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Executive summary

Cloud computing in recent years is on the lips of every IT professional, consumer and accountant. Not everyone can tell precisely what his or her definition of the cloud is making cloud computing sound sometimes like magic from Harry Potter books.

First part of the thesis analyses various definitions of cloud computing and tries to summarizes them. There are several common points in every definition and as such it could be said that cloud *"(…) is a service based on hardware and software scalability accessible via Internet. The cloud uses virtualization technologies and is based on pay-as-you-go pricing scheme*" (p. 5). There is also explanation of cloud computing deployment models and service models. First part also touches environmental aspects of big data centres, security issues and business implications among other things.

Second chapter digs into cloud computing value chain and value networks. The author argues that with cloud computing it is better to look on value delivered via various cloud service providers (CSP) to business as a network of interconnected organisms. Looking for values from customer perspective the author interviewed Regional IT team at British American Tobacco in Amstelveen, The Netherlands to check how cloud solution is seen from their point of view and what challenges the cloud faces in multinational corporation.

Third chapter uses examples of IBM, Amazon, Adobe, Google, Salesforce and Microsoft to check what value network or chain those companies have created with their offering. By looking at the financial statements of companies, the author wanted to check if the cloud business model is sustainable and profitable which resulted to be either not currently profitable or there was no answer available.

Final conclusion of the work is that cloud offers tangible and quantifiable value to its customers. Author suggests that further research should focus on value of cloud computing from the perspective of CSPs business partners as his own findings are limited to one company.

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1. Cloud computing

1.1. The idea

The idea of cloud computing is not entirely new but just recently it enables organisations to fully use the benefits of such services. The idea itself emerged in a work by Douglas F. Parkhill called “The Challenge of the Computer Utility” from 1966. The author back then was only sketching his vision of what we today know as cloud computing and the legal, technical, security and social challenges. In fact, those challenges are still valid.

In November 1996 a group of executives at Compaq Computer met to discuss future of Internet and called it “cloud computing”. Their vision was quite detailed and precise, including personal cloud file storage and web-only applications.

It was not until August 2006, when Google’s CEO Eric Schmidt at a conference used the term “cloud computing” in the way it is used today. It took 40 years from Parkhill’s vision to first commercial implementation of the cloud.

Cloud computing could have the same impact on the software as the foundry model has in the semiconductor industry where there is only a handful of chip-makers producing microprocessors for chip-designers. In the future, there could be a small number of cloud computing providers who would benefit from utilizing their vast datacentres by providing their services to “datacentre-less” companies.

For the last few years about the cloud was in numerous articles, blog posts, consulting whitepapers, conferences. But, what is cloud computing? The more people, the more opinions on the topic. Here are some views about the cloud:

The interesting thing about cloud computing is that we’ve redefined cloud computing to include everything that we already do. I can’t think of anything that isn’t cloud computing with all of these announcements. The computer industry is the only industry that is more fashion-driven than women’s fashion.

Larry Ellison, CEO Oracle, quoted in the Wall Street Journal, September 26, 2008

A lot of people are jumping on the [cloud] bandwagon, but I have not heard two people say the same thing about it. There are multiple definitions out there of "the cloud."

Andy Isherwood, HP VP of European Software Sales, quoted in ZDnet News, December 11, 2008

Cloud is a model for consuming and delivering business and IT services. It can deliver significant economies, enable new levels of speed, flexibility and agility and even serve as a transformative platform for business innovation. From a business perspective, cloud computing is reshaping industry ecosystems, invigorating product innovation and enabling new business models that leverage new sources of competitive differentiation. From an IT perspective, cloud offers improved access to and utilization of information technology through use of highly efficient virtualization and management technology, consumer-style user interfaces and ubiquitous connectivity, including via mobile technologies.

IBM 2012 Annual Report

Ultimately, the cloud is the latest example of Schumpeterian creative destruction: creating wealth for those who exploit it; and leading to the demise of those that don't.

Joe Weinman, Senior VP at Telx and author of *Cloudonomics: The Business Value of Cloud Computing*

What is the cloud then?

1.2. Cloud defined

There are several cloud computing definitions given by both academic scholars and IT consulting companies. One of the first researchers to define cloud was Youseff et al. who wrote that cloud computing is "*collection of many old and few new concepts in several research fields like Service-Oriented Architectures (SOA), distributed and grid computing as well as Virtualization.*" Further, they explain that "*cloud computing can be considered a new computing paradigm that allows users to temporary utilize computing infrastructure over the network, supplied as a service by the cloud-provider at possibly one or more levels of abstraction.*"

Armbrust et al. write that "*Cloud Computing refers to both the applications delivered as services over the Internet and the hardware and systems software in the datacenters that provide those services. (…)Cloud Computing is the sum of SaaS and Utility Computing, but does not include Private Clouds.*"

Joe Wienman in his book *Cloudonomics* uses a simplified and easy to remember definition of cloud computing, reflecting five characteristics:

Common infrastructure
Location independence
Online accessibility
Utility pricing
On-**D**emand resources

Cloud is *common* as it uses pooled resources and dynamically shared infrastructure; *location-independent* as service should be ubiquitous and responsive; *online* – accessed via Internet connection; *utility* – creating value and with usage-sensitive pricing; *on-demand* – with the quantity of the resources available exactly when needed.

As grid computing researchers, Buyya et al. focus more on the technical aspect of cloud computing writing that the cloud is a parallel and distributed system, providing dynamic resources via virtualized computers with negotiated Service Level Agreements (SLA). Vaquero et al. writes that "*clouds are a large pool of easily usable and accessible virtualized resources (such as hardware, development platforms and/or services). These resources can be dynamically reconfigured to adjust to a variable load (scale), allowing also for an optimum resource utilization.*"

Many definitions of cloud computing come from service providers, markets research companies and consulting companies. IDC's, market research company, definition is very general "*emerging IT development, deployment and delivery model, enabling real-time delivery of products, services and*

solutions over the Internet." Gartner's definition is also general and stipulates that cloud computing is "*a style of computing where massively scalable IT-enabled capabilities are delivered 'as a service' to external customers using Internet technologies.*"

In their work on outsourcing and cloud computing, Bohm et al. write what they say a holistic definition of cloud computing saying that "*cloud computing as an IT deployment model, based on virtualization, where resources, in terms of infrastructure, applications and data are deployed via the internet as a distributed service by one or several service providers. These services are scalable on demand and can be priced on a pay-per-use basis.*"

To bring some order to the world of cloud computing, the American National Institute of Standards and Technology has created a standard definition and a Cloud Computing Reference Architecture. It is not a definition sensu stricto, as cloud providers tend to adapt the definition to their own needs.

According to the NIST SP 800-145 definition:

Cloud computing is a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction. This cloud model is composed of five essential characteristics, three service models, and four deployment models.

Essential characteristics include:

1. On-demand self-service. A consumer can unilaterally provision computing capabilities, such as server time and network storage, as needed automatically without requiring human interaction with each service provider.
2. Broad network access. Capabilities are available over the network and accessed through standard mechanisms that promote use by heterogeneous thin or thick client platforms (e.g., mobile phones, tablets, laptops, and workstations).
3. Resource pooling. The provider's computing resources are pooled to serve multiple consumers using a multi-tenant model, with different physical and virtual resources dynamically assigned and reassigned according to consumer demand. There is a sense of location independence in that the customer generally has no control or knowledge over the exact location of the provided resources but may be able to specify location at a higher level of abstraction (e.g.,

country, state, or datacentre). Examples of resources include storage, processing, memory, and network bandwidth.

4. Rapid elasticity. Capabilities can be elastically provisioned and released, in some cases automatically, to scale rapidly outward and inward commensurate with demand. To the consumer, the capabilities available for provisioning often appear to be unlimited and can be appropriated in any quantity at any time.
5. Measured service. Cloud systems automatically control and optimize resource use by leveraging a metering capability at some level of abstraction appropriate to the type of service (e.g., storage, processing, bandwidth, and active user accounts). Resource usage can be monitored, controlled, and reported, providing transparency for both the provider and consumer of the utilized service.

Author	**Service**	**Hardware**	**Software**	**Data**	**Platform**	**Pay-Per-Use**	**Scalability**	**No Upfront Commitment**	**Virtualization**	**SLA**	**Internet**	**Automation**
Armburst et al.	X	X	X			X	X	X			X	
Bohm et al.	X	X	X	X		X	X		X			
Breiter/Behrendt	X	X					X		X		X	X
Briscoe/Marinos	X	X	X				X		X			
Buyya		X					X		X	X	X	
Foster et al.	X	X	X		X		X		X		X	
Gartner	X	X	X				X				X	
Grossman/Gu	X	X		X			X				X	
Gruman/Knorr	X	X	X		X						X	
IBM	X	X	X			X	X		X	X	X	X
IDC	X	X				X	X				X	
Kim	X	X	X	X		X	X	X			X	
McFredries	X	X	X	X					X			
Nurmi et al.	X	X	X				X					
NIST	X	X	X		X		X				X	X
Vaquero et al.	X	X			X	X	X		X	X		
Vykoukal et al.	X	X				X	X				X	
Wang et al.	X	X	X	X								
Weinman	X	X	X			X	X				X	X
Weiss	X	X	X				X					
Youseff et al.	X	X			X	X	X		X	X		
Total	**19**	**21**	**13**	**5**	**5**	**9**	**18**	**2**	**9**	**4**	**13**	**4**

Table 1: Comparison of various cloud computing definitions.

Table 1 summarizes the definitions of cloud computing as for September 2013 using own research. The various definitions agree that cloud is a service based on hardware and software scalability accessible via Internet. The cloud uses virtualization technologies and is based on pay-as-you-go pricing scheme.

Service models:

1. Software as a Service (SaaS).
2. Platform as a Service (PaaS).
3. Infrastructure as a Service (IaaS).

In 2012, network as a service (NaaS) and communication as a service (CaaS) were officially included by ITU (International Telecommunication Union) as part of the basic cloud computing models, recognized service categories of a telecommunication-centric cloud ecosystem.

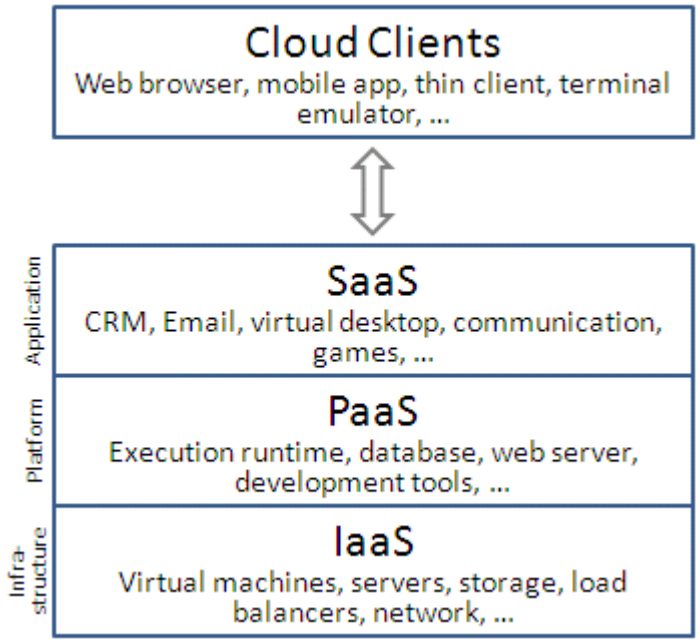


Figure 1: Cloud service models. (source: Wikimedia.org)

Deployment Models:

1. Private cloud. The cloud infrastructure is provisioned for exclusive use by a single organization comprising multiple consumers (e.g., business units). It may be owned, managed, and operated by the organization, a third party, or some combination of them, and it may exist on or off premises.
2. Community cloud. The cloud infrastructure is provisioned for exclusive use by a specific community of consumers from organizations that have shared concerns (e.g., mission, security requirements, policy, and compliance considerations). It may be owned, managed, and operated by one or more of the organizations in the community, a third party, or some combination of them, and it may exist on or off premises.
3. Public cloud. The cloud infrastructure is provisioned for open use by the general public. It may be owned, managed, and operated by a business, academic, or government organization, or some combination of them. It exists on the premises of the cloud provider.
4. Hybrid cloud. The cloud infrastructure is a composition of two or more distinct cloud infrastructures (private, community, or public) that remain unique entities, but are bound together by standardized or proprietary technology that enables data and application portability (e.g., cloud bursting for load balancing between clouds).

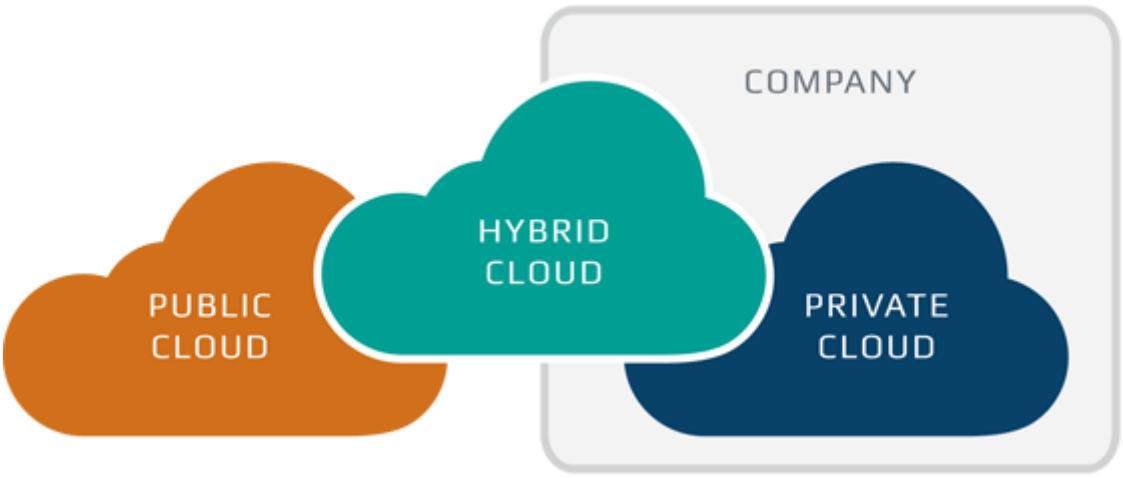


Figure 2: Cloud deployment models. (source: Wikimedia.org)

Even though the NIST definition of cloud computing, people and companies tend to confuse cloud computing with older technologies such as hosting services. The author conducted brief interviews

during Career Day 2013 on 5th March 2013 at Hasselt University. The author asked approximately 7 different company representatives that had something to do with ICT or consulting. There 2 questions asked:

1. What means to your company cloud computing?
2. Do you use cloud computing in your company?

Companies, when asked about the cloud, often referred to the hosting services they provide to their partners or from them. Few companies could answer about their cloud services offered or if they use it on daily basis, which shows that still companies do not know what to do with the cloud, except that they find it as a way to cut costs in the IT department.

According to an article from InfromationWeek.com by Rajan Chandras the cloud adoption is still in early stages. When put on Rogers S Curve the adoption looks like this:

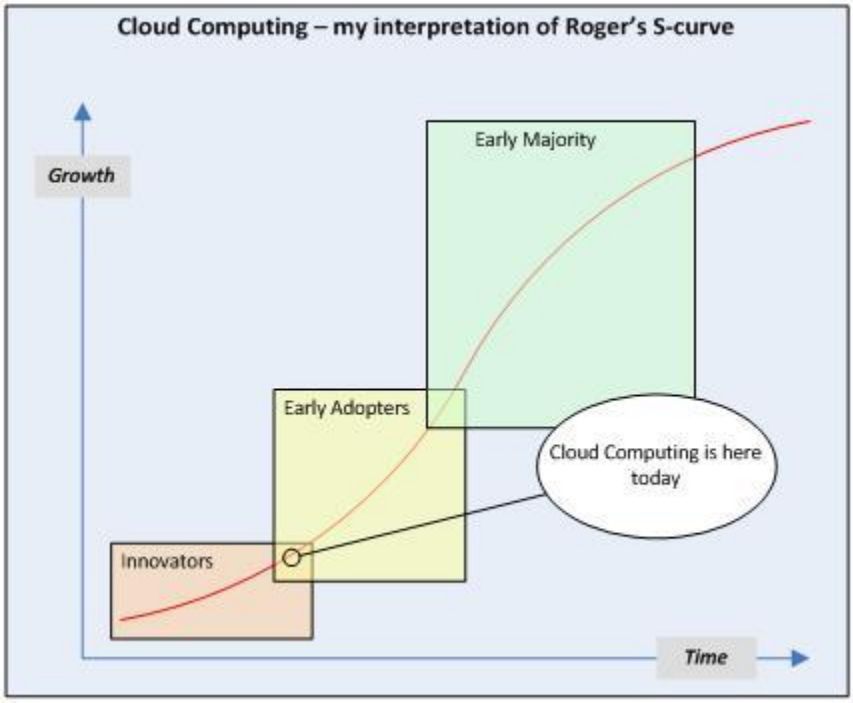


Figure 3: Chandra's cloud adoption model. (source: InformationWeek.com)

It passed the innovators stage and is currently on the horizon of early adopters. From there, and the growing interest in the cloud, the market can grow further as more companies sign on to the cloud.

1.3. XaaS elements

Infrastructure as a Service (IaaS)

Basic type of XaaS element which enables an organisation to use partners' data centres, storage and other basic hardware capabilities to run their business, excluding software which remains organisation's responsibility. Previously, a company had to buy a dedicated server and other essential hardware for its needs so it can be used on provider's premises. Currently, thanks to using virtualisation, it is replaced by buying and paying for the used server power, like it takes place in Amazon EC2 cloud. Sometimes, this type of service is called HaaS – Host as a Service.

Platform as a Service (PaaS)

This service is commonly used by application developers and delivers a complete programming environment using high-power computing. Platform takes care of everything, from editing a code, debugging, deployment, testing and management. It is also in the PaaS provider to determine what programming languages, APIs, OS are supported, as well as management solutions. For example, Microsoft's Windows Azure platform uses .NET, C/C++, Java, PHP and Python as programming languages, whereas Cloud Foundry uses Java, Ruby, Nodejs and Scala. To determine which platform is the best for a developer, an extensive research is needed.

Software as a Service (SaaS)

Most commonly understood cloud model where a service provider enables end-users to use software via Internet connection from its servers without installing or storing anything on local hard drives. In this situation, the provider is paid according to the agreement either a monthly fee or in a pay-as-you-go model. Thanks to this, the company does not have to acquire a software licence and is sure the software used is the newest version possible. The model is also popular as the organization does not have to go into technical details about the software, it just buys the time needed from Application Service Provider (ASP). A commonly used SaaS example are Google Apps which offer basic functionality and access from anywhere at a small to free price.

Major SaaS solutions use currently a multi-tenant architecture meaning that a single version of software is installed by all customers. By horizontal scaling, to support scalability, application is installed on many servers. Some solutions support virtualisation technologies but it is rather an exception currently, rather than norm.

As application used via the cloud must operate with the data bases stored on local servers and computers, access has to be developed via HTTP, SOAP, REST or JOAN. Cloud-service providers have APIs and protocols specifically used by them that are offered to their clients.

Network as a Service (NaaS)

This part of cloud computing nomenclature describes network and computing resources as one enabling users to use networking resources on-demand. Most common NaaS service models are:

a) Virtual Private Network (VPN) – allows to securely access private network over a public or shared network while still under the policies of a private network. Secured with encryption, such connection is difficult, even if impossible, to be listened to by third parties.
b) Bandwidth on Demand (BoD) – a technique which assigns dynamically bandwidth speed of network connection according to the current requirements.
c) Mobile Network Virtualisation – service includes a mobile network enabler who sells access to its network for a bulk price to third parties who do not own wireless network infrastructure or radio spectrum and then offer their services to customers. Typically, a mobile virtual network operator (MVNO) uses network and spectrum of an existing mobile network provider but has separate billing systems, customer service and marketing department. Examples of MVNO: Mobile Vikings (BASE), Virgin Mobile Poland (Play), Virgin Mobile UK (EE).

Communications as a Service (CaaS)

If a company decides to outsource its whole communication infrastructure from a single vendor, then we can talk about Communications as a Service model. Such services can include voice over IP, instant messaging, collaboration and videoconference using both mobile and fixed devices. CaaS provider is responsible for the software and hardware maintenance as well as guaranteed Quality of Service.

This service model is good for small and medium companies as it does not require expensive infrastructure and offers flexibility.

1.4. Security issues

Using cloud services is definitely good for a company as it cuts down IT costs making usage of ICT tools as utilities, on-demand. What is good for the books, it may not be necessary good for the company's security. In a study "Assessing the Security Risks of Cloud Computing" from June 2008 conducted by Gartner, there are seven questions a CIO should be asking her/himself regarding cloud security:

Figure 4: How not to choose CSPs.

1. Privileged user access.
2. Regulatory compliance.
3. Data location.
4. Data segregation.
5. Recovery.
6. Investigative support.
7. Long-term viability.

When company decides to shift completely or partially to the cloud it has to know who, within the cloud vendor, has privileged user access to the servers where the company data is. Sensitive data processed outside an enterprise bypasses company's security controls and as such might be leaked to the public and affect the company in various ways. Competitors might use a cloud provider for corporate espionage.

Usually, a service provider undergoes external audits and security certifications. When choosing a cloud service it is essential to ask for such things as the safer the data is, the safer the company. It is reasonable then to omit unsecure providers even if paying $1,00/month is tempting. If regulatory compliance is not met, then it is not worth sleepless nights. Not to mention possibility of security breach.

Next important thing is the physical location of the data centres. It is nice, for example, for a Belgian company to use a cheaper Polish service provider but the question remains what type of jurisdiction your data falls under. Polish, Belgian? And what about when you use a service in India? You need to make sure your data is guarded by your country's law so that if any dispute arises you know exactly

where you stand. Such things arise when during IT security assessment and asking for details where servers are located.

If company is using an American cloud solution, they are subject to the Patriot Act which enables the US Government and its institution to look what is stored on the servers to investigate criminal and terrorist activity. This means, even company secrets stored in the cloud are subject to such inspection.

Data segregation is another important topic as company data is located on servers alongside data from hundreds or thousands of other different users. There are several techniques of data segregation such as geography-based, vendor-based, container or bucket-based and blob-based separation. HIPAA/HITECH act, which guards US citizens electronic health information, says that patients' data has to be stored within the US boundaries. As such, the data that originates from the US and is intended to use in the US is guarded by the two acts and cannot be transferred further.

Recovery when using cloud services is even more crucial than before as company stores data somewhere in the world and not on its own servers. Time which takes to restore the whole setting is time lost for the company. Cloud computing, especially when using virtualization, approaches the topic differently. Because virtualization puts the operating system, software and data into a single package or virtual server, it can be easily copied or backed up in another data centre and run within minutes. This dramatically reduces recovery time compared to conventional recovery approaches, when servers had to be loaded with software and update first before any data could be restored.

When it comes to investigative support, cloud computing might be difficult in the environment where data is co-located and spread across various data centres. This makes cloud forensics an extremely difficult task. CSP should provide information on how they support finding illegal activities on their servers so that a business is not only assuming that investigative support is backed up by the provider.

Last issue remaining is that in a perfect world, the CSP chosen will never go bankrupt or get acquired by another company. If this would happen, then it is important to know what happens to the data stored on the servers when decided to move to another CSP.

The current issue regarding PRISM (surveillance of data by the US government) might backlash on American CSPs as companies and consumers might withdraw from using unsecure, in their opinion, services. Many companies do not allow using XaaS if servers are located in the US but the service is to

be used in EU. No matter how good the offer can be, IT security plays an essential role when choosing CSP.

1.5. Environmental issues

The rising popularity of cloud services requires a lot of processing power and data storage to fill the needs. That requires building or expanding server farms which are not neutral to the natural environment. Does it mean that cloud computing is less greener that one would think?

In a daily usage of company's servers, their computing power is used in less than 4%, according to data from IBM. That means also there is about 96% of computing power left to be used and utilized. That is a pretty waste of energy just to cool down the servers. In the US in 2010 data centres used 76 billion kilowatt-hours of electricity or 2% of the total power used that year.

Consumers and business rely on data centres not only to send an e-mail with a large attachment, archiving e-mails or keep long forgotten holiday photos. New York Stock Exchange produces daily 2000 Gigabytes of fresh data that needs to be stored for years. In 2011, the whole world produced around 1,8 trillion Gigabytes of data. It is a race between how much data can be made and how much can be stored. Every search in Google, post on Facebook, tweet, video on Vimeo, photo on Flickr – it all adds extra bytes to that enormous amount of information.

The original sin in server design is the need to make sure the servers are up 99,9999% of the time, otherwise the IT person responsible faced consequences for servers downtime. That is probably why a data centre would be utilised by up to 15%. The amount of CO_2 and greenhouse gases emission, electricity consumption does not correlate with server usage. Counting that into the equation was one of the reasons that lead Amazon to develop their cloud service. It just made sense from financial point of view. Also, most of current on-site servers suffer from comatose – a state where a server consumes power even if it works just for few seconds. This is interesting, as consumers are urged to switch off their computers when not used and the principal in data centres is to run all the servers at all cost.

Utilizing idle server time and therefore reducing power waste is not the only benefit of cloud computing. The newly built or redesigned date centres meet the current standards of low environmental impact, using sophisticated techniques to cool down server rooms (which is around $37^{O}C$). Air conditioning is not the standard anymore. Water-cooling technologies and air compression are the new thing in the field. Also, companies install solar panels and wind turbines to be self-sufficient.

However, there is also a darker side to the growing number of data centres. As consumers and business rely on cloud service providers to store their data and be available 24/7, it requires to have a power backup installed on the premises. As such, it includes old-fashioned Diesel power generators and lead-batteries which are not the most environmental friendly. Several companies in the US where fined by state environmental watchdogs for pollution and not having the needed permission for such generators. In 2010 in California, server farms belonging to e.g. Google, Microsoft and local authorities where polluting the air in the state with Diesel fumes and ended up on a Toxic Air Contaminant Inventory.

There is over 3 million date centres, large and small, private and public, scattered around the world, using a power of 30 nuclear plants. This number could either grow as the demand for new services grows or go down as the companies start using virtualization and scaling down the current centres to meet their needs.

There are currently good examples of companies and organizations trying to be greener with their data centres. The prime example would be National Energy Research Scientific Computing Center utilizing around 96,4% (July 2012) of all available computing power from the servers and mainframes at Lawrence Berkeley National Laboratory in California. They achieve it by queuing up larger projects, therefore running the machines 24-hours, always fully loaded. LexisNexis US downsized their server room from 25000 sq. foot to around 10000 sq. foot by updating hardware and consolidating servers. Columbia Sportswear moved entirely their main data centre to a virtualized one, scaling down from 300 to 65 machines, running on 80% utilization.

New data centres have also a low level of Power Usage Effectiveness or PUE, counted as Total facility power/IT equipment power with the ideal score being 1,00. The current best PUE score belongs to Facebook's data centre in Prineville, Oregon with PUE = 1,07. Modern data centres have the score around 1,22-1,07. In the past, this rate would have been 2,00-1,92 making the current data centres twice as energy-efficient.

1.6. Current cloud market

Cloud services, since sketched in 1996 by Compaq, took time to conquer the consumer and business users' hearts and minds. Both groups have different needs in terms of the cloud services. Business needs services to support their operations, whereas consumers want to share photos and videos with

their friends and family, not being concerned too much about the technical things behind it. As such, cloud computing market has to be divided between companies and consumers.

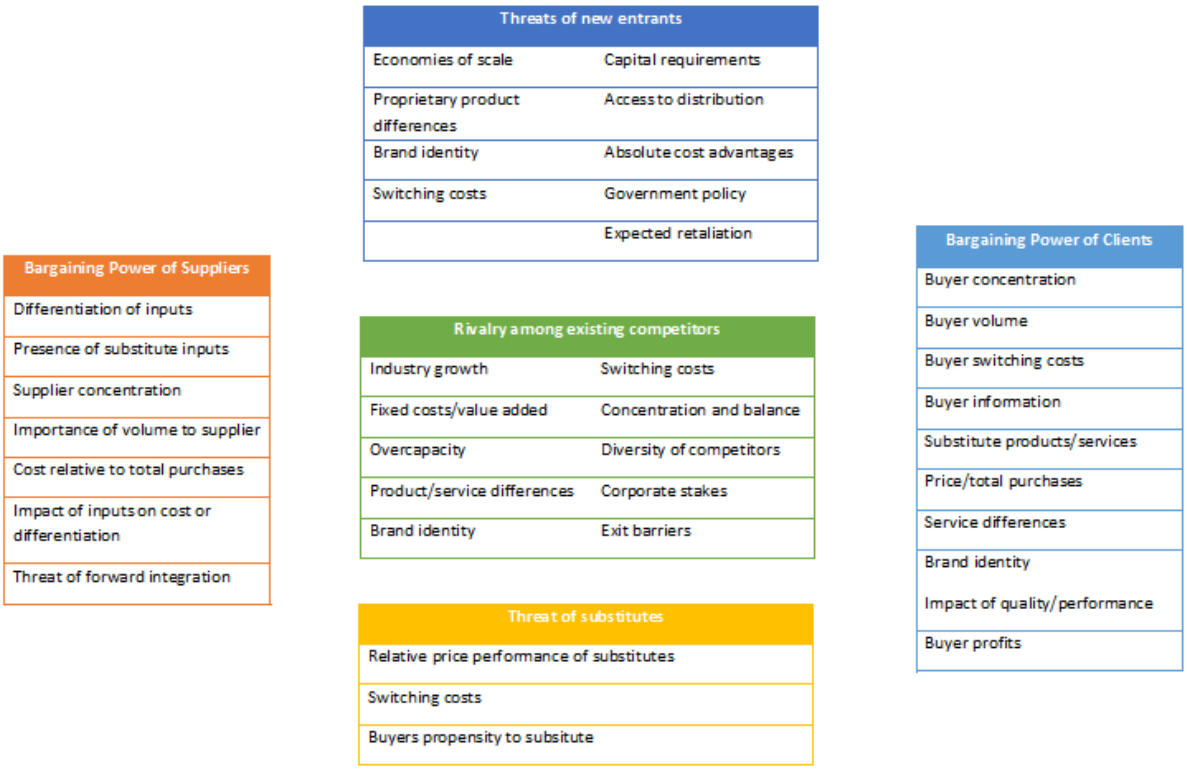


Figure 5: Porter's 5 Forces for cloud computing. (own illustration)

By using Porter's 5 Forces framework it was possible to analyse how the cloud market looks like currently. With a big choice of cloud providers customers have relatively high bargaining power but when a vendor is chosen the high cost of switching from one vendor to another makes supplier bargaining power high as well. With high switching costs there is low threat of substitution and low customer willingness to switch providers. There are high barriers of entry for new competitors as they would need a big upfront investment in brand and data centre building, not to mention the switching costs for new users which could make transfer impossible. There is big competition among companies for every penny companies want to spend on cloud services. Once locked-up on one platform, the vendors would want to squeeze the company like a lemon from its money as the cost of switching CSPs can be uneconomical.

SWOT analysis gives similar answers to Porter's 5 Forces model.

Strengths	**Weaknesses**
• Allows businesses, communities and individuals to collaborate virtually • Provides virtual storage space • Flexibility • Fast and accessible information	• There is a gap between service providers and individuals/companies who subscribe to the cloud • Audit and internal control compliance • Personal security
Opportunities	**Threats**
• More effective communication and collaboration • Better quality of work • Saves money, time and effort • Mobility • Automated – less need for IT support	• Privacy breaches • Identity theft • Compromise CIA of information (Confidentiality, Integrity and Accessibility) • Technical glitches and failures • Lock-in effect

Figure 6: SWOT analysis of cloud computing. (own illustration)

There are opportunities on the cloud market for better business performance but there are risks associated with it. Internally, the cloud enables for better communication and overview of data while there are security risks and compliance with audit and internal control over data on the cloud.

CloudTimes.org created back in 2011 a good representation of companies on cloud market distinguishing them for IaaS, SaaS and PaaS providers.

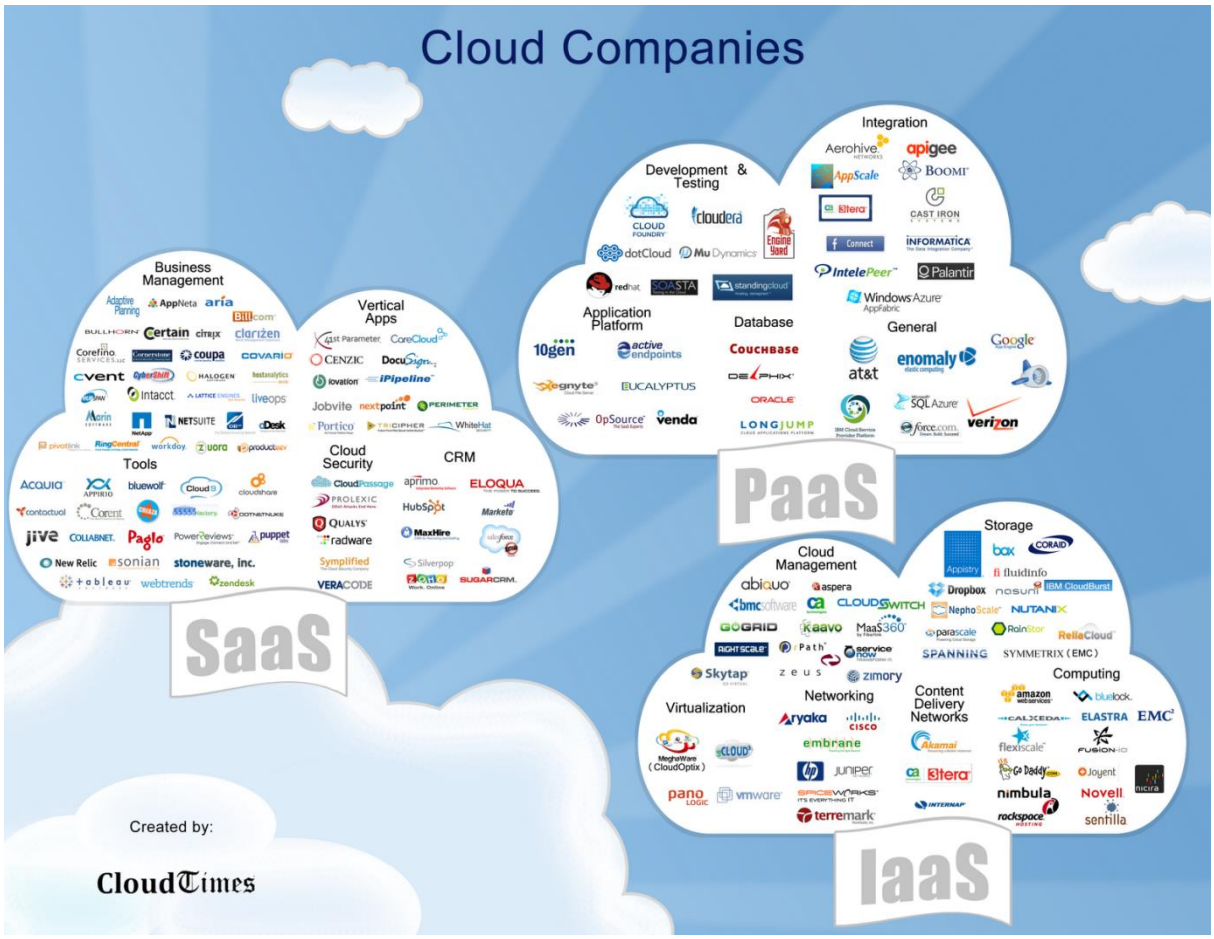


Figure 7: Cloud computing market as of 2011. (source: CloudTimes.com)

According to it, there were around 150 companies offering various XaaS solutions for companies that would suit their needs. The biggest is SaaS market followed by IaaS and then PaaS. That, of course, does not mean that market is saturated as there is still plenty of room for new, innovative cloud ideas that could be developed.

Business market

Cloud offerings for business started as first which is logical as businesses seek constant savings and agility to run their business. In 1999, Salesforce.com was the first company to offer business applications through their website. It was a pioneering offer, first of the many more coming later to market.

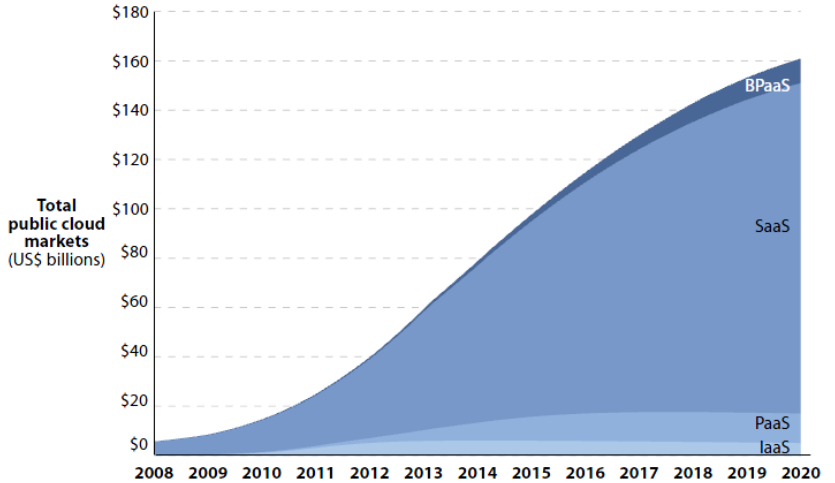
Amazon launched its Amazon Web Services in 2002; Google introduced Google Docs in 2006. The same year Amazon introduced Elastic Compute Cloud EC2 offering power of its servers to small companies, start-ups and individuals.

IBM came to the market in 2007 and it is currently shaping the cloud as part of their "Smarter Planet" solution for governments and businesses. Microsoft's Azure launched in 2009 and since that year all the major players in the IT world, like Oracle, Fujitsu, Teradata, HP and Dell, have entered the market with their cloud solution.

According to Forrester Research, the global cloud computing market will be worth 160 billion USD in 2020 with SaaS solutions having the biggest share.

Figure 3 Forecast: Global Public Cloud Market Size, 2011 To 2020

The spreadsheet detailing this forecast is available online.



	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
BPaaS ($)	0.15	0.23	0.35	0.53	0.80	1.26	1.95	2.93	4.28	6.00	7.66	9.08	10.02
SaaS ($)	5.56	8.09	13.40	21.21	33.09	47.22	63.19	78.43	92.75	105.49	116.39	125.52	132.57
PaaS ($)	0.05	0.12	0.31	0.82	2.08	4.38	7.39	9.80	11.26	11.94	12.15	12.10	11.91
IaaS ($)	0.06	0.24	1.02	2.94	4.99	5.75	5.89	5.82	5.65	5.45	5.23	5.01	4.78

58161 Source: Forrester Research, Inc.

Figure 8: Forester Research forecast for cloud computing. (source: Forrester Research)

In the IaaS segment there is currently a strong consortium of companies supporting an open source project called OpenStack. The project itself emerged from NASA and Rackspace Hosting collaboration and was intended to help companies run cloud computing services on standard hardware. Since then it attracted over 150 companies like Intel, AMD, IBM, Canonical, Red Hat, Cisco and VMware who develop and use the software. IBM in March 2012 decided to use OpenStack in all of its clouds being build, thus encouraging other companies moving into the open source coalition they lead.

Microsoft Azure as PaaS focuses on developers which is popular among coders already using Microsoft's tools. Also, the company offers a range of cloud-enabled application ranging from SQL Server to Office on a monthly-payment scheme.

VMware, being a major player in the cloud market, had been focused on creating cloud services for other companies. It was not until recently when they announced developing their own public cloud which will have to compete with their clients' services. Citrix, VMware and OpenStack main competitor, remains focused on developing software running the clouds and also supports its own open source project – CloudStack.

Cloud solutions for business include practically every industry: healthcare, consulting, media, manufacturing, engineering, HRM, accounting etc. If there is an industry that would benefit from using the cloud, sooner or later there will be a solution available.

CIO.com has published a list of Top 10 enterprise software already available on public clouds. Those services include:

1. Development and Testing
2. Development Platform Servers
3. Training Servers
4. One-time Big Data Projects
5. Website
6. Customer Relationship Management
7. Project Management, Expense Reporting & Time Management
8. Email
9. Human Resources
10. Cloud-Based Anti-Spam and Anti-Virus Services

E-mail is a nice example of why companies move to the cloud. Managing e-mail servers can be a painful process as it needs time and processes to filter spam, prevent the system from attacks and can be frustrating when the e-mail server is down. A cloud offering is worry free for users and cheaper for the company to maintain.

Consumer market

The development of consumer cloud came at first with Google and introduction of Gmail in 2004. It was the first e-mail account a person could open and read their e-mails anywhere in the world, using a web browser. It did not require an e-mail application running on the computer, was user-friendly and, for that time, a big storage for e-mails – 2GB. Since then, a Gmail account became key to every Google service offered: YouTube, Maps, Google+, Search, Drive, Picasa, Android, Chrome, Chrome OS.

Figure 9: Cloud is not magical.

However, it was not until Apple introduced its iCloud and launched it on 12th October 2011 that the consumers fully benefited from what cloud can offer them. Consumers used Dropbox to store files, Flickr or Picasa to share images but that was it. With iCloud, Apple showed the importance of sharing applications, music, videos, contacts, documents across company's various devices with the client having little to none computer knowledge about how it works. It just did and it is the best thing about it. Other companies had to develop their own ideas on how to adjust to the new situation. Google revamped in April 2012 their Google Docs into Google Drive to make it more look and work like the iCloud, combining together the storage for photos and documents. SkyDrive by Microsoft was at first a data storage service, similar to Dropbox. It later got integrated into Office, Windows Phone 7/8, Windows and Xbox to become a central file storage so documents and photographs could be accessible anywhere, on any Microsoft-powered device.

Streaming, either music or video, has been a major thing in the consumer market since Netflix and Spotify started their offerings. By a monthly subscription or a pay-rent scheme, users gain access to thousands of movies and TV series or millions songs. They do not need to store them locally on a hard drive or memory card, it all comes via an Internet connection to their device.

But not only music or videos can be streamed. Microsoft recently introduced Office 365 for home users and students that you rent from the company on a monthly or yearly subscription basis and is then streamed to the computer so that it is always the latest available version. No patches or updates to install.

In the consumer world, the cloud offerings come around a topic of ecosystems. Apple in this case is a prime example as it offers a coherent ecosystem within the iCloud for sharing stuff across multiple devices. But Apple was not first. Google, since introduction of Gmail, encouraged users to sign to its services with Gmail account making Google experience a personal one. With introduction of Chrome OS and Chromebooks the company showed how it envisions computing in the cloud – everything stored online accessible on-demand with little local storage. Google also was the first to integrate their web services into newly developed Android mobile platform. Contacts and Gmail synchronisation was supported out-of-the-box, it just required singing in with a Gmail account.

Microsoft came later into the ecosystem fight with releasing a newly designed Windows Phone 7 for smartphones and integrating SkyDrive for file storage, Xbox platform for gaming and full Office support and integration. Since then, Redmond-based giant released Windows 8 for laptops and tablets, Windows 8 RT for tablets, Windows Phone 8 for smartphones and a this fall a new Xbox One – all being part of the ecosystem. Customer market is not only Microsoft, Google and Apple-oriented, however those companies offer a holistic approach to the cloud for customers.

It is worth mentioning here Flickr, Yahoo's photo sharing service, created in 2004 which made sharing albums easier and became very popular among ordinary users, professionals and bloggers. Netflix, Spotify, Deezer, Amazon Videos – streaming videos and music to your home by those services became easier and available on the go, just requires Internet connection.

Consumers use cloud mainly for entertainment purposes, less often to backup files in the cloud or work. They also prefer free solutions to the paid ones.

1.7. Cloud – new outsourcing market?

Since 1989 when Kodak decided to outsource its entire IT department to IBM the market for outsourcing services grew dramatically. At a current value of nearly $1000bn for just IT and BPO services one can outsource everything from HR services, accounting, project management, medical devices, medical assistance to IT provisioning.

Cloud computing can be seen as outsourcing method, a more developed version of external IT hosting. With pay-per-use basis and no on-premise installation of servers and applications it is almost perfect way to outsource IT software and services. Cited on ZDNet.com website, Tony Morgan, Chief Innovation Officer from IBM UK&I, sees cloud as evolution of outsourcing. “The cloud is just one of the sourcing models for organisations,” he says.

It can be seen that cloud computing and outsourcing go hand in hand. Customers demand cost-effective, flexible and efficient IT services delivery from their service partners for the best price while at the same time they want innovations or customer-specific potential innovations from the providers. Cloud computing provides technical basis for business flexibility. What is interesting, those business needs where addressed by companies who were not previously thought as being outsourcing businesses: Amazon and Google. They market their by-products (e.g. computing capacity and large storage) as new products and thus developing new source of revenues. They have entered the traditional outsourcing value chain and compete with established outsourcing players.

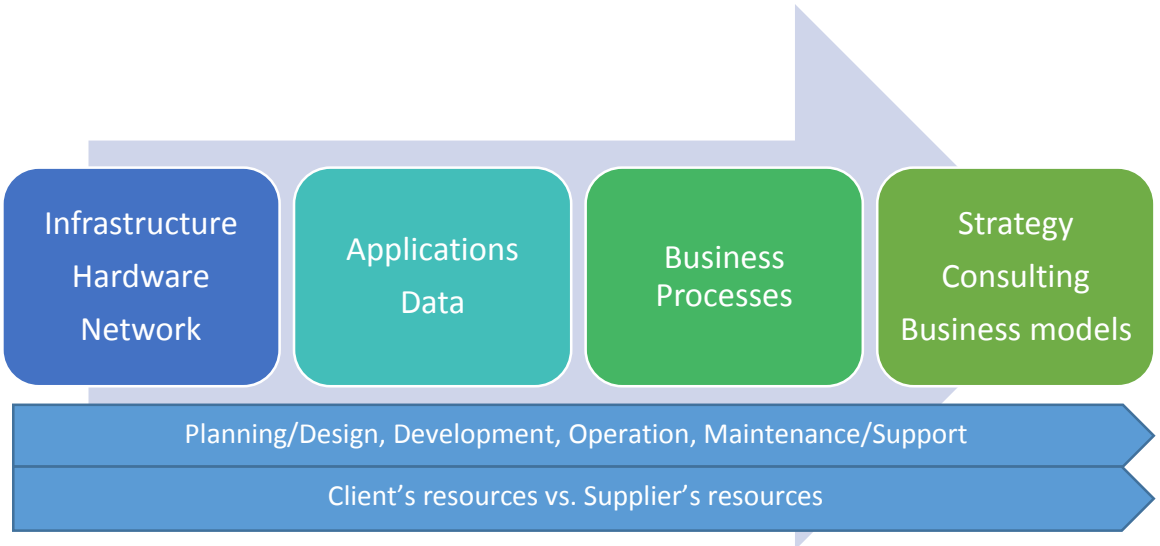


Figure 10: Traditional IT service outsourcing value chain (own illustration).

1.8. Business implications

Cloud computing is mostly praised for cost savings in building new or extending current IT infrastructure. The question remains, is there something more to the cloud than just saving money?

Coursera.org and edX.org are companies offering Massive Open Online Courses (MOOCs) from top universities around the world to users worldwide. Both companies started in the Spring 2012 attracting millions of users hungry to learn new things. The rapid growth of courses offered from the start and capability to serve all the demand would not be able without heavy utilisation of cloud computing. Both companies rely on Amazon Web Services and EC2 and without cloud their start would take much longer than just few weeks.

MOOCs are an example that development and start of a new business can take weeks rather than months using cloud computing. A study by Deloitte says that cloud in fact is a disruptive technology which lowers barriers to entry for new businesses and enables new business models which are more reliant on intellectual property and knowledge rather than the initial capital required.

Cloud, requiring less upfront investment, enables companies to focus more on their core business using freed IT resources for activities which create more value like innovation or decision making. Qantas Airways moved in 2011 from a 22-year-old system supporting its frequent flyer program to the cloud enabling the company to get a scalable architecture which copes with current and future demand. With Microsoft's introduction of Office 365 the company in fact shifted from being a product-provider into the position of service-provider, giving always up-to-date software delivered through the cloud.

Cloud-based solutions could empower people from poorer countries to develop new businesses with significantly less upfront capital needed to start their company and quicker deployment. In India, for example, fishermen use text messages, which could be thought as cloud solution in broader sense, to check where to go with their catch so their margin is bigger and they do not have to sell the fish below price or throw them away.

What is important for a business moving or starting in the cloud is the quality and reliability of the service offered by the vendor. To assure this, companies usually sign service-level agreement (SLA) which ensures stable performance in the long run. An IBM Redbook from 2012 states 14 key performance indicators (KPIs) that are measured to assure the SLAs levels are achieved.

Service-level category	KPIs	Definition	Unit of measurement
Availability	Service window	Time window within which KPIs are measured is available	Time range
	Service/System availability	Percentage of time that service or system	%
	MTBF	Meantime between failure	Time units
	MTTR	Meantime to repair	Time units
Performance	Response time	Response time for composite or atomic service	Seconds
	Elapsed time	Completion time for a batch or background task	Time units
	Throughput	Number of transactions or requests processed per specified unit of time	Transaction or request count
Capacity	Bandwidth	Bandwidth of the connection that supports a service	bps
	Processor speed	Clock speed of a processor	MHz
	Storage capacity	Capacity of a temporary or persistent storage medium, such as RAM, SAN, disk, or tape	GB
Reliability	Service/System reliability	Probability that service or system is working flawlessly over time	%
Scalability	Service/System scalability	Degree to which the service or system can support a defined growth scenario	Yes/No, or description of scalability upper limit

Table 1: SLA categories according to IBM.

In addition to the what is in the table, SLAs must cover also financial costs of cloud usage so it is clear for both parties how much is being paid/received and the process is supported by the vendors IT system.

1.9. Future of the cloud

In the perfect world, companies should move to the cloud as soon as possible, without hesitation. All things are in favour of the cloud computing model and using computer power as a utility. Early adopters and start-ups are benefiting from cloud resources as they are leaner and more focused on core activities. How the future of grid computing looks like?

Consultants from McKinsey believe that the future is in the public cloud deployment model which could be, in their view, in a form of a separate IT company servicing the mother company and others. There are no such examples yet on the market but such notion would be an interesting case.

With companies seeking alternatives to on-site IT developments cloud adoption might increase dramatically in 2013. The revelations about US government wide spying action might have stopped cloud adoption but no reports were presented on this topic. Choosing CSP now requires careful selection of cloud vendors and taught negotiations regarding SLAs.

Mohammed et al. (2009) describes a possibility of virtual clouds where a Virtual Cloud Service Provider (VCSP) works just like a MVNO in the telecommunication industry. Using existing services from different providers and wrapping them around a value-added service such company would create its own “cloud service”. VCSP would be responsible for things like service quality, privacy and security giving the customer an out-of-the-box, worry-free service, much like an Application Service Provider.

With the rising demand for cloud computing, the demand for fast and reliable Internet connection will rise as well therefore Internet Service Providers (ISPs) will need to deliver not only a fixed-line connection but also a mobile one. The use of smartphones, tablets and laptops on the go and constant access to cloud services challenges the ISPs.

According to a study “Forecast Overview: Public Cloud Services, Worldwide, 2011-2016, 2Q12 Update” by Gartner from August 2012, North America will remain the main cloud market in the years 2010-2016 with 61% market share, followed by Western Europe with 17% share.

A survey by North Bridge Venture Partners, an American venture capital company, released in 2012 asked 785 people from 39 companies about their view on cloud computing and its future. Over 50% of responders believed that many categories of business software will be disrupted by the cloud. 55% of CIO’s asked have increased their budgets for SaaS.

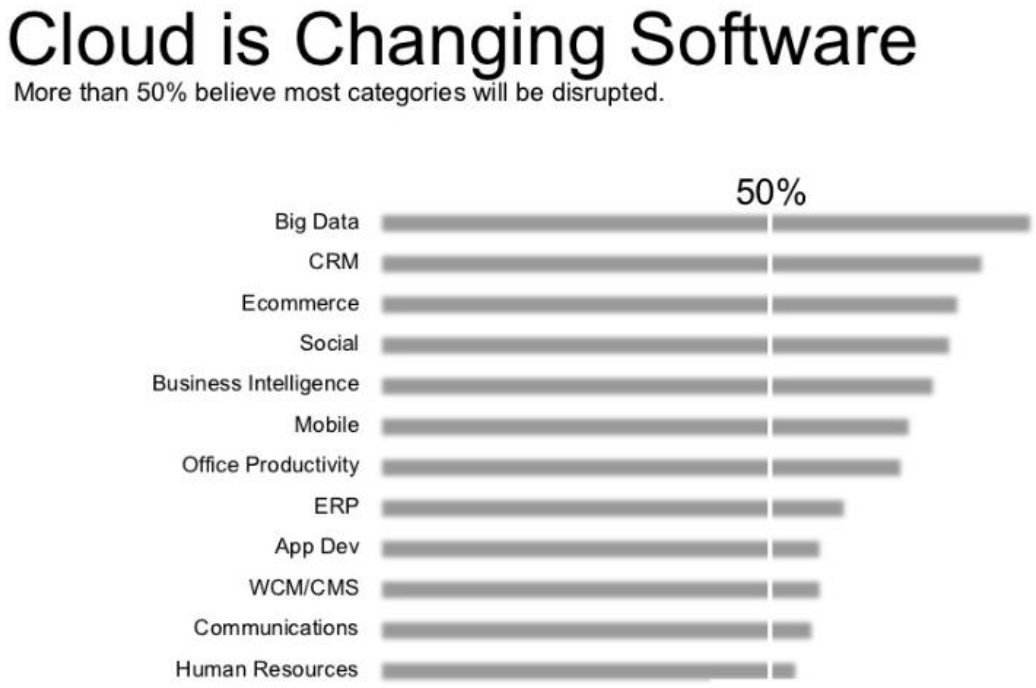


Figure 11: North Bridge VP survey results.

The biggest cloud drivers, according to the survey, where scalability, business agility and cost.

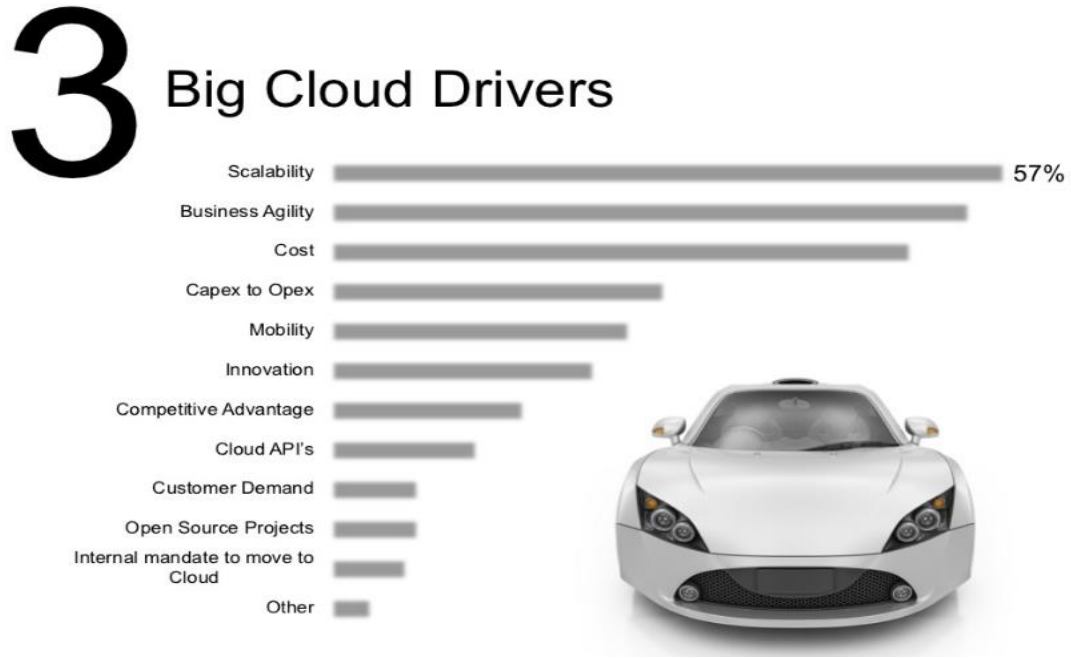


Figure 12: North Bridge VP survey results.

When asked what is stopping cloud adoption in the companies the most common answer was security, followed by regulatory issues/compliance.

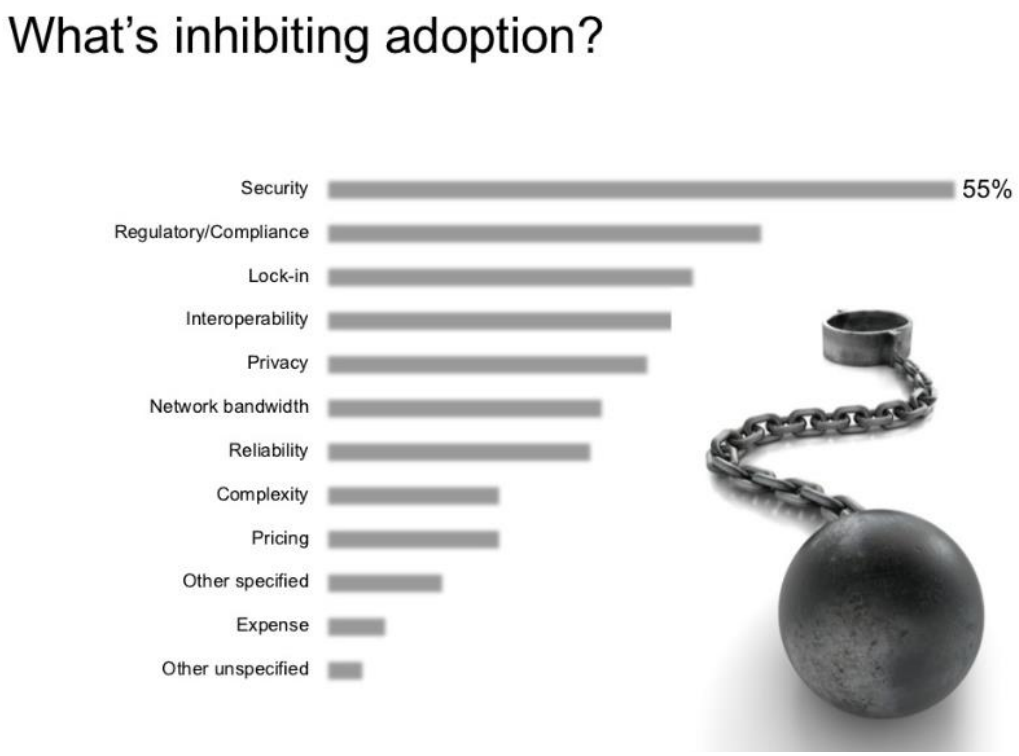


Figure 13: North Bridge VP survey results.

The move to the cloud is inevitable as more and more companies realise benefits of various services offered by the vendors. The home market is ready to accept more advanced cloud services than just streaming and photo sharing. It is now up to developers and people with ideas to offer new, attractive ways of using cloud services by the customers, either business or home ones.

2. Cloud computing value

Few researchers so far have decided to investigate the benefits that the XaaS solutions give and therefore the literature about the subject is quiet narrow. This chapter tries to focus on cloud benefits from the end customer perspective. Using his time as an intern at British American Tobacco, author asked the IT team their about what benefits they see in the cloud solutions.

2.1. Value of the cloud

The most important question about cloud computing is “where is the value in it?” Indeed, what is and how to capture the value of using computing as utility.

Value in economics is a term used to measure a benefit that a customer gains from a good or service bought. It is usually measured in currency units with an interpretation “how much a consumer is willing and able to pay for a good or service?” It is important to note that economic value is not the same as market price. The difference between the two is called “consumer surplus”. A simple example would be drinking water which has higher value than the market price.

In other words, value is a measurement of how much the good is worth in comparison to other goods. Since Adam Smith and David Ricardo economic value remains part of a debate between different schools of economy.

2.1.1. Value chain

Michael Porter’s classic work on value chain can be used to capture the value of cloud computing. In his work from 1985, Porter explains that a value chain is a system of connected, yet independent activities which, linked, affect effectiveness or cost of each other. Basic idea of a value chain is that the links between activities serve as important source of competitive advantage and value adding. The activities are classified into primary and support (or secondary) activities which every product or service needs to pass within the chain to gain proper value and margin for the company.

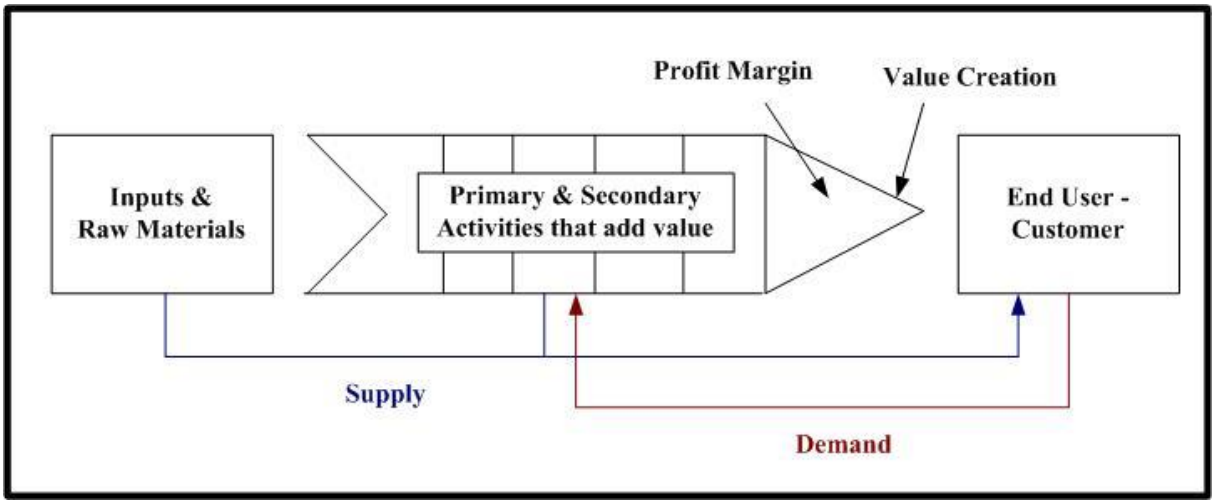


Figure 14: Simplistic representation of a value chain. (source: Wikimedia.org)

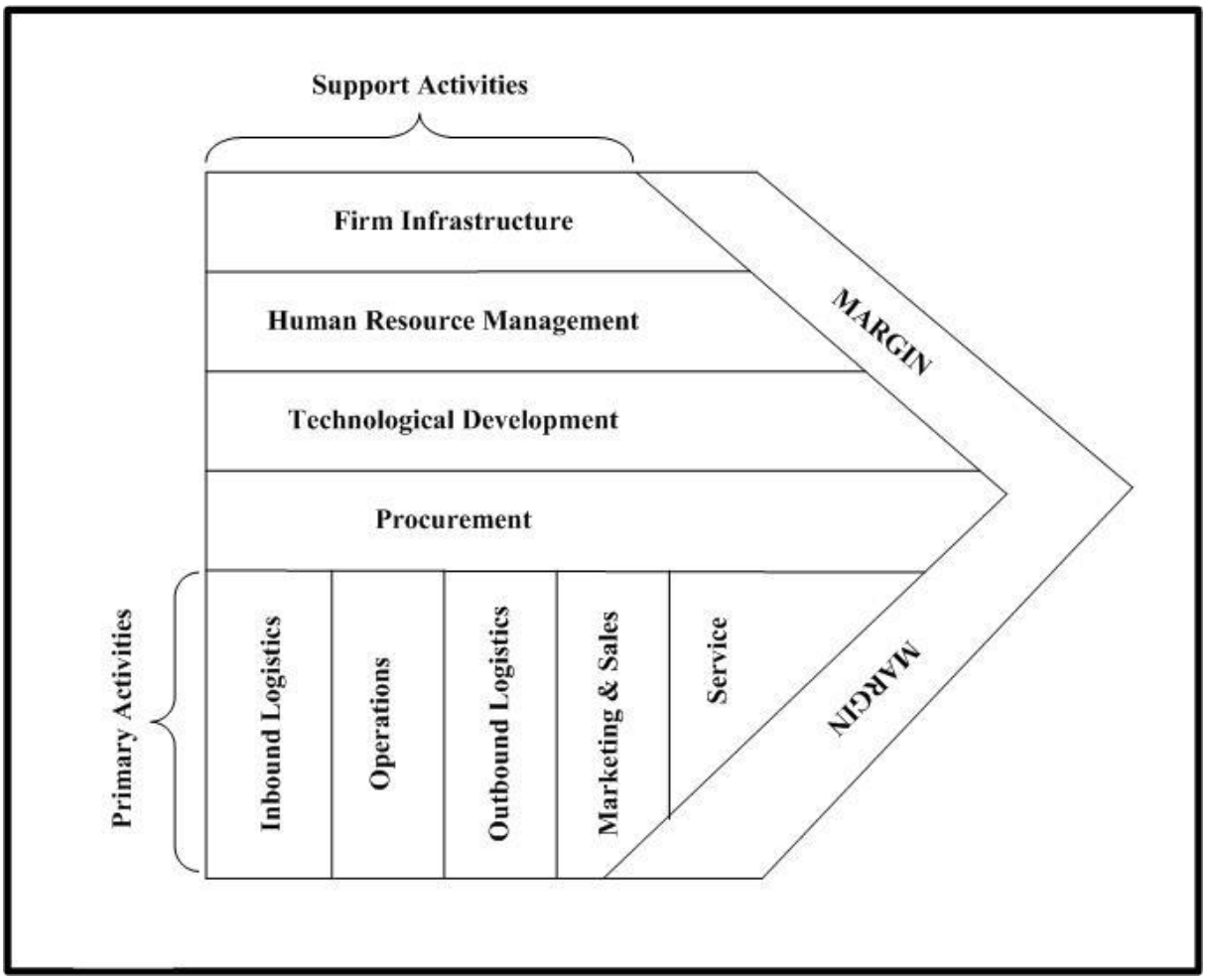


Figure 15: Original Porter's value chain. (source: Wikimedia.org)

Being wrote in the 1980's, can Porter's work support today's cloud computing and its value creation? Mohammed et al. (2009) write in their research paper that the value chain should be updated into a value network which then would include a whole spectrum of interactions between companies creating value. Their research led the scientists to develop what they call cloud value chain reference model using the classic concept, incorporating at the same time value networks.

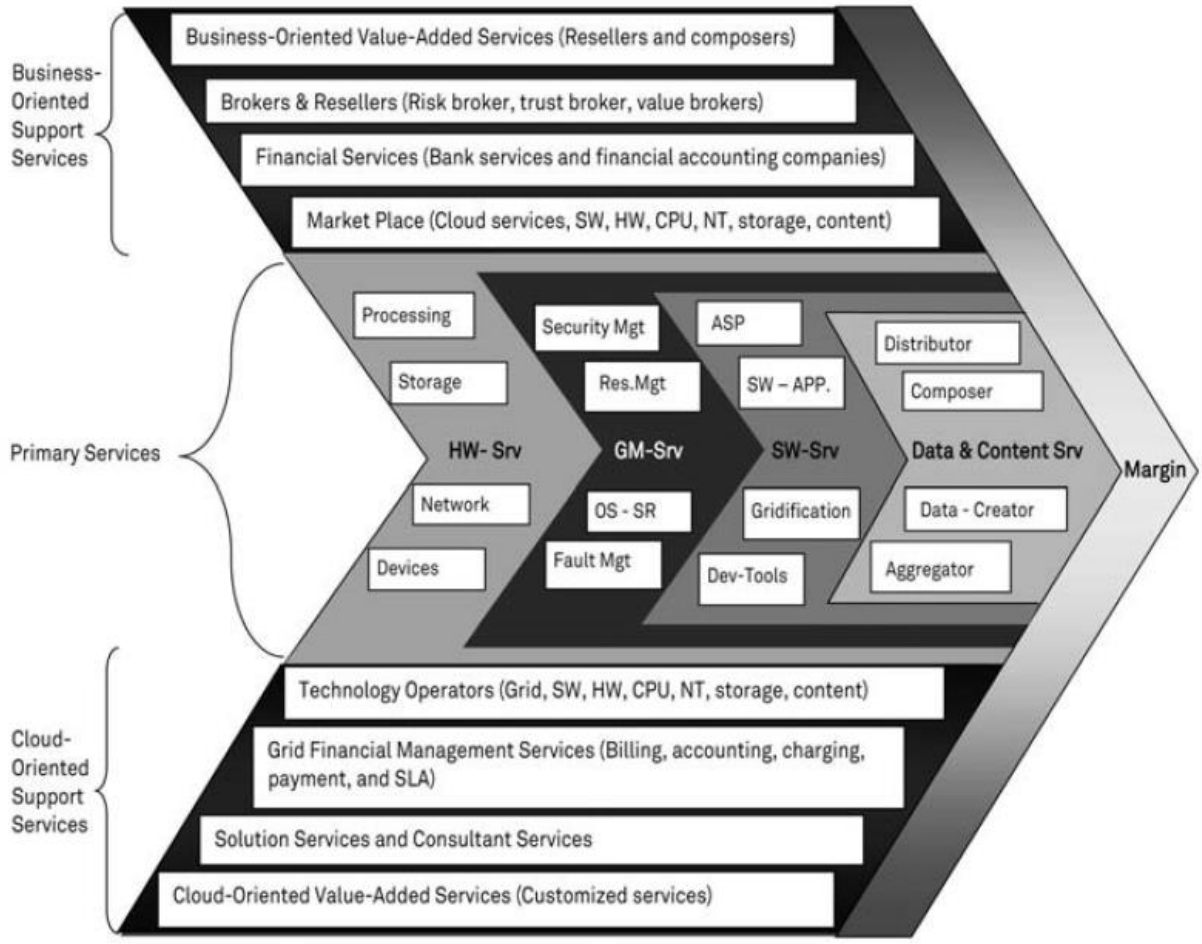


Figure 16: Cloud value chain reference model (source: Mohammed et al. 2009).

The researchers proposed a very comprehensive model using Porter's value chain. They have distinguished primary services, business oriented support services and cloud oriented support services. Their work is based on a microeconomic level, giving a good understanding of the actors in the value chain and their roles.

Cisco's Internet Business Solutions Group (IBSG) in their white paper "The Cloud Value Chain Exposed" try fitting different IT solution providers into one generic value chain of cloud computing. The authors

argue that by fitting various companies into the chain they can help them better understand their customer's needs and create better value offer that meet their partner's needs.

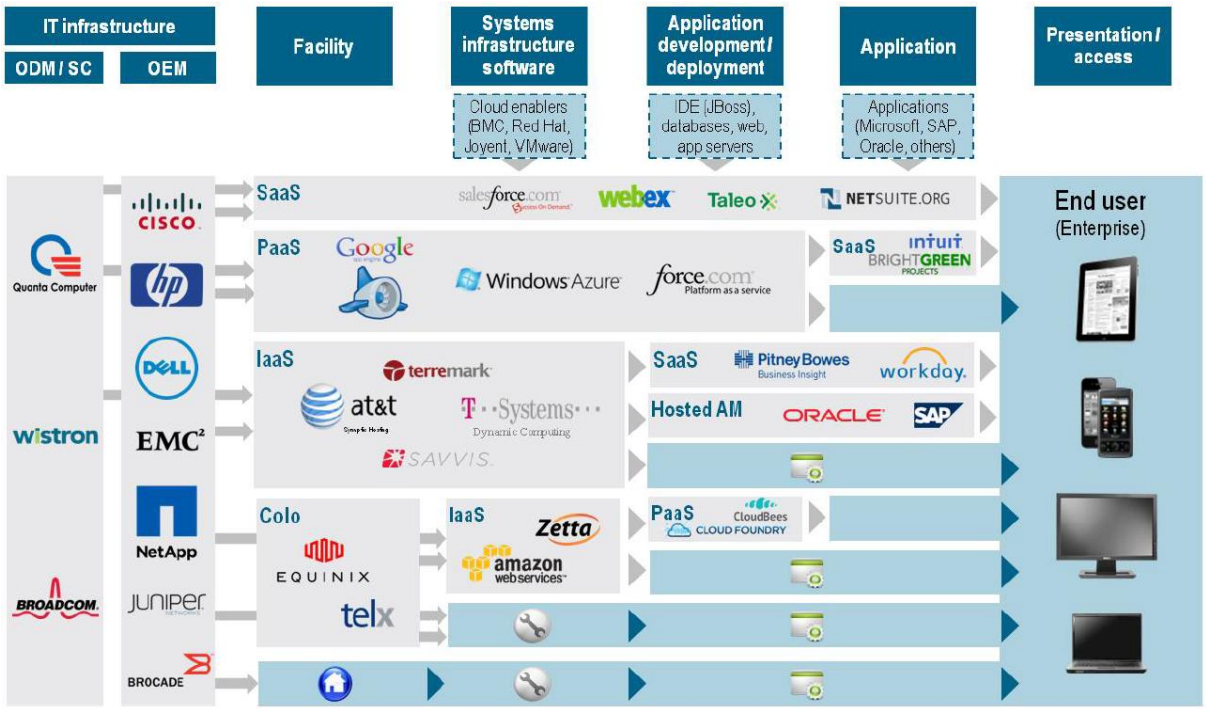


Figure 17: Cisco's cloud value chain. (source: Cisco)

2.1.2. Value network

However classic Porter's work is, in today's world of innovation coming in all shapes and sizes the view of a value chain can be a bit out-dated in some industries or the change in the industry reshaped how the value chain looks. In works by Peppard and Rylander (2006) and Holweg and Pil (2006) the researchers suggest using a value network approach which initially requires shifting from linear thinking into a more complex grid type. It allows thinking more globally about value creation, mapping new possibilities and discovering potential threats.

Value networks occurred as a result of companies starting cooperating with others in the same industry or different ones. Partnerships, alliances, joint ventures – it all led to developing networks of value rather than a linear approach. Think for a second about Star Alliance or Sky Team – it is a network of companies (airlines) offering its customers (passengers) a wide range of available flights of the same or better service quality (value). Here the value is created not in linear way – it is multidirectional,

focused on benefits for passengers (wide selection of fights) and the airlines itself (full airplanes, better airport slots).

The value grid consists of three dimensions for a company to identify ways of enhancing performance: vertical, horizontal and diagonal. In the vertical dimension companies look for opportunities beyond their own traditional value chain. Horizontal dimension explores opportunities in the parallel value chains. Most complex way – diagonal – involves exploring more widely and looking at different tiers and value chains for value creation opportunities.

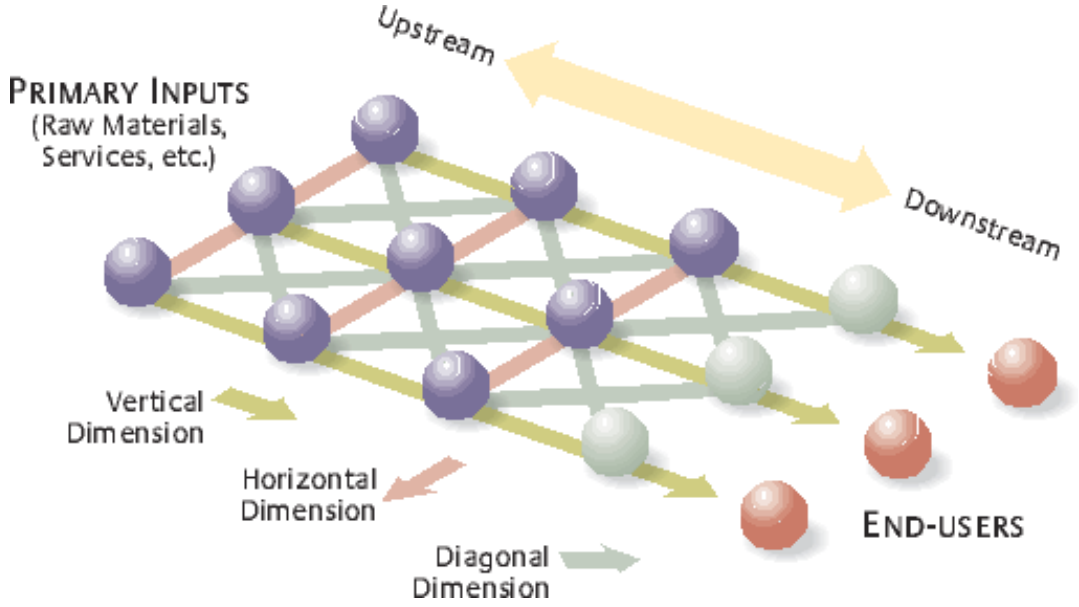


Figure 18: Value network. (source: MIT Technology Review)

An example of a horizontal move into value chains of other companies is Toyota. The company decided to licence its hybrid engine technology to Ford and Nissan. In a linear way of thinking, Toyota's move was at least unwise, not to mention dangerous for its own value creation. However, an engine is a product as any other and Toyota by licencing their technology had become a supplier of technology to others, gaining economies of scale and control over the future development of hybrid engines.

Another example of horizontal thinking comes from Microsoft. For years, home users thought of Microsoft as Windows and Office supplier. Few knew other company's products like Windows Mobile for early smartphones users. It was never an entertainment company until in 2001 it introduced its first Xbox gaming console, competing successfully with Sony, Sega and Nintendo – industry giants. Currently, as announced in April 2013, the Xbox system is not only a gaming console but an

entertainment system for the living room supplying customers with games, TV shows, Skype calls, movies and music.

Böhm et al. (2010) used value networks to develop a generic model for cloud computing using e^3-value methodology. They distinguish different players within the market and categorise them by roles they play: application provider, (technology) platform provider, market platform, infrastructure provider, consultant, aggregator, integrator and consumer.

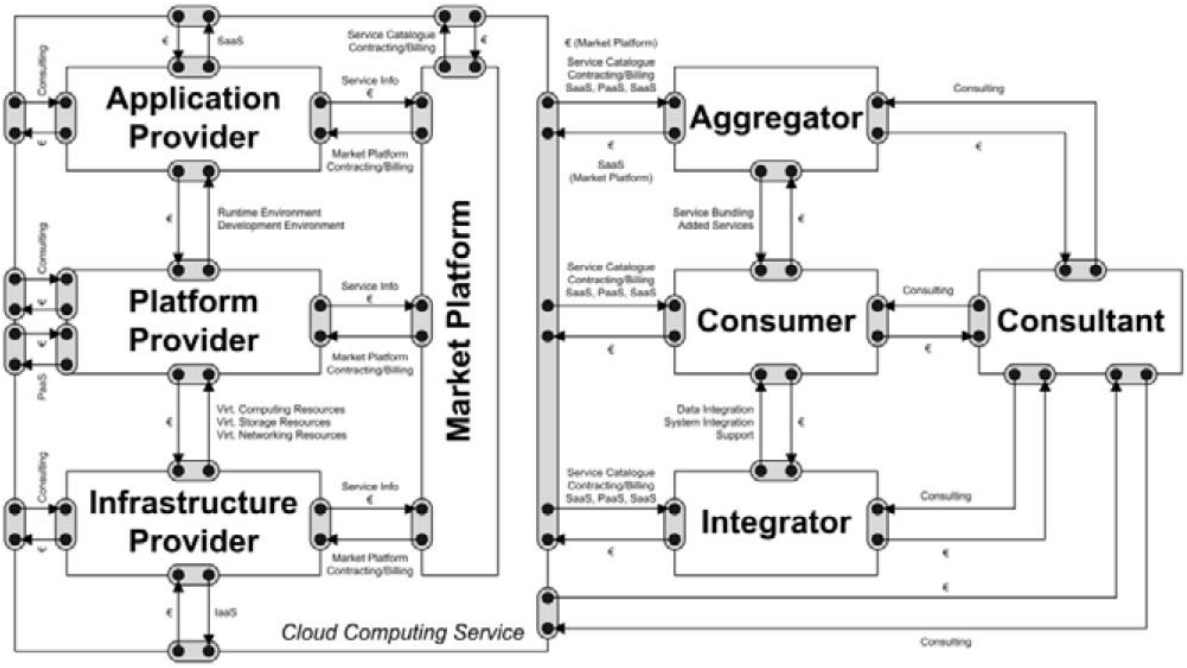


Figure 19: Cloud computing value network (source: Bohm et al.).

While conducting further research, a role of data provider (providing data and information to other actors within the network) and monitor (security and governance related issues) emerged which is not included in the generic value network.

The **customers'** role is to buy the needed services through various like service provider or platform provider.

Service providers, or IT vendors, create and run services offering value to the customer and an aggregate services provider respectively. Infrastructure provider grants them access to his hardware to run the service on.

The technical backbone lays in hand of **infrastructure providers**. They offer the crucial, scalable hardware for the services where the service providers provide their offerings. They are also sometimes called IT vendors.

Aggregate services providers (aggregators) blend current services or parts of them to form new services offered to customers. Thus, they are both customer and service provider. Aggregators focusing on data integration rather than services are known as data integrators. They role is to make sure that current data is prepared and is valid to be used by diverse cloud services and can be noted as a sub-role of aggregators with core candid on technical data integration. Muylle and Basu in their work use a concept of “system integrator” or “business process integrator”. With these names these authors generally refer to aggregators focusing more on the technical aspects necessary for data and system integration while (service) aggregators in a broad sense also include the business aspects of merging services to offer new service bundles.

The **platform provider** acts as a kind of catalogue in which different service providers offer services. Often the services are based on the same development platform but also completely open, platform-independent development directories are possible. The platform provider offers the technical basis for the marketplace where the services are offered.

Last, the **consulting** for the customers serves as a support for the selection and implementation of relevant services to create value for their business model.

The value network presented is a good macroeconomic model, enabling companies to strategically position themselves on the market with their service(s) and identify new business opportunities.

2.2. Commonly named benefits

Businesses when asked why they adopted the cloud or why they are considering moving to the cloud mostly will name one of the few benefits that the cloud gives them as listed below:

- Agility
- Flexibility
- Cost-saving (pay-per-use)
- Economies of scale
- Reduce time-to-market
- Business transformation enabler
- Shifting from capital expenditures to operating expenditures
- Location independence
- Outsourcing
- Focus on core competencies

No study so far focused on challenging these assumptions by measuring some kind of KPIs before and after implementing cloud solution by the business. As result of that, companies take above benefits as common knowledge and hardly ever debate over them.

Cloud definitely is a cost-saving solution for businesses which do not have to build data centres as they rent the computing power from cloud providers. This also gives flexibility and agility in deploying applications and services within the company. In 2007, a software engineer for The New York Times had 4TB of articles from 1851-1922 to generate PDF files. Using Amazon's 100 EC2 virtual machines and S3 the whole process took less than 24 hours with total cost of 240 USD. It is a clear example how cloud solutions help business reach goals much quicker.

2.3. Flexibility and scalability

Companies today need to be flexible to respond to increasing market demands. One of the ways to meet those demands is flexible IT infrastructure which supports ad-hoc content creation and deals with data overload.

Flexibility in cloud computing world means that one can access the service offered from anywhere in the world, from whatever computer type and brand available for the user. The main limitation is that there has to be Internet connection available, preferably broadband one.

Flexibility means also that if there are more VMs required or more users have to gain access to the SaaS system, this can be done by few mouse clicks. The total computing power bill changes accordingly. In the previous example of NYTimes articles, instead of running 100 instances, the user could run half or double the number of VMs, the amount of time for the task would be bigger or shorter and so would be the final invoice.

Amazon Web Services (AWS), as described later in the thesis, offers a fully flexible IaaS solution for companies who need computing power without building vast data centres. The flexibility and scale of deploying services using AWS is practically limited to company's data centres performance (officially, to meet demands, the basic limits are 20 VMs for on-demand service and 100 for spot instances. Those limits can be increased by Amazon if requested).

Scalability of cloud is a great feature for high data-processing tasks like new drugs discovery, DNA sequencing, weather forecast and scientific experiments. Based in Berkeley, California National Energy Research Scientific Computing Centre (NERSC) offers scientists the power of their supercomputers to perform simulations ranging from nanostructures to theoretical physics. As the systems' computing power is measured in petaflops, the demand for a spot is so big that scientists have to queue up waiting for their simulations. It can be seen that the service offered is not really cloud computing as there is no scalability and flexibility in it as well as no virtualization techniques are used however for scientists access to such powerful infrastructure is essential.

Pfizer, the world's largest pharmaceutical company, adopted Amazon's EC2 to set up Virtual Private Cloud to separate their research computations from other computations on the platform. This allowed extending computing capabilities of their current high performance computing (HPC) system to meet the workload of many on-going projects: drug discover, analytics, modeling. In the words of Pfizer's

Head of HPC for R&D, Dr Michael Miller “AWS enables Pfizer’s WRD to explore specific difficult or deep scientific questions in a timely, scalable manner and helps Pfizer make better decisions more quickly.”

In North America, AON, British provider of professional services such as insurance, HR services and outsourcing, deployed Salesforce CRM for its 7,000 employees to gain better insight into the company after years of acquisitions in the region. Mergers and acquisitions bring risk that current systems might not meet necessary requirements as data can be duplicated, not visible enough or lost. AON understood the challenge and decided to move to one single CRM system. The choice of Salesforce came to them after evaluating different vendors. The solution was scalable and flexible to meet demands and gave the company better insight into their customer base connecting different departments within the company to the same platform.

2.4. Cost-savings and outsourcing

When looking through various consulting documents the most common phrase associated with the cloud is cost-savings, followed by outsourcing. This seems to be the most important thing about cloud computing. Without a doubt, deploying a XaaS service in a company can save money. A small analysis was performed at British American Tobacco Nederland B.V. when it was looking for a system for sending mass e-mails to the retailers. The findings was that such system as a SaaS solution would be nearly 10 times cheaper over a period of 10 years than a system deployed in-house (see Table 2 for details). On the other hand, when BAT Nederland was looking for a CRM system which would serve as a basis for Stakeholder Relationship Management Service, although SaaS-solution was preferred it turned out that it would be financially ineffective with higher cost over 10-year time (see Table 3). The findings differ from what consulting documents saying that enabling cloud cuts costs. The analysis did not take into account any development of new functionality and keeping the software always up to date which CSPs do and in classic buyer-seller relationship can be achieved with a proper SLA and post-sell service.

The analysis took into account inflation in the European Union and The Netherlands and current average saving rate in Dutch bank according to Centraal Bureau voor de Statistiek (CBS) and European Central Bank (EBC).

					inflation	EU	0,013		
		risk-free rate	0,01			NL	0,0155		
		EURUSD	1,3564			US	0,021		
In-house solution				SaaS solution					
Initial investment	€ 7 000,00			Contact management	€ 240,00	per year			
Support	€ 2 000,00			Mailing system	$ 1 800,00	per year			
Year	Value	PV	Year	Contact mngt	Mailing sys. $	Currency change	Mailing sys. €	Sum	PV
0	€ -7.000,00	€ -7.000,00	0	-€ 240,00	$ -1 800,00	1	-€ 1 327,04	-€ 1 567,04	€ -1 567,04
1	€ -2.000,00	€ -1.980,20	1	-€ 243,12	$ -1 837,80	0,9921645	-€ 1 365,61	-€ 1 608,73	€ -1 592,80
2	€ -2.000,00	€ -1.960,59	2	-€ 246,28	$ -1 876,39	0,9843905	-€ 1 405,30	-€ 1 651,58	€ -1 619,04
3	€ -2.000,00	€ -1.941,18	3	-€ 249,48	$ -1 915,80	0,9766773	-€ 1 446,14	-€ 1 695,62	€ -1 645,76
4	€ -2.000,00	€ -1.921,96	4	-€ 252,73	$ -1 956,03	0,9690246	-€ 1 488,17	-€ 1 740,90	€ -1 672,97
5	€ -2.000,00	€ -1.902,93	5	-€ 256,01	$ -1 997,11	0,9614319	-€ 1 531,42	-€ 1 787,43	€ -1 700,68
6	€ -2.000,00	€ -1.884,09	6	-€ 259,34	$ -2 039,05	0,9538986	-€ 1 575,93	-€ 1 835,27	€ -1 728,91
7	€ -2.000,00	€ -1.865,44	7	-€ 262,71	$ -2 081,87	0,9464244	-€ 1 621,73	-€ 1 884,44	€ -1 757,65
8	€ -2.000,00	€ -1.846,97	8	-€ 266,13	$ -2 125,58	0,9390087	-€ 1 668,86	-€ 1 934,99	€ -1 786,93
9	€ -2.000,00	€ -1.828,68	9	-€ 269,59	$ -2 170,22	0,9316512	-€ 1 717,37	-€ 1 986,95	€ -1 816,75
10	€ -2.000,00	€ -1.810,57	10	-€ 273,09	$ -2 215,80	0,9243512	-€ 1 767,28	-€ 2 040,37	€ -1 847,12
	NPV	**€ -25 942,61**						**NPV**	**€ -18 735,65**
				Difference	**€ 7 206,96**				

Table 2: Comparison cost between in-house mailing system and SaaS mailing system solution.

				inflation	EU	0,013
		risk-free rate	0,01		NL	0,0155
In-house solution				SaaS solution		
Initial investment	€ 36 500,00			CRM system	€ 16 800,00	per year
Support	€ 2 900,00					
Hosting	€ 1 800,00					
Year	Value	NPV	Year	Value	NPV	
0	€ -36 500,00	€ -36 500,00	0	-€ 16 800,00	€ -16 800,00	
1	€ -4 700,00	€ -4 653,47	1	-€ 17 018,40	€ -16 849,90	
2	€ -4 700,00	€ -4 607,39	2	-€ 17 239,64	€ -16 899,95	
3	€ -4 700,00	€ -4 561,77	3	-€ 17 463,75	€ -16 950,15	
4	€ -4 700,00	€ -4 516,61	4	-€ 17 690,78	€ -17 000,50	
5	€ -4 700,00	€ -4 471,89	5	-€ 17 920,76	€ -17 050,99	
6	€ -4 700,00	€ -4 427,61	6	-€ 18 153,73	€ -17 101,64	
7	€ -4 700,00	€ -4 383,77	7	-€ 18 389,73	€ -17 152,44	
8	€ -4 700,00	€ -4 340,37	8	-€ 18 628,80	€ -17 203,38	
9	€ -4 700,00	€ -4 297,40	9	-€ 18 870,97	€ -17 254,48	
10	€ -4 700,00	€ -4 254,85	10	-€ 19 116,30	€ -17 305,73	
	NPV	**€ -81 015,13**		**NPV**	**€ -187 569,16**	
				Difference	**€ 106 554,03**	

Table 3: Comparison cost between in-house and SaaS CRM system.

As mentioned in chapter 1.7., cloud is a game changer in the outsourcing industry with new players that need to be considered by current market players and new tools enabling them to deliver interesting value to companies across the world. Cloud also lowers barriers of entry for new companies that can rapidly deploy services using XaaS solutions without the necessity of buying own servers or building new data centres.

The nature of cloud solutions, with no upfront payments, means also shifting from capital expenditures (CAPEX) to operational expenditures (OPEX). With this accounting change it possible to generate savings from IT spending. Adobe's Creative Cloud is a good example here. With introduction of monthly payment to access all Adobe products users can choose for how long they are willing to pay for the service (OPEX) without spending approx. 2500 USD on software (CAPEX). Same thing goes for Microsoft's Dynamics CRM solution. For a monthly fee of 65 USD/user (OPEX) businesses gain access to fully functional CRM whilst developing such solution in-house can cost (CAPEX) several million

dollars (software licence, hardware, man-hours, consulting, integration). This shift is important when thinking about company's IT strategy. With the combination of outsourcing, cost-saving and OPEX CIOs can reduce IT costs, while gaining at the same time scalability and better performance.

2.5. Business transformation

Implementing any cloud solution in business means that current processes need to be aligned with technology advancement as automating current processes can be inefficient and dismantle (need better word for it) the benefits brought by XaaS. This also allows focusing more on the core competencies and leaves IT provisioning to specialised companies. According to 'Cloud Survey report' by KPMG from early 2013, business processes redesign is among the top issues companies endure while implementing cloud. This is often also a hidden cost of the cloud which research document omit while focusing only on the pros.

2.6. Dark side of the cloud

While everything seems to be easy with the cloud: saves money, it is scalable, agile, easy to deploy there are things that research documents and consulting companies do not say. KPMG first noted that deploying cloud has hidden costs that goes beyond cloud deployment. It's the cost of business process re-engineering, IT management, system integration, infrastructure management and IT configuration.

Implementing cloud influences current systems and infrastructure which possibly can cause glitches, errors and data issues. If data is scattered around various systems, i.e. stakeholder data in CRM system, Lotus Notes database, Excel spread sheets, Word documents and on business cards, then there is no real visibility of stakeholders information and when a cloud solution is to be implemented to capture such information in one place then one have to ensure data cleanliness and exchange between current systems and cloud system. Or, if cloud is supposed to be the only place to store such information, how we can guarantee safety of personal information?

What is more, as mentioned before, cloud makes companies redesign the processes to fit new possibilities. But when a company has poorly designed processes or employees have poor idea on how a process looks like this causes great challenges for success of cloud implementation. Processes need to be defined and employees made aware of new structure. This takes time and money.

While ABBA might sing "it must be funny in the rich men's world" – the truth about money and cloud is that can end up being not funny at all. If project operates only on assumptions that there is need for

new service and it has to be a cloud one then without deep thinking how it impacts the current IT infrastructure and business processes it can go wrong. Many existing companies are not ready for cloud solutions even if they think they are. Not seeing the big picture and cloud influence on the company makes cloud project cancelled or being over-spent. Such thing has to be carefully revised and part of project's concept definition.

2.7. Value of cloud for British American Tobacco IT

Cloud computing research focuses mostly on the side of cloud service providers giving just little insight how companies implementing such solution benefit from it. The author, having the possibility of working in IT department of British American Tobacco office in Amstelveen, The Netherlands, was able to discuss cloud solutions and their meaning for the company with IT architects, IT account managers and security managers which gave interesting information how a non-IT company perceives cloud.

Questions asked were as follows:

1. What cloud computing means to you?
2. Are there any cloud solutions currently in place?
3. What are the requirements to deploy cloud services at BAT?
4. What value brings the cloud to BAT?
5. What challenges faces BAT IT with cloud services?

The answer to the first question was that cloud is an externally hosted solution with specific applications that allows performing business processes, does not impact current IT infrastructure and is paid on-the-go. This description is similar to the most common understanding of cloud computing.

When asked about current cloud solutions available it was mentioned that there is probably none currently in place. Author's own work found SaaS solution Kenexa and AFAS in HR department which are used for recruiting and payroll respectively. No more solutions deployed where found.

The company has on-going projects which use cloud computing. Those projects involve stakeholder relationship management service, online collaboration, automated facings check, digital signature and digital signage. All five projects involve using cloud solutions for faster delivery of projects and better performance as well as cost savings. Digital signage is a project where almost 2000 TV screens are to be installed in outlets to display commercial information and ads. With the use of SaaS solution it will be easier to manage the screens, push content on them, monitor status. Another project, automated

facings check, uses Amazon's AWS with proprietary software on them for planogram compliance check. Using only pictures made on a smartphone or tablet device and uploading them to the service, sales representatives receive feedback on how an outlet aligns with the signed agreement between him/her and BAT. The tests were very successful and thanks to cloud-nature of the solution it can be implemented rapidly.

The security question seemed to concern my interviewers the most. There is general ban for using any services that are hosted outside EU as it raises privacy concerns and this was long before the PRISM revelations have been uncovered. Cloud vendor, before it can be considered for solution, needs to undergo a deep security assessment by the IT security team which then gives a verdict whether or not to go into business relation with. The process asks for questions about psychical security of data centres, data separation, data centre location, other parties included in the project. All this rates the project which triggers other steps in the IT security assessment. Projects can require deep involvement of IT security team or not, depending on the scope of the project.

When asked what value cloud brings to the company the interviewers were not sure about the answer. They definitely noticed cost savings as well as rapid deployment and implementation of new solution without touching current infrastructure. There was concern around integration of cloud service and current software and the cost impact of such integration in the overall cost-benefit analysis. Cloud was prised for being flexible and adaptable for current business needs which would not be possible in the usual way of deploying services.

It was noted that cloud general value is that no additional servers have to be bought or current servers extended as everything is hosted outside the company. Even with the risks involved the cloud seemed to be a good way of extending IT infrastructure in the company. Although, implementing cloud can complicate company's IT landscape with additional services available and new connections with servers that can cause lower performance of either of the services or both. Also, it had to be taken into account that global projects can cause implementation issues as well as feasibility of local cloud projects and as such they must be consulted with global teams.

In summary, the team interviewed understands the benefits given by the cloud and is well aware of the risks involved when implementing XaaS solutions. They know when cloud solution is vital and good for projects and when to say stop and rethink the project's goals.

3. Comparing value propositions

This chapter focuses on comparing value proposition of different cloud service providers and their offer for businesses. It tries also to check if business model of CSPs is sustainable. Using available documents and own research, the author tries to investigate different value propositions using Salesforce, Amazon AWS, Google Apps Engine, Windows Azure and Adobe Creative Cloud as an example. The companies chosen are public and publish yearly financial reports so that it can be checked if the business model is sustainable.

3.1. IBM SmartCloud

IBM is known to experiment with virtualization technologies dating back to 1960's when researchers created first virtual machine on CP-40 and CP-67 operating system using IBM mainframes. CP-67 enabled sharing memory across virtual machines and giving each user own memory space. Successful experimentation led to release commercial offer in 1972. Having the technological knowledge and advancements in IT, IBM continued to expand and improve their virtualization technology using automation and standardization in their technology in order to increase hardware and data centre efficiency. The first clear direction for cloud computing was made in 2007 when the company strategically positioned itself as not only as solution-provider for building and managing the cloud but also service-provider for businesses who were looking for XaaS solutions.

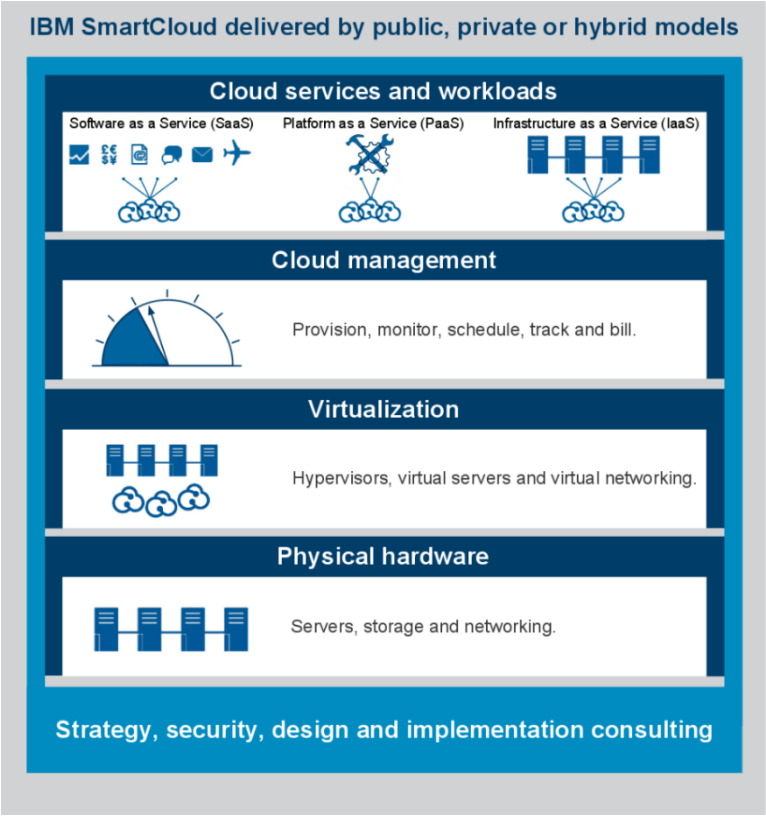


Figure 20: IBM SmartCloud model. (source: Wikimedia.org)

IBM SmartCloud is a brand for IBM's ecosystem of products and solutions for cloud computing. It includes infrastructure as a service, platform as a service and software as a service that can be deployed as a public, private or hybrid cloud.

Those offers are put under names SmartCloud Foundation, SmartCloud Solutions and SmartCloud Services.

Solutions for cloud design and management are the core offer for IBM and companies can entirely rely on their solutions and hardware. It is also possible to just pick few solutions for a cloud and integrate it on non-IBM cloud platform.

IBM SmartCloud Enterprise and Enterprise+ is an IaaS solution similar to Amazon AWS and Rackspace offering robust user experience. Companies are encouraged to migrate to the cloud with their current software licence (bring-your-own-licence) and charged per use.

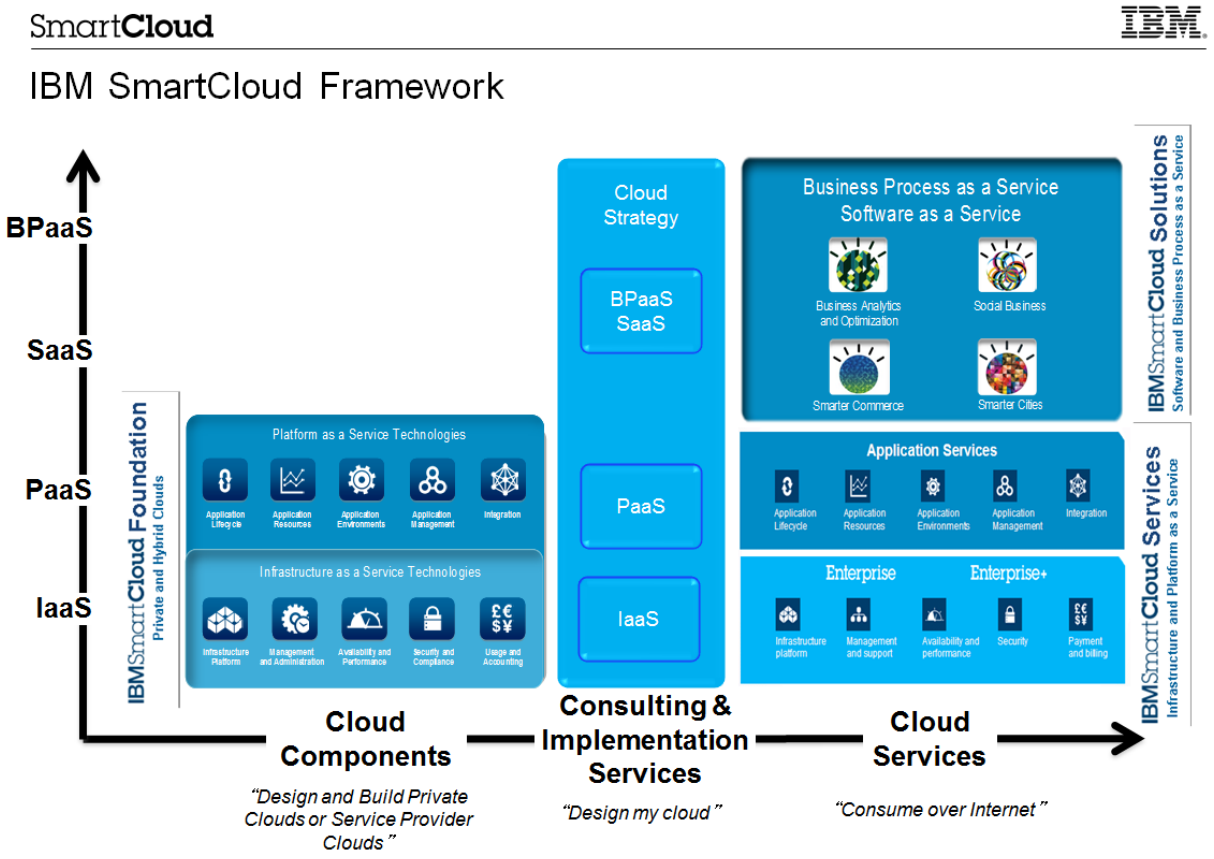


Figure 21: IBM SmartCloud Framework. (source: IBM)

What is IBM SmartCloud value chain or network? IBM offers, as one of the few big players in the market, a complete way to deploy cloud solutions for companies as well as own cloud services. Being business process outsourcer for many years, cloud seems to be a natural addition to IBM's business. Starting a cloud business with IBM technologies gives the benefit of having everything from one vendor

which should not give any issues as the cloud model was researched thoroughly and everything should work fine.

As a service-provider, IBM gives clients access to reliable and mature infrastructure in its data centres with automatic scaling, transparency of service, SLAs, efficiency and agility. Offering a wide range of IaaS, PaaS, SaaS and BPaaS (business processes as a service) IBM offers full scope of services.

3.2. Salesforce.com

Based in San Francisco, California Salesforce.com was established in 1999 by former Oracle executive Marc Benioff and 3 Clarify employees Parker Harris, Dave Moellenhoff, and Frank Dominguez. It is mostly known for its cloud-based CRM system – Sales Cloud.

The CRM system offered is a typical SaaS solution where the company can choose between different subscription plans and gain access to the functionalities of CRM system in the cloud. The prices differ from $25/month to $300/month per user so every company can choose the best option. As cloud solution, there is no need to have on-site server for the CRM and buy costly licences, pay maintenance and implementation costs. Therefore, Sales Cloud wants to replace such companies Oracle or Microsoft with their expensive, bulky CRM systems offering a clean and affordable solution. One would argue that it is a disruptive technology that reshapes the market.

Salesforce is not limited to their CRM solution and being only a platform provider. They can also be seen as application provider as they offer applications which can be used with the CRM system. What is more, they are also a market platform offering third party applications that enrich and enhance the Sales Cloud. With linking cloud offering with customers and third-party suppliers the company has created a unique value network (ecosystem) allowing the customers to customize the CRM to their needs while enjoying the benefits of outsourced system.

In Salesforce CRM service a lock-up effect can be noticed. This effect means that if companies decide to start using Salesforce service they cost of moving from it to another platform can be either dramatically high or undoable.

Value here: rich CRM system ready to be used within minutes from signing on-line and choosing suitable yearly plan and amount of users. Customizable, enriched with extra add-ons (free and paid), mobile. No on-site servers needed and no licencing fees. It offers scalability so the system grows with the company and it needs. No need to upgrade current licence or add additional space. Managers can

simply click to add new user and new position to the billing option. The lock-up effect described above could mean that breaking from this value chain can be hard.

3.3. Amazon Web Services

Introduced in 2006 Amazon Web Services (AWS) was initially thought as a way to occupy idle servers in Amazon's vast data centres. It is in essence IaaS solution giving access to high-speed computing and large volume storage. The best known services offered are Amazon Elastic Computing Cloud (EC2) which allows to rent virtual servers to run one applications and pay by the hour. EC2 is known for using open-source Xen Project as native hypervisor and virtualisation environment for managing multiple systems on servers. The service is used by, for example, Foursquare, Reddit, Autodesk, NASDAQ.

Second widely known service is Amazon Simple Storage Service (S3) which is a bucket storage service offered by Amazon and paid by every 1GB of space (currently: $0,15/1GB/month + transfer costs). The service is primarily used for web hosting, image hosting and backup storage. Used by Coursera, Pinterest, Dropbox, Bitacasa, Netflix and Minecraft.

Amazon has split the world in 9 regions + 1 for US government with dedicated data centres for AWS. The data centres are not connected between each other in case of outages preventing the snowball effect of the entire infrastructure. An outage during Christmas 2012 resulted in Netflix being out of service for north-eastern USA but the rest of the country was not affected.

Companies using AWS report saving millions of dollars on infrastructure otherwise spent on new servers or data centres giving them ability to focus more on their core business. Automobili Lamborghini says using AWS helped them reduce infrastructure costs by 50% and Nuremberg Airport reports 60-70% decrease in web hosting costs.

AWS Marketplace for both individuals and companies offers specialized software running on AWS. The software includes SAP Hana, SAP Business Objects, Sage One, various Linux/Unix distributions, MS Windows Server 2012, MongoDB, Wordpress etc. The software can be free or a monthly fee is paid for it using the software and EC2 instances. Additional charges for storage can also occur.

The complexity of Amazon Web Services can be overwhelming. With 38 services on offer finding and combining together the necessary ones can be hard. There are various aggregators and consulting companies that can help deploy needed services.

What is the value of using AWS? First, and foremost, the scalability of EC2 is enormous. One might start using low-cost instances and then scale them up until the level of performance meets their needs. EC2 can be scheduled to auto-scale if a CPU usage meets a certain threshold. Pfizer uses EC2 for new drugs discovery saving thousands dollars. FC Barcelona relies on AWS for website hosting and peak-hours traffic handling and they seem to be very satisfied. S3 stores 2 trillion objects as of April 2013 which was up from 102 billion in March 2010. The scalability, again, is enormous. Of course, mind the price for every GB of storage someone uses. Marketplace provides great tools from open-source projects to commercial software for small, medium and big companies allowing them to grow their business for a fraction of cost as licences tend to be much cheaper when using AWS. No servers needed and no licencing fees. No wonder many start-ups use AWS to start their business as it allows shorting the time needed to operate from months to days or even hours.

The initial value proposition of Amazon Web Services is on-demand capacity and scalability. The graphic below explains in simple ways benefits of Amazon's cloud versus traditional data centre.

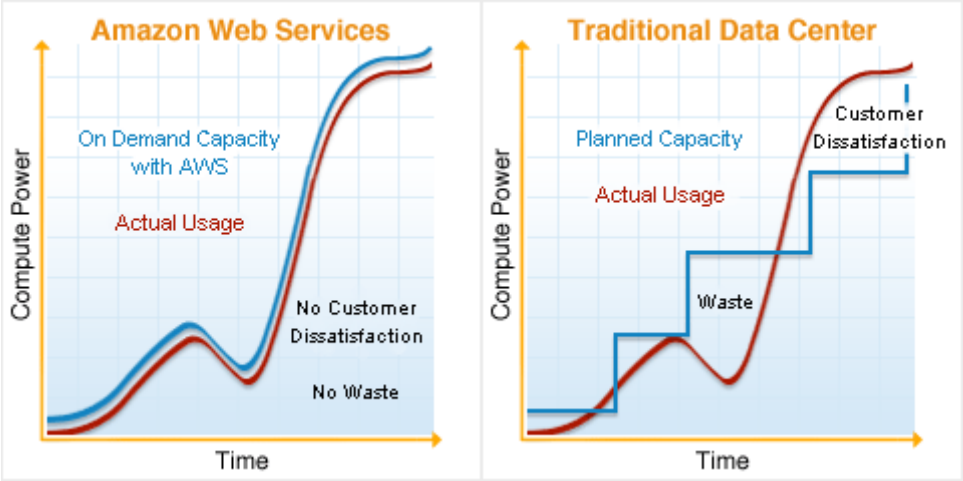


Figure 22: AWS vs. traditional data centre. (source: akp-blog.com)

As it can be seen, AWS offers no waste of computing power utilizing the servers to their maximum possibilities while customers can enjoy great service.

3.4. Windows Azure

Windows Azure is part of Microsoft offer for business to build, manage and deploy applications using Microsoft data centres scattered around the world. It supports various programming languages, frameworks and tools both Microsoft-specific and third-party software. The offer is platform-as-a-

service and infrastructure-as-a-service. The services can be purchase on a pay-as-you-go basis on 6 or 12-month contracts.

The current offer includes:

- Websites – building sites with ASP.NET, Node.js or PHP and deployed by FTP, Team Foundation Server or Git.
- Virtual machines – creating and running both Windows Servers and Linux virtual machines.
- Cloud services – PaaS environment for creating applications and services.
- Data management – SQL database for cloud use.
- Media services – PaaS offering for encoding, streaming, content protection and analytics.
- Marketplace – store with some add-ons for Azure. Not too many applications available in comparison to AWS and Salesforce but this could be a reason of Microsoft's closed environment.

The most important value proposition in Azure's offer is the access to the most recent Microsoft applications and services for a fraction of licencing fees. A website can be build using Windows Server, Internet Information Server and .NET framework – all coming from one software vendor. While this is a great idea of PaaS offer – we give you platform to build applications on, you pay as for what you use – the company marginalizes other applications and services, primarily open source, in favour of their product portfolio.

The other value offer is computing power of Windows-run virtual machines that can be easily used by current Microsoft customers who are used to their products.

Among businesses using Azure there is Herbalife, Essex County Council, BMW Latin America, ABBYY and Avanade (join venture between Accenture and Microsoft).

According to Gartner's Magic Quadrant research for IaaS providers, Microsoft is a visionary with their Azure offer, but they are far behind Amazon Web Services in terms of ability to execute and leadership.

Figure 23: Gartner's Magic Quadrant for IaaS. (source: Gartner)

3.5. Google AppEngine

Google's PaaS offer and part of Google Cloud Platform was launched in 2008 for developing and hosting web applications in Google data centres. Applications run in a sandbox environment and across multiple servers. The service offers automating scaling for web apps – up to 7 billion requests per day. The service has the benefit of being free up to a certain point of consumed resources when the billing process starts. Currently AppEngine supports only Python and Java with PHP and Go being in testing phase.

Applications created in AppEngine can be available as standalone web apps on dedicated websites or at Chrome Web Store as applications for Chrome browsers, Chrome OS and Windows. Most of them are offered for free, using advertising and user tracking to generate revenue.

As a free service, AppEngine has daily limits for application creators and they are shown in Table 4.

Quota	**Limit (per day)**
Instance-hours	28 hours
Emails	100 (5000 admin emails)
Bandwidth in	Unlimited
Bandwidth out	1 GB
Datastore	1 GB
Datastore Operations	50k
Blob Storage	5 GB
XMPP API	10k stanzas
Channel API	100 channels opened
URLFetch API calls per day	657,000

Table 4: Daily usage limits of AppEngine.

All instances above the daily limits are priced per use and billed either daily, weekly or monthly.

The value offer here seems to be quite simple: free, but limited, PaaS for web applications that is easy to use and benefits from using Google data centres. The offer breaks into the value network in several ways:

- Traditional software vendors supplying developers with programming software.
- Hosting companies as the apps are hosted on Google servers and benefit from infrastructure scalability.
- SQL solutions – Google offers its own version of SQL based on MySQL with databases not greater than 10GB.
- Removes system administration and development threats as Google handles code deployment to cluster, monitoring, failover and launching necessary application instances.

There is a concern among developers about the lock-up effect of the service as the free offer is tempting but it is hard to escape from the platform to another one.

Among users of Google's Cloud Platform is Khan Academy who uses AppEngine for hosting and development platform; Best Buy for application development; UK's MetOffice for website hosting; Ubisoft for online game development and redBus.in for data analytics.

The platform is still young and not that well established like Salesforce but it is backed by Google which makes it an important player on the market.

3.6. Adobe Creative Cloud

Available to the public since May 2012, Adobe Creative Cloud was a major shift for Adobe's business model. The strategic decision to become a service-provider rather than product vendor changed how a major company perceives its business model. For as low as $50/month (in yearly plan) users get access to a plethora of Adobe products, community support, 20GB of storage and much more than ever before. Users treated new offer with suspicions as they were not convinced enough about the leasing model for software. The same problem has (had?) Microsoft with Office 365 which is offered on yearly subscription and offering the latest version of the software.

Is Adobe successful with their Creative Cloud? The company reports having 12,8 million licences sold for both Creative Suits and standalone applications. Since its introduction, Creative Cloud has gained 1 million paying users and is expected to grow to 4 million users in 2015 generating nearly 2 billion USD of revenue.

As the company moves products to the cloud, it challenges also computer piracy as there will not be any possibility to install illegal copies of the software and the bottom line is not affected.

What is the value of Adobe's offer? Firstly, users have access to the whole portfolio of Adobe products, always up to date with recent patches and fixes. The cloud offers close collaboration capabilities among teams located in different parts of the world. Portfolio display and social networking of users as they can share and comment their work.

The most important value of the offer is total cost of ownership (TCO) of the software. Creative Suite 6 Master Collection giving access to 12 applications cost 2599 USD upfront. Additional upgrades were 500 USD extra. With Creative Cloud, access to over 30 products plus extras, you need 4 years and 4 months to reach the initial cost of Creative Suite 6 and it does not take into account annual upgrades. The math here seems to be easy. Also, if someone is an occasional user then a monthly plan or access to only one application can be better solution than paying upfront $999 for Photoshop.

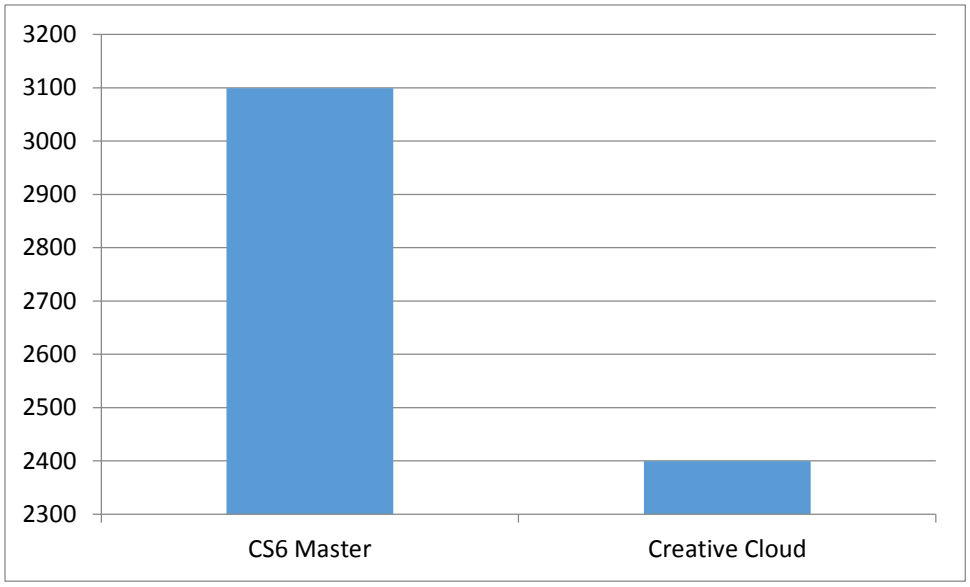


Chart 1: TCO of CS6 Master Collection (including one upgrade) and Creative Cloud over 4 years.

3.7. Profitability of chosen CSPs

It was an interesting approach to check if the chosen business model for companies is profitable. The solemn purpose of any company is to deliver profits to its owners and stakeholders. Using publicly available annual and quarterly financial reports from 2013 for such analysis the findings are inconclusive as many companies hide their cloud services details in the financial statements.

Salesforce.com, as publicly traded company on New York Stock Exchange (ticker: CRM), has to publish quarterly and yearly financial reports showing company's performance. Valued at 31,78 billion USD (as of 29.11.2013) the company has not made a profit yet. As the CEO Marc Benioff said grow first, profit later. As for Q3 2014, the company had a an operating loss of 98 million USD with revenues of 1,08 billion USD. During Q3 the company reported 36% increase in Subscription and Support revenues to 1 billion USD.

Because the company's business is strictly associated with its subscription base, it needs to have a high number of new subscriptions and low, even very low, churn rate. As the financial reports do not stipulate the number of users and customers it is estimated to be around 5.8 million users from 165000 customers for the year end 2013. The margin made by the company was nearly -3% meaning that the service was being sold below profitable price (i.e. a service worth $100 is being sold for $97 discounting the price by $3). CEO of the company predicts that first profits should be generated in about 2-3 years.

Adobe's shift to becoming service-provider and decision to stop selling their products and encourages users to move to the cloud since 2013 impacted company's profitability. In their yearly financial statement, they warn the investors that because of the shift of strategy the revenues are expected to decline in short term and may decline further in the long run. This is to be expected from the business model as company is now dependent on the number of paying users. From the Q32013 financial statement there is a 24% decline in revenues from products sold with 63% increase in subscription base which would mean that users are shifting to cloud. As expected, the total revenues have declined year-to-year by 7%. It is worth following Adobe and their change from traditional software vendor to SaaS solution provider and how other companies react to that shift.

Salesforce and Adobe are examples of companies who provide quite good understanding how cloud service provider operates and generates revenues. Amazon, Google, Microsoft and IBM hide their cloud-business performance under various names and do not disclose details.

Does Amazon generate much profit from their Web Services? AWS is not company's biggest business; however it plays important part in portfolio diversity. Amazon quarterly and yearly financial statements put Web Services in the section Other and thus no details are explained. In their 10-K filling for fiscal year 2012 Amazon says "*We expect spending in technology and content will increase over time as we add computer scientists, software engineers, and merchandising employees. (…)"* It is later explained that capital expenditures was 3,8 bln USD for year 2012, up from 1,8 bln USD in 2011, and was used to invest in technology infrastructure, including AWS. The total sales for Amazon US under Other section was 2,5 bln USD in 2012 and rose from 1,6 bln USD in 2011 and 0,95 bln in 2010. There is an assumption among financial experts that the gross growth in Others was thanks to AWS but until the company does not give any more specific details it is guessing.

According to IBM's 2012 Annual Report, cloud computing revenues grew by 80% that year and represent over 1/3 (together with business analytics and Smarter Planet) revenue of company's Global Business Services division of 18,57 bln USD. Not more details are given on the topic regarding cloud services and infrastructure.

Google and Microsoft to not disclose any information about their cloud offer in annual statements and as such it is difficult to say if the business is profitable. There are some hints that both companies generate around 1 billion USD revenues from their cloud offer but this information is not confirmed.

As a whole, cloud seems to be a financial black hole which takes money, creates value but no profits can be seen nor be reported. This is a concern for entrepreneurs thinking about starting own cloud business. With high barriers of entry in IaaS market and low in SaaS, not knowing when the return of investment can be expected is not the best indicator of decision making. Many companies try to build their business on the cloud market but only few may survive.

4. Conclusion

The search for cloud computing value network and value chains presented an interesting opportunity to dig deeper into what is really marketed as cloud. With so much hype around it some companies bet their lives on cloud offering. And, indeed, companies like Salesforce and Zoho offering SaaS solutions for businesses must attract new and retain current customers offering great solutions for low price.

For start-ups, cloud seems to be a perfect solution for starting their business. Dropbox, for example, since the start uses cloud services, mostly Amazon's AWS, to store data. The significant lower barriers of entry suggest that many more start-ups will pay-per-use rather than buy and deploy servers and applications. As always, this will be a subject of company's business strategy and needs.

If company strategically moves to new cloud solution in favour of currently used technology it's business strategy and business processes need to facilitate new solution. This, known as Information Systems Strategy Triangle (Keri E. Pearlson and Carol S. Saunders), means that any decision made requires proper alignment between IT strategy, business strategy and organisational strategy. Otherwise it is doomed to fail.

A good example how such triangle works is British American Tobacco's TaO project. TaO standing for TOM (Total Operating Model) and OneSAP (global ERP solution) is an organisational and IT strategy to allow the company perform better with one common way of working and make the company leaner and more agile. It was part of business strategy to perform better than competitors and ease the way of work. Deployed region by region since 2013 and ending in 2015 the program has already been seen as a success where proper business strategy is followed by IT and organisational strategy. According to project leaders, every 1 GBP spent on the TaO project will save 8 GBP once the implementation is finished.

Cloud is reality, if we like it or not. Consumers love cloud, instant synchronisation of all their data between devices, easy way of working and access to files from all over the world. Business is more reluctant when it comes to cloud. True, it sees the benefit of it yet it also sees the risks that comes with external solutions.

5. Further research and limitations

This work does not complete topic of value networks and value chain in cloud computing. The author is aware of limitations caused by focusing on finding benefits of the cloud in one company which may differ from other companies using cloud computing.

Additional research should be conducted in search how businesses perform before and after cloud computing implementation. Such work was not yet available by any researchers when the thesis was written and it is hard to tell whether or not from business perspective cloud gives benefits.

The cloud benefits are heavily described by cloud vendors and consulting companies but have not been challenge by research in the area. It is known that cloud lowers the cost for IT services but it is not known if the performance of the solution gives tangible benefits for company.

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