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Cloud Computing and Its Impact on Modern IT Management

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ABSTRACT

Cloud computing is being used by more and more people, but there hasn't been a thorough study of what it means for managers. This essay looks at cloud computing in the context of other big changes in information technology (IT). It also looks at how it changes IT management and the problems it creates. The paper looks at the IT trend of centralisation and decentralisation and talks about what it means for managers when it comes to the main parts of cloud computing, such as hardware (INTEL, IBM chips to support virtualisation); services (Google, Amazon.com); applications (SaaS, Software-as-a-Service); virtualisation (VMware); or a mix of these (Citrix).

Keywords: cloud computing, Information Technology Management, centralization, decentralization, hardware, services, applications, virtualization, SaaS, VMware, Citrix

INTRODUCTION

Both the use of cloud computing and the amount of writing about how to do it technically are growing very quickly. We are still very far behind on what we know about how cloud computing affects management, though. This essay looks at cloud computing and how it fits in with other big changes in information technology (IT). It also looks at how it could completely change management and the problems it could cause.

The first part of the paper looks at the IT cycle of centralisation and decentralisation over a few main time periods: 1) mainframes and batch transaction processing (like in banking systems), fully centralised IT, and results going to end users; 2) mainframes and online transaction processing processing, IT is still centralised, but end users (like those who use ATMs and online ticket systems) connect with the system.
3) PCs, end-user computers, and decentralisation within businesses; 4) Web 1.0, decentralisation for the masses, and full access to email, home banking, online shopping, social networking, and other things; 5) Web 1.0 plus outsourcing, where the front end of the business goes to the web and low-cost transaction handling tools and assistance can be found anywhere; and Web 2.0 plus cloud computing, where web 2.0 tools, net PCs, mobile technology, and cloud computing services are used by virtualised businesses.
After this background information, we'll look at what cloud computing is and what its main parts are: Virtualisation is supported by devices like Intel and IBM chips; services like Google and Amazon.com; software like Software-as-a-Service (SaaS); and virtualisation software like VMware. their coming together (Citrix). Then, we look at what cloud computing means for managers. Finally, we argue that cloud computing is both a big change in IT that will affect how IT professionals do their jobs and a possible revolution in management that will affect how managers think about and run their businesses.

INFORMATION TECHNOLOGY PHASES

To better understand where cloud computing fits in the swinging cycle of centralisation and decentralisation in IT, let's take a quick look at some of the most important times in the last 40 years of IT growth in businesses.
For the first time, there were mainframes and batch transaction handling in the 1970s. IT was centralised, and processes for things like salary, financial statements, bills, accounting systems, and more were done offline and in groups on the computer. Users only got the results, like copies and reports.

When transactions moved online in the 1980s, the second time began. This was made possible by things like credit cards, ATMs, and online ticket systems. There were a lot of point-of-sale (POS) systems and a lot of people using electronic data exchange (EDI). It was still centralised and deals were still done on the computer during this time. The only change was that the input interface was now online, so users could directly query the system and get results.

The third era took place in the 1980s and 1990s, during the PC Revolution, the rise of end-user computers, and the decentralisation of businesses within themselves. On their own computers or on the network at work, users saved data and run programs. At first, they did all of their computing at work. Later, home computing came along, and people could use their home PCs to run easy programs like word processors and spreadsheets and do small business.

Businesses began to understand the World Wide Web's IT potential around the middle of the 1990s, but there were still structure and technical problems that kept them from fully utilising this potential. But by the late 1990s, financial markets were totally into IT. Venture funders were eager to spend money on IT, even though it wasn't clear how to make money in the long run. This caused the speculative boom to pop in the early 2000s, which set off a falling trend in IT that ran until around 2003.

The Web 1.0 era was the fourth stage in the history of IT. It brought about mass decentralisation and let anyone with Internet access do personal and professional things online, like email, banking at home, shopping, socialising, and more.

The fifth time was when Web 1.0 and outsourcing came together. Back-end tasks like non-strategic transaction processing systems, web support, and anything else that could be done cheaper somewhere else in the world started to be seen as "services" that could be bought from outside providers. These providers could be anywhere, on-shore in the US, near-shore in places like Mexico, Canada, and Central America, or off-shore in places like China, India, and Brazil. However, the front end of business moved to the web. Companies could lower their high IT fixed costs by outsourcing computer chores and services that were clear and not part of their main business. On the other hand, outsourcing alliances had their own issues because they usually involved long-term contracts in a field where technology changes quickly and where few qualified companies (like EDS, CSC, IBM, and ADP) were big enough to handle the big outsourcing partnerships of the 1990s and 2000s. It became very hard to manage IT outsourcing companies or agreements. CIOs were put in an even tougher situation than before: they were still in charge of the IT tasks that stayed in-house, but they also had to plan, control, and oversee the delivery of the IT services that were outsourced, even though they no longer had direct control over these resources. Now, measuring performance meant keeping track of both successes and failures, as well as figuring out who was to blame for mistakes in a setting where clients and outsourcers often pointed fingers.

The sixth and most current era is when Web 2.0 and cloud computing come together. This is more than just hiring, since some of the back end and some of the front end of a business can be done by someone else. There are no longer virtual organisations; instead, there are virtualised organisations. Teams from all over the world work together using web 2.0 tools, net PCs, mobile technology, and cloud computer services.

DEFINING CLOUD COMPUTING

It's not clear where the word "cloud computing" came from. The term didn't become popular until around 2006 or 2007, but we found references to it from a lot earlier. One example is a study from 1997 at MIT by Gillett and Kapor [6]) showed a picture of the Internet's union method. It showed a cloud of intermediary networks, which were labelled "cloud," and routers linked sources and receivers to this cloud. Diagrams with a cloud in them were popular in the field. A cloud indicated an Internet-based network where someone else was managing X. I want to use X as a service without having to run it on my own computer. While this style of drawing was popular, it took a while for the word "cloud computing" to catch on.

"A collection of related concepts that people recognised but didn't really have a good descriptor for, a definition in search of a term, you could say" (Willis [13]) for a long time. In August 2006, Google CEO Eric Schmidt used the phrase "cloud computing" to talk about what they were doing in terms of Software as a Service (SaaS). This is seen as one of the first well-known public uses of the phrase. As a result, the term took on "the PaaS/IaaS connotations associated with the Google way of managing data centres and infrastructure" (Willis [13]). Weeks later, Amazon launched its EC2 "elastic computing cloud" services using the word "cloud." This was the first time most people heard this word.

There are a lot of different meanings of cloud computing out there right now, ranging from very broad to very narrow and focussing on the needs of different groups. When the World Economic Forum began researching cloud computing in 2009, they

had to deal with the difficulty and disagreement of previous definitions. In the end, they chose a broad definition that encompassed "all types of remote services, from Software-as-a-Service to virtual machines." (Oram 10).

When people talk about broad definitions, they usually start with what cloud computing lets people and businesses do:

What the Internet was meant to be in the first place: an endless computer made up of networks of networks of computers. This is what the cloud is. In even less words, "the Cloud is the Computer." Finch [4]

"Cloud computing is when a company's computer infrastructure is spread out and virtualised." Casey [2] "Applications and files are stored on a "cloud" made up of thousands of computers and servers that are all connected to the Internet and can be accessed through it." With cloud computers, everything you do is on the web instead of your computer. based. Anyone with an Internet-connected computer can get to all of your files and apps. Miller [8]

"Gartner defines cloud computing (hereafter "cloud") as a type of computing in which highly scalable IT functions and information are offered as a service over the Internet, possibly to many outside customers. The people who use the services only need to know what the service does for them, not how it is put together." Cloud is not a building block, a platform, a tool, a system, a website, or a company. There is a way to do it. It can be built and used with a lot of different designs. You can use the cloud to make private clouds in your own business, but there is only one public cloud that is built on the Internet. Research by Gartner [5]

Narrow meanings, on the other hand, tend to focus on the technical side of the cloud: "Cloud computing is the use of a network of servers, all of which work together to complete a specific task. This is also known as grid computing." One of my friends once said, "If it's not using MapReduce, it probably isn't a cloud." Casey [2] The University of California Berkeley's RAD Lab (Reliable Adaptive Distributed Systems Laboratory) did a full study in 2009 and came up with a description that is becoming more and more popular:

When you hear the term "cloud computing," you should think of both the software and hardware in the datacenters that provide those services over the Internet. For a long time, the services have been known as Software as a Service (SaaS). We'll call the gear and software in the data centre a "Cloud." Armbrust et al. [1]

James Urquhart [11] says that arguing about different definitions and models of cloud computing has already taken up too much time and energy. He also says that most people know what it is and are ready to "change the conversation" to focus on its business aspects. Urquhart says, "the market seems to have come to the conclusion that cloud computing has a lot in common with obscenity." This quote comes from the famous 1964 court case about obscenity and the First Amendment. It might not be easy to describe, but you'll know it when you see it.

We may be seeing the "change in the conversation" that Urquhart has been calling for now that the U.S. government has chosen to use cloud computers. The Information Technology Laboratory of the National Institute of Standards and Technology (NIST), a non-regulatory agency of the Commerce Department, put out what is likely to become the "de facto standard definition" (Urquhart [12]) of cloud computing after consulting with IT experts and other interested parties for a long time. The official, multi-part NIST description of cloud computing begins with two warning notes. It then goes on to list five important traits, three service models, and four application models.

Note 1: Cloud computing is still a new way of doing things. The private and public sectors will have a heated discussion about how to better define it and talk about its uses, problems, risks, and rewards. Over time, these meanings, traits, and qualities will grow and change.

Note 2: The cloud computing business is made up of a lot of different methods, companies, and market areas. This description tries to cover all the different ways to use the cloud.

Definition of Cloud Computing:

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 promotes availability and is composed of five essential ***characteristics,*** *three* ***service models****, and four* ***deployment models****.*

Essential Characteristics:

Self-service when you need it. A customer can easily configure computer resources, like server time and network storage, as needed without having to talk to each service provider directly.

Wide connection to the network. You can access capabilities over the network and use standard methods that make it easy for a variety of thin or thick client platforms, like cell phones, computers, and PDAs, to use the system. Pooling of resources. Using a multi-tenant model, the provider's computer resources are shared among many customers. Depending on what each customer needs, different real and virtual resources are given and changed. Location freedom means that the customer doesn't have to know or control the exact location of the resources being given. However, they may be able to define location at a higher level of abstraction, such as country, state, or server. Storage, processing power, memory, network traffic, and virtual machines are all examples of resources.

Very quick flexibility. Capabilities can be quickly and flexibly added, and sometimes even automatically, to help with scaling out and quickly releasing them to help with scaling in. For the customer, it often looks like the supply options are endless and can be bought in any amount at any time.

Service Checked. Metering at a level of abstraction that makes sense for the type of service (e.g., storage, processing, bandwidth, and live user accounts) lets cloud systems automatically control and optimise resource use. Monitoring, controlling, and reporting resource usage gives both the service provider and the person using the service more information. Models of service:

Software as a Service (SaaS) in the cloud. Customers are able to use the service provider's apps that are running on a cloud platform. Through a thin client interface, like a web browser (for example, web-based email), the apps can be accessed from a number of client devices. In the cloud, the customer doesn't handle or have control over the network, computers, operating systems, storage, or even the specific features of each application, though the customer may be able to change some settings for each application.

PaaS stands for "cloud platform as a service." It is possible for customers to put consumer-made or bought apps on the cloud system.

made with computer languages and tools that the service supports. The customer does not handle or have control over the network, computers, operating systems, or files that make up the cloud infrastructure. However, they do have control over the apps that are installed and probably the settings of the application hosting environment.

IaaS stands for "Cloud Infrastructure as a Service." The customer is given the option to set up processing, storage, networks, and other basic computer tools. These allow the customer to install and run any software, such as operating systems and apps. The customer does not handle or have control over the cloud infrastructure itself, but they do have control over the operating systems, storage, installed apps, and maybe even some networking parts (like host routers).

Deployment Models:

Your own cloud. The technology in the cloud is only used by one organisation. It could be run by the organisation or a third party, and it could be on or off-site.
Cloud for everyone. Several organisations share the cloud technology, which helps a group of people with similar issues (like purpose, security, policy, and compliance). It could be run by the organisation or a third party, and it could be on or off-site.

The public cloud. Anyone or a big group of businesses can use the cloud technology, which is owned by a company that offers cloud services.

Mixed cloud. The cloud system is made up of two or more clouds, which can be private, community, or public. Each cloud is its own thing, but they are connected by standard or custom technology that lets data and apps move between clouds (for example, cloud bursting for load-balancing between clouds).

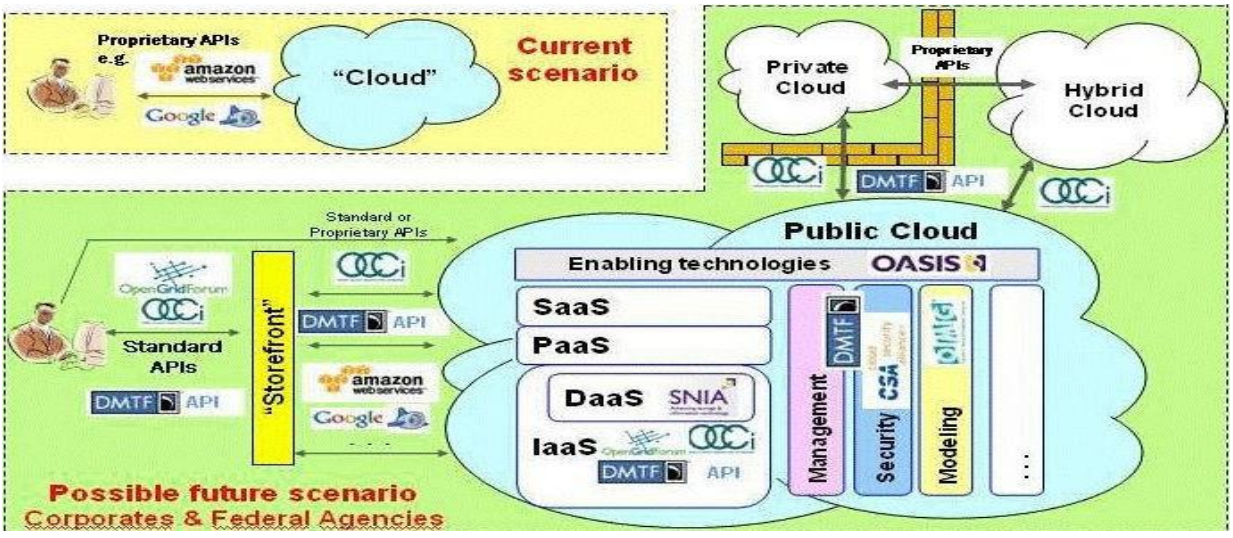
Note: Cloud software makes the most of the cloud model by focussing on statelessness, low coupling, flexibility, and semantic interchange in its service-oriented design. Mell & Grance [7]

Figure 1 shows the service models with an extra level that includes business process as a service, which is not in the original description of the service model.

Figure 2 is a picture of how the implementation models for businesses and the government might look in the future, going beyond the original description.

Business Process (BPaaS)	SaaS plus business process customization by provider
Software as a Service (SaaS)	Applications to be customized and used in provider site
Platform as a Service (PaaS)	Tools and languages for application development with DB and integration support
Infrastructure as a Service (IaaS)	Servers, network and storage hardware facilities

Figure 1: Cloud Computing Service Models



Source: http://cloud-standards.org/wiki/index.php?title=Cloud_standards_positioning

Figure 2: Deployment Models for Corporate and Federal Agencies

WORKING IN THE CLOUD

Some of the most important parts of cloud computing are hardware (like Intel and IBM chips for virtualisation), software (like VMware, Microsoft, and others), services (like Google and Amazon.com), applications (like Software-as-a-Service, or SaaS), virtualisation (like VMware), or a mix of these (like Citrix, which combines SaaS and virtualisation in a classic way). A service provider, like Google or Amazon, gives you devices, virtualisation software, and sometimes even apps. Users don't have to host their own servers; instead, their computers run virtual machines where our server can live. One of the service provider's computers has software called VM ware that virtualises computers. This means that one of the provider's computers can run many virtual machines, each with its own operating system, hard drives, and application software. Virtualisation would be very slow if it were only done in software, so chip and CPU makers like Intel and AMD built hardware into their chips that lets you build virtual machines. To stay safe and avoid the problems of When companies like Intel make virtual machines, they include a special code on the CPU chip. This way, when users log into the virtual machine on the provider's real machine, they know that the host machine is theirs and can't be accessed by anyone else without their permission.

It is important to note that cloud computing can also be done in-house. For example, instead of having PCs on everyone's desks, an organisation may only have netbooks linked to the cloud, since most of the time, the processing power of separate PCs is just sitting there unused.

MANAGERIAL IMPLICATIONS

During the first stage of IT development we looked at here (mainframes and batch transaction processing, fully centralised IT, and end-users getting outputs), computers lived in a "secret world" away from users, who didn't know how they worked or what the words meant. Computers became more noticeable during the second time, which included mainframes, online transaction processing, and IT that was still centralised. This is because end users started dealing with computers through ATMs and online ticket systems.

The way businesses work has changed because of IT, but management didn't notice because they thought technology was someone else's problem. During the third period (PCs, end-user computing, and EDI), internal business decentralisation happened, and management realised that they were now in charge of not only their own organisation but also a network of partnerships and relationships between organisations with customers and suppliers.

From Web 1.0 to full access to e-mail, home banking, online shopping, social networking, and other services, the fourth period saw a huge drop in the cost of EDI-like relationships. This meant that businesses of all kinds could have a large web presence. Many of them, though, still had "walls" between their online and offline operations, and they had to learn some hard lessons as they worked their way up to thinking like a single organisation. For example, Toys-R-Us had such an unexpectedly big hit when they first started selling toys online for Christmas that they ran out of stock and were late with their Christmas deliveries because their online and offline inventories were kept separate.

In the fifth time, which included Web 1.0 and outsourcing, the front end of business went to the web, and support and transaction processing systems that were not competitive were made more common and outsourced. E-commerce grew at a speed that had never been seen before, and both small and large businesses moved their operations to the web as people learnt how to use social media in every part of their lives.

With virtualised businesses that use Web 2.0 tools, net PCs, mobile technology, and cloud computing services, the sixth period (Web 2.0 plus cloud computing) is starting a time of big changes in how businesses are run.

Miller [8] and Carr [3] say that the rise of cloud computing is like the rise of energy in the 20th century. Businesses could buy power from electrical companies instead of using their own sources to make energy. This cut costs and made the power more reliable. In the same way, cloud computing frees businesses from having to build and manage their own computer power. It also frees them from the mainframe and desktop-centric frameworks of the past and creates a future where all businesses can access computing resources that are provided and managed by someone else in the cloud, 24 hours a day, 7 days a week.

Virtualised businesses depend on teams that can work together from anywhere at any time using Web 2.0 and the cloud. Not only is there change in IT, but there could also be a shift in management. Fingar (page 4) suggests that

"The world shifts from using Information Technology (IT) for transaction and information management to a far more organic Business Technology (BT) for collaboration and interaction management," as one expert put it. Now the question is: Are managers ready to lead and manage on the web, using cloud computing and Web 2.0 tools to make new things happen? Things like time and room needs that have always been a part of the business system are now suddenly up for grabs. If a company's data, files, programs, and apps are all in the cloud, they don't need as many local computers and hard drives. This makes massive decentralisation possible, since employees only need a netbook, digital tablet, or even a smart phone to store, retrieve, and work together on files from anywhere—at work, at home, or on the road.

More and more of these workers are "digital natives"—they grew up with laptops and smartphones, prefer instant messaging to e-mail, and look for people who might know something first when they don't know it, whether those people are friends or strangers inside or outside the company (Ommeren et al. [9]). To lead and manage these digital natives, older managers will need to "naturalise" into this sixth period in the development of IT in organisations. They will need to be able to "live" personally and professionally in Web 2.0 and cloud computing, which may seem like a strange land to them. They will have different jobs and work in different ways because of cloud software. That being said, it also changes the way managers think about business and how they organise people and jobs. Fingar [4] says that "in a process-managed enterprise, connect-and-collaborate leadership takes the place of command-and-control leadership, where every member of a business team is a leader." It means taking advantage of chances and letting other people lead when they know what needs to be done. The Cloud makes big changes possible, but the result will depend on the company's culture. Giving yourself permission, being willing to take risks, and making a lot of small bets are some of the

signs of a business culture focused on the cloud. When we first came to the brave new world of Web
When it comes to Web 2.0 and the cloud, managers have to figure out how "digital natives" think, learn, and act so that they can help their employees and businesses grow.

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