a capacity of approximately ¼ cubic yard and the scoop reach was considerably smaller than their mechanical counterparts’. These initial characteristics made hydraulic excavators irrelevant to mining, general excavation or sewing contractors. Instead, the entrant firms applied them to small industrial and farm needs. However, the hydraulic technology eventually advanced to the point where it exceeded the performance required at the higher-end of the market.

While searching for the reasons why large incumbents fail when confronted with disruptive technologies, the author advances some counterintuitive findings. Their very own capabilities and good management often impede successful large incumbents. His work explains the reasons why this situation occurs. The resource allocation process naturally directs resources toward higher margins and larger markets. As an example, disk drive makers became large and successful by exploiting their basic value chain; they focused their investments and developed strengths – in research, development, sales, marketing and administration – to align to the needs of the customers, simultaneously responding to challenges posed by competitors. As a consequence, the straight (i.e., continuous) path to improving profits was to move upmarket, toward higher-end products**,** which yielded better gross margins. Moving towards lower-end market segments appeared to be counterproductive.

3.1 Simplification of the Technological Problem

Because Cloud Computing model allows enterprises to receive computing capabilities through a ubiquitous channel (i.e., the Internet) while metering the consumption of computing resources, Cloud Computing is often called utility computing (or on-demand computing). Utility computing (Farber, 2002; Carr, 2003; Lindquist, 2004; Johnston, 2013) assimilates the Cloud delivery methods with electricity supply. In this context, data centers could act similarly to power plants. A decade ago, Carr (2003) predicted some of the current trends, even though not all specifications were validated after time. The author believed that companies would get to fulfill their IT requirements simply by purchasing fee-based Web services from third parties—similarly to the way they currently buy electric power or telecommunications services. Current articles continue to use this analogy. Johnston (2013), for instance, shows that Cloud Computing model acts like a utility. The way people switched from using their own electrical generators to the grid and pay for how much they use, they are now starting to pay for Cloud services as they use them.

Even though parts of information technology are commoditizing, we don't necessarily believe that Cloud Computing is transforming the entire information technology industry into an utility supplier. Nevertheless, the analogies presented before are useful to point out the distinct advantage of the Cloud Computing model, which is enabling companies to benefit from computing power without having to generate it.

While the new developments simplify the enterprise technological matter, some utility computing advocates argue that as computing resources become ubiquitous, they lose strategic importance. They are, thus, compared to commodity inputs and "from a strategic standpoint, they become invisible" (Carr, 2003). Consequently, because of that, it should become much harder for a firm to differentiate through technology. Indeed, in anticipation of Cloud Computing's pervasiveness, the access to sophisticated information systems can no longer bring a competitive advantage. But does that make information technology "invisible" from a strategic perspective? Theorywise, in order for a resource to be strategically relevant and, therefore, to have an impact on a company's competitive position, it must be: valuable, rare, inimitable, and non-substitutable. Information technology doesn't seem to follow the rules in this respect. As McAfee (2005) observes that at the first glance it seems that information technology, no matter in which organizational category it falls (i.e., functional, networking, or enterprise), fails to meet the strategic relevance criteria. Especially with the advent of the Cloud Computing model, vendors offer a wide range of information technology software and services, which thus become increasingly accessible and easy to deploy, making these resources not rare and highly imitable. However, while the software itself might not meet the requirements of a strategic resource by the above criteria, the way it is selected, implemented, and used, can offer a company plenty of differentiation opportunities. The unique fit between technology and a company's objectives, resources, processes and capabilities should be very difficult to replicate. There are managerial challenges inherent in adopting and using these otherwise ubiquitous and imitable software products that will make information technology meet the strategic relevance criteria.

As organizations are moving "from an era of IT scarcity to one of abundance" (Levie, 2013), Carr's (2003) theory according to which information technology becomes less important is partially proving valid, and only in the sense that, as the founder of Box (www.box.com) suggests, it is becoming "less about the technology, and more about the information". Companies need to find new and improved ways of taking advantage of their information (HBR IdeaCast, 2013). As Cloud Computing is "forcing software and hardware apart" (Raza, 2013), the technology is more likely to become commodity, while data and information gains a central stage in the pursuit of the competitive advantage.

3.2 Transformation of the Enterprise IT Role - Less Technical Expertise Required

In a computing environment based on the Cloud, the enterprise IT professionals are no longer required to have a keen expertise in specific technological matters such as hardware configuration, server management, infrastructure and operating systems maintenance, and so on. In a world permeated by the Cloud model the highly technical expertise would shift upward in the value chain, being required in data center operations.

Given the technology abundance and the high accessibility of computing power enabled by the Cloud model, some analysts are wondering about the role of CIOs and the prospects of IT organizations in the near future. Originally IT departments were formed to centralize expertise for purchasing, implementing, and managing technology in the enterprise (Levie, 2013).

In the context of IT commoditization Carr (2003) believed that the CIO's role in the enterprise would become merely operational, if not extinct. Due to transition to the Cloud Computing model, there are IT professionals that fear the v of validation of this prediction. While it is true that the role of enterprise IT and that of CIOs are changing, recent trends show that the IT organization actually becomes more important. It is no longer going to play the role of "technology wizard" or system maintenance team; instead it is becoming "the information broker" for the company (Levie, 2013).

For the purpose of increasing an organization's digital capabilities, CEOs will need to place the information technology at the core of their company. Gartner shows that the role of a company's IT function is becoming one of Cloud service brokerage (CBS), which consists in managing aggregation, integration and customization of multiple Cloud services (Lheureux, 2013). The CIO in his turn, instead of orchestrating maintenance and technical engineering work, needs to become an innovation driver. According to Capgemini Consulting research with MIT, CIOs are increasingly turning to the utility computing model of the Cloud in order to speed up the digital evolution of the company while they focus on more strategic activity, such as driving new revenue opportunities (Tolido, 2013). To this end, the CIO's role gets challenged and repurposed or replaced by a Chief Digital Officer – CDO (Di Maio, 2013).

3.3 Different Performance Metrics

At the dawn of Cloud Computing the targeted customers were rather undemanding. When referring to webmail services, mostly individuals constituted the first customer segments, which was one reason why independent software vendors (ISV) did not regard Software as a Service (SaaS) as a threat to their businesses. Additionally, large players in the software industry did not find it attractive to enter a relatively small market, which was offering lower profit margins. Things have changed along the way to the point where, in the world of today, Cloud services are adopted on a broader and broader scale by organizations, although the traditional IT organizational model is still dominant. The present performance of Cloud Computing and the advantages of deploying the model are more substantial in small and medium enterprises than in large ones. The Accenture and WSP report (2010) reveals that the larger IT users get less benefit from working with the Cloud solutions covered by the study than the smaller companies. When the efficiency gains from resorting to Cloud solutions are regarded as environmental benefits the study found that in organizations with over 10,000 users the reduction in GHG emissions was 30 percent, while in firms with up to 100 users the reduction could reach 90 percent.

There is a variety of performance metrics in software and IT services of which we mention: security, cost, application management and performance, integration with existing computing systems, scalability, customization, enterprise IT control, rapid provisioning. Originally, the Cloud Computing model presented strengths in scalability, rapid provisioning, virtualization, and low-cost utility-based pricing while the attributes most valued by incumbent firms were security, in-depth customization, standard practices, and enterprise control.

Krikos (2011) shows that public Cloud model presents a performance trajectory capable of meeting and exceeding the high-end demand of the market. It is expected that Cloud Computing will make significant progresses in integration capabilities, security, compliance-rich applications, and configuration management. Latest reports indicate that the cost of implementing Cloud setups has fallen, while performance has improved. For example, renting a server in the Cloud entails about one-third of the expense of buying and maintaining similar equipment (Manyika et.al, 2013). The granular services and applications of Cloud model (e.g., storage, databases, information, and security) are expected to improve in performance as Cloud providers grow and become more adept. Industrialized data centers could eventually afford investing heavily in research, and could also attract better engineers and data specialists. As an example, Amazon Redshift (http://aws.amazon.com/redshift/) – a data warehouse service in the Cloud – uses advanced techniques to achieve significantly higher performance in data warehousing and analytics workloads than traditional databases, while the service is priced at approximately one tenth of the average of data warehousing solutions (InformationWeek,2013).

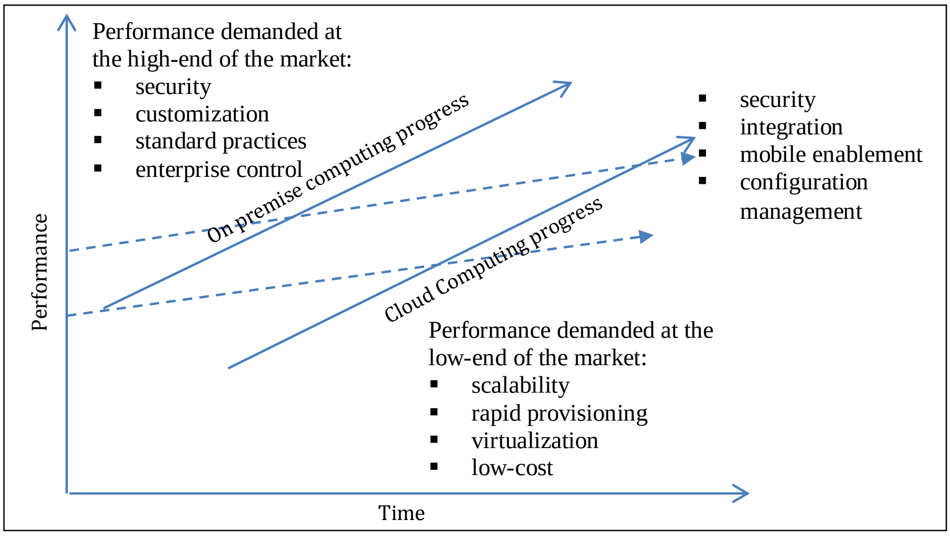

Figure 2: Cloud Computing Performance Metrics (based on Christensen, 2000)

An additional attribute that could speed up Cloud Computing's performance trajectory toward the level expected at the high-end of the market is the accessibility of enterprise software from mobile devices. Mobile access is an increasingly desirable feature of enterprise systems as the Bring Your Own Device (BYOD) phenomenon proliferates. While Software as a Service (SaaS) is highly accessible via browsers running on mobile devices, on premise enterprise solutions offer limited access to business applications via mobile devices. At the same time, making business applications available to multiple devices is one of the key challenges facing CIOs today. The development process required to run client applications on multiple mobile platforms is time consuming and often done poorly according to Belmans and Lambrette (2012). Software as a Service (SaaS) simplifies the process of adapting the enterprise applications to suit mobility related challenges.

4.4 Transition Difficulties FACING Established Organizations

IT industry

According to a 2011 market study, only about 20% of the market for public and private Cloud services belonged to incumbent technology providers (Heric at. al, 2012). Following the logic of Christensen's (2000) argumentation on disruptive phenomena, it is not surprising that large established enterprises have a hard time switching their business models to become Cloud services providers. Their customer base is mainly comprised of large companies in the consumer markets, which still rely on legacy systems to perform their computing operations.

The IT industry traditionally consists of infrastructure technology providers, applications development companies, and data technology vendors. The dominant companies in this market are Cisco, Hewlett Packard, IBM, SAP, and Oracle. According to a Gartner presentation of the Cloud landscape (Smith, 2013), the most significant players in the Cloud Computing industry are: Amazon (leader in the IaaS market), Salesforce (leader in the SaaS market), Google (important PaaS and SaaS provider), VMware (virtualization leader, which is just becoming a Cloud service provider), and Microsoft (broad strategy, delivering all three service models).

Business press reveals that Oracle has been slow to embrace Cloud business model and is still slow to follow successful Cloud competitors (Douban, 2013). The company has achieved important steps in gaining the capabilities to offer Cloud based solutions through acquisitions. The present offering consists of PaaS and SaaS solutions. SAP is another example of an incumbent that had "a turbulent start in the Cloud Computing space" (Linthicum, 2013); after several failed attempts to establish a Cloud Computing solution for its entire Enterprise Resource Planning (ERP) suite, SAP undertook two major acquisitions in 2012 (Burgelman and Rolland, 2013). SAP's Cloud offering focuses on small and medium enterprises while enhancing its enterprise suite with the SaaS offering. Hewlett Packard's initial efforts are also considered slow and disjointed (Smith, 2013). It currently shows ambitious plans in extending its IaaS solutions offering, especially targeting application infrastructure services.

Other industries

Turning to consumer markets, we find out that enterprises with established on premise computing, which have large quantities of legacy servers and applications, find it very difficult to migrate to Cloud Computing models. Some of them may also lack the incentives to do so, at least for the time being. According to McAffe (2011), in the next few decades, a lot of successful, well-managed firms from a variety of industries are going to stumble upon the shift to the Cloud. At the present, organizations that embrace the Cloud to a great extent fall in three categories: (1) those that don't have much of an installed base of IT, (2) Web-centric companies (e.g., Zynga, eBay, Netflix) and (3) older organizations that "perceive a sea change". The other enterprises are uneager and very cautious about the Cloud, as they think the transition is still immature and insecure.

The Cloud requires a level of trust that some managers are reluctant to grant. Enterprises show many concerns about placing sensitive data in an external Cloud, especially as policy makers have yet to regulate issues of ownership and liability for data residing in the Cloud. Some high-profile failures (e.g., Amazon Web Services outage on 2012 Christmas Eve) may have affected even more the business community's perception of Cloud reliability. Nevertheless, technology is constantly improving. McKinsey Global Institute argues that Cloud setups are growing more reliable (since they are capable of shifting processing from one machine to another if one becomes overloaded or fails), eliminating productivity-draining outages (Manyika, 2013).

Surveying the trend in adopting Enterprise Resource Planning (ERP) systems on a Software as a Service (SaaS) basis, an Aberdeen study highlights that seventy-nine percent (79%) of ERP deployments in large companies are on premise compared to only 4% as SaaS. The gap is much smaller in regarding small organizations: 59% on premise compared to 26% as SaaS.

The same study indicates that sixty-six percent (66%) of managers that are unwilling to consider a SaaS solution invoke security concerns and stability. They are concerned over exposing their internal financial data to competitors or over the risk of compromising customer data. The study reveals interesting findings: 38% prefer to have control over the upgrade processes; 35% say that an ERP system is too basic and strategic to running the business, hence should be kept in-house; and 30% of the respondents are worried about possible downtime, which they believe may occur more often than in the case of an on premise solution.

Reports related to web security in the Cloud indicate that, on average, on premise solutions produce more incidents of data loss or data exposure than the Cloud based solutions. That is 11 incidents per solution over a year, compared to 6, according to Aberdeen report. The same relationship is valid for security related downtime: on premise solutions had an average of 11 incidents per on premise software solution, compared to 6 for Cloud based solutions. (Castellina, 2012). Thus, there is evidence that security concerns are rather based on perceptions, while the actual impact of Cloud based solutions on data security and stability is not well understood.

4.5 Changes in the Basis of Competition

The expanding adoption of Cloud Computing model for a broad range of information technology services entails competitive environment changes in most industries – i.e., information technology consumers, IT industry, and IT related professional services and commercial activities.

Consumer industries

With the traditional computing model, the best technologies and sophisticated information systems were accessible only to large companies that could afford them. McKinsey Institute indicates that Cloud technology could provide the opportunities and tools to allow small enterprises to compete with large companies and advance into new markets rapidly (Manyika et.al, 2013). Because of this, Cloud Computing model intensifies competition within most of the industries, as they all have computing needs. At the same time, by decreasing company dependence on building its own computing infrastructure, it lowers entry barriers in many domains.

IT industry

In the IT industry the basis of competition is rapidly changing along with Cloud model proliferation. The on–premise technology providers are threatened by new entrants in the Cloud market. Due to the pervasiveness of Infrastructure as a Service (IaaS) and Platform as a Service (PaaS) models, the Software as a Service (SaaS) market presents low entry barriers. New entrants take advantage of the low required initial investment and the quick time to market featured by the SaaS model. The established software vendors cannibalize part of their products and services to offer instead solutions configured as services in order to build a competitive position in the Cloud Computing market.

Important players in a market created by a disruptive innovation don't usually come from within the industry, but rather are startups or companies established in adjacent industries that enter the emerging market aiming to take advantage of the newly created opportunities. At the same time though, Cloud Computing models display a particular feature that, to some degree, favors incumbents, as different from the case of other disruptive technologies. Because data and information are at the very core of the competitive capabilities of a firm and because IT services and products are closely associated with those capabilities, the "vendor quality" (HPB, 2011) of service providers becomes one of the key factors in the decision to initiate a collaboration with them. The Cloud service provider becomes a virtual business unit of the company employing it. This fact could indicate that the barriers to entry into the Cloud industry are not low overall. Most probably, they are higher upstream the value chain (e.g., in the IaaS market) and lower for stages closer to the final consumer of IT services. For the SaaS industry, barriers to new entrants continue to decrease as the developments in the lower layers of the Cloud stack (IaaS / PaaS) enable newcomers to quickly build applications without spending capital on infrastructure (Belmans and Lamburete). As for Platform as a Service (PaaS) model, the in-house development and technical staffs constitute important strengths. At the same time, entering the Infrastructure as a Service (IaaS) requires substantial financial investment in order to build and support the Cloud infrastructure (Gorelik, 2013).

In relation to vendor quality perception, usually companies that have been longer in business enjoy an image of greater stability and lower risk because of which well-established IT companies can have an advantage over new entrants in the competition in the upstream segments of the Cloud Computing market. At the same time, because of the difficulties IT industry incumbents face in their transition to the new value network created by the Cloud Computing model, established companies from adjacent industries could be advantaged over established IT software and services providers.

The fact that Amazon entered the Cloud market and became the leading Infrastructure as a Service (IaaS) provider validates the assumption of Christensen's (2000) theory according to which the providers of the disruptive product and the fast winners are not the established companies of an industry but rather new entrants. In Amazon's case, before it entered the Cloud Computing industry Amazon was not a technology provider. As its business model revolved around selling goods and services through the Internet it had to develop particularly strong core competencies in IT infrastructure, which then was able to leverage for the IaaS business. At the same time, Amazon satisfies the vendor quality criterion, as it earned over time a reputation of a stable and powerful company. Although, as Gartner shows, Amazon Web Services (AWS) is "the overwhelming market share leader" (Leong et.al, 2013) the industry is highly dynamic. IaaS start-ups like Joyent, Nimbula, and Eucalyptus display rapid growths (Belmans and Lambrette, 2012).

Cisco Internet Business Solutions Group analyzes the wide range of roles that Cloud providers play in the Cloud value chain. Pointing to the intricacies of the Cloud Computing industry, the whitepaper shows that PaaS providers, for instance, can deliver services both to end users and SaaS providers. Similarly, PaaS providers can either be customers of IaaS providers, or run their own IT infrastructures. The complex nature of relations among Cloud providers and consumers dictates the necessity of fine-tuning the value propositions put forth to meet the needs of partners in the industry's value chain. E.g., the value proposition of an IaaS provider that serves enterprises directly would be different from that offered to SaaS vendors.

Data centers and information and communication infrastructure technologies are often forgotten fundamentals when discussing about the chain of creating IT products and services. The emergence of Cloud services is causing changes in that respect, of which some are mentioned below:

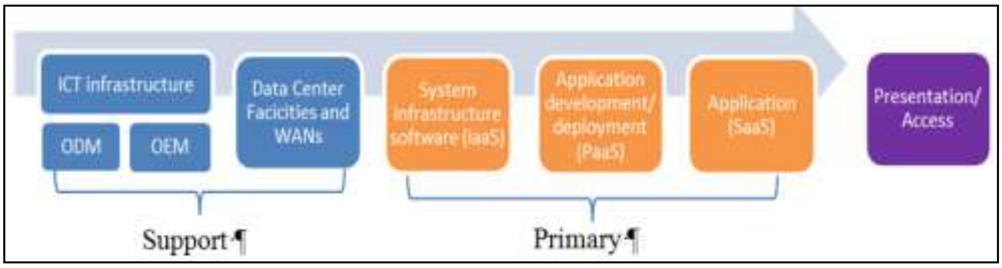

Figure 3 Simplified Cloud Value Chain (Belmans and Lambrette, 2012)

- Datacenters undergo consolidation, which leads to fewer and larger datacenters that begin to dominate the landscape.
- The Cloud Computing industry emerges as a major player in IT infrastructure purchasing, exhibiting increasing buying power and sophistication.

- Cloud services providers are finding innovative ways to develop their IT infrastructure by working directly with original design manufacturers (ODM), bypassing original equipment manufacturers (OEMs). As a consequence, ICT infrastructure OEMs must innovate in order to avoid commoditization.

- ICT infrastructure providers are at risk of being commoditized due to certain technology innovations that are closely linked to Cloud datacenters (e.g., software defined networking – SDN – and mobile chipsets).

Professional IT services and commercial activities

The complexities of the Cloud Computing industry gave rise to a new market, namely Cloud brokerage services, with the mission of bringing together buyers and sellers of Cloud services. The Cloud brokerage model can be applied to various stages in the value chain; while some brokers are limited to reselling SaaS applications, others are dedicated to finding the IaaS capacity among many vendors that best matches the key performance indicators specified by the buyer. Other Cloud brokers extend their services to the emerging market of business process as a service (BPaaS) – the delivery of automated business process outsourcing (BPO) services that are sourced from the Cloud and constructed for multi-tenancy (Gartner, 2013b).

Cloud service brokerage (CSB) makes it easier for organizations to consume and maintain Cloud services, especially when multiple vendors provide them.

The transition from legacy systems to Cloud Computing, which is foreseen to happen in the next future, will require the ability to deliver migration services cost-effectively as a key success factor for Cloud services providers. In the long term, however, when the transition workload lessens, the focus will shift to the capability to deliver services that add business value, such as developing applications, strategy and transformation planning, and business process management. In this context, it is expected that requirements for new competences will emerge and industry specific expertise will become increasingly important (Belmans and Lambrette, 2012).

Concluding Remarks

Adopting the Cloud Computing model is the most effective solution for satisfying the growing computing needs of small businesses and startups. The readily available computing resources and the convenience of use are the important factors that encourage the adoption of Cloud based solutions. But migration from the on premise information technology to the new model poses significant organizational challenges. Aside from the technological issues, there are hurdles related to the organizational culture and established practices.

Large organizations in a wide range of industries – technology creators, vendors and consumers – are confronted with difficulties in their transition the Cloud Computing model. In some cases, the incentives for leaving the comfort zone are not clear. The benefits of the new computing model don't generally become apparent before the transition becomes imperative for company survival.

The significant debate around security signals an important impediment to adopting Cloud solutions. There is a lot of business concern regarding data security and data integrity when evaluating the pros and cons of adopting the Cloud Computing model. As the paper indicates, these concerns are partly addressable by perfecting policies and guidelines on data manipulation in the Cloud. The history of using Cloud services by the organizations, however, does not warrant the level of reluctance on security basis. We believe that the stronger barriers are rather cultural, being raised by perceptions and by the fear of losing control.

The arrival of local information processing technologies (i.e., microcomputers) back in the 1980s was an essential step for the future development of the business information technology. Business managers gained control over organizational information processing and management (Applegate, 1996). Today however, as enterprise computing enters a new era, the capabilities provided by owning computing machines and infrastructure components lose their relevance and may even turn into organizational disadvantages. Cloud Computing instead enables organizations to fully benefit from running sophisticated computational systems without the need to own them. Mainly because of the resistance to letting go of the legacy systems, the Cloud Computing adoption rate increases at a slower than expected pace.

Incumbents of the traditional IT industry that manage to build an image of stable and trustworthy organizations may have a competitive advantage as they fulfill the vendor quality requirement that seems to be an important factor in the relationship with customers. However, they still need to deal with the difficulties of the disruptive transformations that Cloud Computing instills into the market.

In contrast with the new spirit of IT services that the Cloud Computing concept is shaping, the traditional hardware vendors such as IBM, HP and Dell are beginning to be perceived as mere "sellers of physical boxes" (Glance, 2013). Along the same lines, Rebeca Henderson (2005) drew attention to the fact that Nokia, back then a leader of mobile communications, was selling "just boxes", thus losing sight of the interconnectedness of the larger system in which the "boxes" had to fit. Every information technology service provider that wants to participate in the Cloud value chain should be driven by the vision of the system for which it offers components.

In any of its forms, computer hardware might have always been just "boxes". But considering the role they played in the traditional computing context, they have been important, as they constituted the on premise support of the much valued computing processes. Cloud Computing evolved as a simpler and most likely improved alternative: placing the "boxes" backwards into datacenters and performing the computation through the network and thin clients.

The Cloud Computing model is not the only recent development that requires a paradigm shift in computing. Together with the increased use of mobile platforms and the prevalence of social web technologies, companies are constantly under the pressure to revise their familiar ways of doing business. Overwhelmed by the ever increasing amount of data, organizations are forced to identify new and better ways to compute and make use of information. In this context a "let go of the old and trust the new" attitude promises to be the winning choice.

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