THE IMPACT OF CLOUD COMPUTING ON ENTERPRISE ARCHITECTURE

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Abstract: This research investigates the impact of cloud computing on enterprise architecture, to position these effects the Zachman framework was used. First the effects where distilled from existing literature and later validated in real-life cases. The outcome is that cloud computing has impact on the implementation details of a strategy, but this impact bring a positive effect to the business.

INTRODUCTION

Currently, many companies are interested in using cloud computing capabilities, but they do not know where to expect effects when choosing for the cloud computing concept (Joint, 2009). When it is more clear for organizations what the effects are of cloud computing, and how these could be tackled, An organization can make a more informed choice about using cloud computing for certain functionality. Within this research the effects are investigated based on current literature and presented with the use of the Zachman framework for enterprise architecture. The findings from the literature where validated in a real life cases where cloud computing was used to support a business function within the context of an admission process within higher education organizations.

CLOUD COMPUTING

There is much discussion in the industry about the exact definition of cloud computing. In this paper we adopt the definition of cloud computing which is proposed by the NIST.

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.(NIST, 2009).

In the following paragraphs the different characteristics, service models and deployment models are described.

Characteristics

As mentioned in the NIST definition cloud computing consists of five characteristics, these characteristics are pay per use, scalability, use of internet technology, self service, multitendancy.

- Pay per use – Cloud services are shared among different users therefore economies of scale can be applied. This results in an payment model which makes it possible for users to pay for the real use e.g. Based on CPU usage)(Armbrust, et al., 2009)
- Scalability – The usage of the cloud services can differ from time to time, to provide a stable availability it should be possible to scale up the resources so it is also available in peak times, and scale down in low usage time. This characteristic is realized through the use of virtualisation technology (Buyya, Yeo, Venugopal, Broberg, & Brandic, 2009)
- Use of internet technology - The services are offered to different platforms such as windows, apple, PDA and available from every location. To realize this a standardized internet protocol is used to offer the services, this doesn't demand special software for a service on the clients device. (Weiss, 2007)
- Self-service – computing services can be acquired and used at anytime without the need for human interaction with cloud service providers. Computing services include processing power, storage, virtual machines , user access (Sriram & Khajeh-Hosseini, 2010)
- Multitendancy – The realize a cost effective model in combination with the scalability characteristic a provider must provide its services to multiple customers (Motahari-Nezhad, Stephenson, & Singhal, 2009).

Service models

The chararistics of cloud computing are offered in different service models, these models deliver their services to different types of users. In the figure shown below the type of user per service model is shown. The service models are also called the cloud stack.

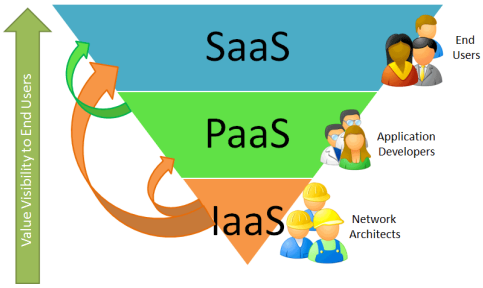

Figure 1 Cloud computing stack (Schuller, 2010)

SaaS

Software as a Service (SaaS): is cloud computing layer where users simply make use of a web-browser to access software that others have developed, maintain and offer as a service over the web. At the SaaS level, users do not have control or access to the underlying platform and infrastructure that is being used to host the software. Salesforce's Customer Relationship Management and Google Gmail are popular examples that use the SaaS model of cloud computing.(Armbrust, et al., 2009)

PaaS

Platform as a Service (PaaS): is the layer where applications are developed using a set of programming languages and tools that are supported and provided by the PaaS provider. PaaS provides developers with a high level of abstraction that allows them to focus on developing their applications. Developers can provide their customers with a custom developed application without the hassle of defining and maintaining the infrastructure. Just like the SaaS model, users do not have control or access to the underlying infrastructure being used to host their applications at the PaaS level. Google App Engine and Microsoft Azure are popular PaaS examples.(Boniface, et al., 2009)

IaaS

Infrastructure as a Service (IaaS): is the lowest layer where users use computing resources such as databases, CPU power, memory and storage from an IaaS provider and use the resources to deploy and run their applications. In contrast to the PaaS model, the IaaS model allows users to access the underlying infrastructure through the use of virtual machines which automatically can scale up and down. IaaS gives users more flexibility than PaaS as it allows the user to deploy any software stack on top of the operating system. However, flexibility comes with a cost and users are responsible for updating and patching the operating system at the IaaS level. Amazon Web Services' EC2 and S3 are popular IaaS examples.(Murphy, Abraham, Fenn, & Goasguen, 2009)

Deployment models

The different service models can be delivered to the users trough four different deployment models, based on type of use and security demands of a service it can be deployed locally in the public or a deployment model which can be positioned in between these models. Below are the different deployment models.

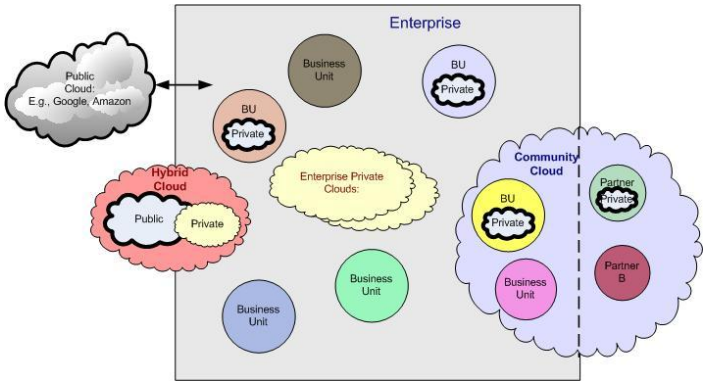

Figure 2: deployment models (Brown, 2009)

Public

Is a deployment strategy which uses the publicly available internet to deliver the services to the users. A great advantage of this deployment type is that the services is available for any internet connection, an down side however is the security. The cloud services like Gmail and Azure are services provided trough the public cloud.(Armbrust, et al., 2009)

Private

This deployment strategy can be compared with the traditional in-house hosting of a service, however it uses the technologies on which cloud computing is based such as virtualization to provide advantages to the organization.(Armbrust, et al., 2009)

Community

A community cloud is a bit like a private cloud however the cloud is share among a community of organizations. This is done to divide the costs and risks of running an own cloud. These cloud can be found in share service centers which service multiple organizations.(Buyya, et al., 2009)

Hybrid

A hybrid cloud is a cloud computing environment in which an organization provides and manages some resources in-house and has others provided externally. For example, an organization might use a public cloud service, such as Amazon's Elastic Compute Cloud (EC2) for general computing but store customer data within its own data centre. (Cole, 2009)

ENTEPRISE ARCHITECURE

Enterprises are getting more complex by the day, they have to deal with strong competition, much and complex legislation and fast changing whishes from customers. All these factors have their impact on the functioning of an enterprise. An organization has to get a balance between these factors. The discipline that creates the balance between all these factors is enterprise architecture. The formal definition of enterprise architecture according to IEEE is:

The Architecture (of a system) is the fundamental organization of that system embodied in its components, their relationships to each other, and to the environment, and the principles guiding its design and evolution.(IEEE, 2000)

Zachman

In eighties of the 21 century Johan Zachman was confrontated with these effects and decided to develop a framework which helps organizing and rationalizing the architecture of a enterprise. Zachman made an analogy with the construction of a building. With the construction of a building one needs an architect to develop an sketch of a building according to the wishes of a customer and to process goes further till the building is build and in use. In Zachman's framework a same analogy is used. The framework consists of 6 rows and 6 columns, the columns are about the questions on how, what where, who, when and why. On the crossing of a column with a row information is given on how the question for the column can be answered. Thus the intersection (cell) between why and contextual reasons why the organization wants, why does it stets himself the goal.

IMPACT OF CLOUD COMPUTING ON ZACHMAN CELLS

EFFECTS FROM LITERATURE

Based on the literature and from the view point of an existing organization the following cells of the Zachman framework are impacted.

	What	How	Where	Who	When	Why
Contextual						
Conceptual						
Logical						
Physical						
As Built						
Functioning						

Table 1 Effects of cloud computing positioned in the Zachman Framework

Legenda
No direct impact
Partly impacted
impacted

Contextual

In the contextual layer of Zachman the high level business context which depicts in gross terms the size, shape, partial relationships, and basic purpose of the final structure. In this layer not much effects are expected with the use of cloud computing, since the business is still doing the same thing as they did.(Broberg, Buyya, & Tari, 2009). The effect that is expected is that the internet technology offers possibilities to realize the work on other locations, this is shown in the where cell of the Zachman framework.

Conceptual

The conceptual layer is constituted with the designs of the business and show the business entities and processes and how they relate. This layer is not affected either, the high level business processes and entities stay the same.(Motahari-Nezhad, et al., 2009). Based on the found literature one can say that cloud computing does not influence the conceptual layer. This sounds logical since the business goals are set in this layer, the only possible impact is in the how cell. This can happened due to complex organizational specific processes which need to be supported, but could not be

realized with cloud services since these services must offer a standardized process which must fit in multiple organizations.

Logical

In the logical layer the first big impacted is expected, this is in line with the expected fulfillment of the cells. In this layer the service or application specific demands are distilled, since cloud computing offers a standardized solution we expect a mismatch between the business wish and the service possibilities. Due to the growing attention for Business process management and business rules management which make it possible to run processes or rules which are easily adjustable, because of these developments the how and why cells will be partly affected.

Physical

The physical layer consists of the technological aspects of the to realize solution. Cloud providers need to standardize their solutions to serve multiple customers, this means many whishes of customers could not be realized by the standardized solution. Things like processes, rules and roles use technologies which are at a mature stage (Rosca & Wild, 2002) which offer a way to easily logically change the aspects without changing the code. Due to this abstraction these cells are only partly affected.

Effects in practice

As expected cloud computing has mainly impact on the where row and on the other rows starting from the logical layer down to the physical layer in the Zachman framework.

The table below shows again the scores from 1 to 5 where cloud computing was impacted, where a 5 shown there is a big impact and a 0 means no impact.

	What	How	Where	Who	When	Why
Contextual	0	0	3,5	0	0	0
Conceptual	1,0	3	2	4	0	2
Logical	2,2	3,5	2,4	2,7	1,7	2,8
Physical	2,7	2,7	4,3	2,5	1,5	4

Table 2 impact of cloud computing on the Zachman framework

This impact of the where cell is higher but also rated more positively which means that the impact was good for the business, it revealed new possibilities for the business such as new working locations. This is clearly visible in the high scores in the where row where a 5 is a positive interpretation and a 0 a negative interpretation. Table below shows the interpretation of the impact of cloud computing.

	What	How	Where	Who	When	Why
Contextual			5			
Conceptual	4	4,3	5	4		5
Logical	3,7	3,3	4,3	2,7	2,5	3,3
Physical	4	3,5	3	1	3	5

Table 3 interpretation of the impact of cloud computing

CONCLUSIONS

Based on the outcomes of the validation we can conclude that the impact of cloud computing to cells in the Zachman framework is there as expected, and the interpretations of these impacts are positive to the business. In short this means that cloud computing had impact on the way an enterprise architecture is filled, but this impact is positive. The mean reason why cloud computing impacts the enterprise architecture is that cloud solutions offer a standardized solution which usually does not fit 100% the demand and/or expectation of the users.

REFERENCES

Moore, R., Lopes, J., 1999. Paper templates. In TEMPLATE'06, 1st International Conference on Template Production. SciTePress.

Armbrust, M., Fox, A., Griffith, R., Joseph, A., Katz, R., Konwinski, A., et al. (2009). Above the clouds: A berkeley view of cloud computing. EECS Department, University of California, Berkeley, Tech. Rep. UCB/EECS-2009-28.

Boniface, M., Nasser, B., Papay, J., Phillips, S., Servin, A., Yang, X., et al. (2009). Platform-as-a-Service Architecture for Real-time Quality of Service Management in Clouds.

Broberg, J., Buyya, R., & Tari, Z. (2009). MetaCDN: Harnessing [] Storage Clouds' for high performance content delivery. Journal of Network and Computer Applications, 32(5), 1012-1022.

Brown (2009). Cloud types. In Cloudtypes (Ed.): strategicitarchitecture.com.

Buyya, R., Yeo, C. S., Venugopal, S., Broberg, J., & Brandic, I. (2009). Cloud computing and emerging IT platforms: Vision, hype, and reality for delivering computing as the 5th utility. Future Generation Computer Systems, 25(6), 599-616.

Cole, A. (2009). Hybrid cloud Retrieved 03-06-2010, from http://searchcloudcomputing.techtarget.com/sDefinition/0,,sid201_gci1356520,00.html

IEEE (2000). Recommended Practice for Architectural Description of Software-Intensive Systems: IEEE.

Joint, A. B., E.; Eccles, E. (2009). Hey, you, get off of that cloud? Computer Law & Security Review, 25(3), 270-274.

Motahari-Nezhad, H., Stephenson, B., & Singhal, S. (2009). Outsourcing Business to Cloud Computing Services: Opportunities and Challenges. HP Laboratories–2009.

Murphy, M., Abraham, L., Fenn, M., & Goasguen, S. (2009). Autonomic Clouds on the Grid. Journal of Grid Computing, 1-18.

NIST (2009). The NIST Definition of Cloud Computing. from http://csrc.nist.gov/groups/SNS/cloud-computing/.

Rosca, D., & Wild, C. (2002). Towards a flexible deployment of business rules. Expert Systems with Applications, 23(4), 385-394.

Schuller, S. (2010). Cloud stack.

Sriram, I., & Khajeh-Hosseini, A. (2010). Research Agenda in Cloud Technologies. Arxiv preprint arXiv:1001.3259.

Weiss, A. (2007). Computing in the clouds. netWorker, 11(4), 16-25.