Cost Analysis Of Cloud Computing And Its Applications In Greek Businesses

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Abstract

In this paper we examine cloud computing as a solution to a company's IT infrastructure, and thus we perform base cost analysis for CC products and services for a typical Greek company using Matlab and the present value method. Firstly, we describe the various cloud deployment and service models. Furthermore we list the main cloud products offered by hosting companies, and state some of the general advantages of CC. Moreover we establish our assumptions for our hypothetical company for both the server and cloud options. Finally we present our results and analysis graphically and offer some insights on the processed data.

Keywords: Cloud Computing, Cost Analysis, Greek Businesses

1. Introduction

It is true that IT industry is constantly changing. A substantial transformation in the IT world is cloud computing. Cloud computing (CC) is an Internet-based computing method that provides shared processing resources and data to computers and other devices on demand and enables ubiquitous, access to a shared pool of configurable computing resources. [1]

During the last decades, cloud computing has created an evolving landscape that improves how a business operates and holds the potential for significant cost reduction and major productivity boost.[2] Thus it has become highly demanded in the business area and nowadays, a vast number of enterprises in all over the world, store, access and manage data and software over the Internet using third-party data centers instead of having local servers. However, according to Hellenic Statistical Authority, only 10.33% of Greek businesses used

cloud computing services in 2015.[3] We believe that CC could definitely be a viable alternative solution for Greek businesses' survival and development in the ongoing financial crisis.

2. Cloud Computing Deployment Models

Public Cloud: services and infrastructure are hosted off-site by a cloud provider and accessed by clients via public networks. It offers great economies of scale and redundancy and it is the best solution for companies without sensitive data.[1][4]

Private Cloud: services and infrastructure are stored and maintained on a private network accessible for only one specified client. It has a high level of security and it is suitable for companies with sensitive data.[1][4]

Hybrid Cloud: combines both public and private cloud elements. It allows a company to use the public cloud for non-sensitive operations and the private setup for sensitive.[1][4][6]

Community Cloud: infrastructure is shared between several organizations from a specific community with common concerns.[1]

According to the 5th annual State of the Cloud Survey of the latest cloud computing trends conducted by RightScale in January 2016, 18% of the respondents uses only Public cloud and 6% Private cloud, while 71% uses Hybrid cloud.[5]

3. Cloud Computing Service Models

Cloud Computing comes in the following three major setups:

Infrastructure as a service (IaaS): provides virtualized hardware, computing infrastructure via internet. The company can rent data center environment instead of creating and maintaining its own servers. Some of the offerings are virtual server space, network connections, IP addresses, cloud hosting and virtual data centers.[1][4]

Platform as a service (PaaS): extension of IaaS. It provides a platform and environment that allow developers to build applications and services over the internet and it does not require physical infrastructure or expert knowledge. Some of the features included are operating system, server software, database management system, management services and tools for design and development.[1][4]

Software as a service (SaaS): businesses are able to rent and access software applications over the internet rather than housing the same applications in their own data center. SaaS is the best solution for a manager, who needs costly software for a short period of time or once in a while. A wide range of business applications, including accounting, invoicing, tracking sales and communications are hosted in "the cloud".[1][4]

4. Main Cloud Computing Products

There is a variety of CC products, which can help Greek businesses survive and improve their effectiveness and productivity.

Storage: A company has the opportunity to store, access, manage and retrieve its data from the "cloud" (third party virtualized pools of storage) and not from its own storage IT.[7] A company can store a wide range of data, such as documents, videos, pictures, files, page blobs and disks, tables and queues.[8][9] A Hellenic Statistical Authority research showed that 53.4% of Greek businesses that purchase cloud services in 2015 preferred to store their files in cloud environment.[3]

Virtual Machines (VM): A company does not need to have many servers or desktops, but it can lease virtual machines from the cloud instead. A virtual machine (VM) is an emulation of a particular computer system and it not only has operations based on the computer architecture, but also specialized hardware and software. In the cloud, companies can create and customize the server image (memory, hard disk, network) to meet their needs.[8]

SQL Database: Cloud environment, apart from storage, offers to companies a fully-managed database service that enables them to set-up, manage and administer their relational MySQL databases in the cloud. First of all, a database is not only an organized collection of data, but it also interacts with the user to capture and analyze data. With SQL Database a manager can set questions to the database, in order to collect and use better his storage data. Cloud includes also NoSQL data models. However, most applications are built around an SQL data model and thus users often have to rewrite the application code in NoSQL databases.[8][9][10]

Virtual Private Network (VPN): extension of a private network (a network with private IP address space) across a public network (Internet). VPN makes it easy for users to send and receive data across shared or public networks, even if their computing devices were not directly connected to the private network. Indeed, it combines location independence with the benefits from private network. That's why VPNs are very useful for geographically separated offices and for managers, who work outside the office. Moreover, a VPN is also a great solution for small businesses, because they cannot usually afford a network, which can support the majority of applications needed.[11]

Bandwidth: the data speed supported by a network connection (megabits per second) and it affects the time needed to download or upload information from the cloud. It's essential to clearly understand an application's performance requirements and usage patterns to plan for network bandwidth capacity and to identify potential bottlenecks. With a concentration of user traffic where end users all access the same cloud application or the same network (connection between public and private cloud), it's important for cloud admins to investigate shaping and optimizing WAN traffic. [12]

Internet Protocol (IP) Address: a numerical label assigned to each device (e.g. computer, printer) which participates in a computer network which uses the Internet Protocol to communicate. It identifies host or network interface and addresses location. A business can own these IP addresses and also associate them with its cloud environment in the region of the Reserved IP addresses. [13]

Cloud hosting: Cloud provides hosting for websites on virtual servers as much as the companies need. The most important benefit is that in case one server goes offline it will not affect the availability of the website, because the virtual server will continue to pull resource from the remaining network of servers.[4]

Cloud Computing ERP Applications: In recent years more and more cloud providers have created ERP applications adjusted for companies. Some characteristic examples are Marketing and Management Cloud, Sales Cloud, Accounting and Finance Cloud, CRM Cloud and Human Resources Management Cloud.[14] Eurostat indicated that Cloud Accounting and Cloud CRM are the most usual cloud applications in EU companies.[15]

Cloud accounting: With traditional accounting software, companies have to pay for software license, maintain cost, database, hardware, systems management and other software. Cloud accounting is similar to traditional accounting, but its software is hosted on remote servers and all application functions are performed on the company's desktop, while it requires no expansive equipment and licenses, no backups and no updates. Real-time reporting and visibility throughout the organization, greater mobile capabilities and collaboration, accurate account balances, fewer errors and better management of multi-currency and multi-company transactions without additional software and update cost are undoubtedly achieved.[16]

Cloud CRM: CRM (Customer Relationship Management) helps companies store and manage customer information, such as contact information, accounts and sales opportunities in a central place. It is not just a contact list, but it is a way to establish closer and better relationships with customers, track activities and gain visibility into deal stages, as it creates a complete, automatic, developed and organized customer database, in which data can be filtered to find the company's ideal prospects. It is appropriate both for small companies, which face difficulties in affording expensive CRM software and infrastructure and for large companies, which obtain evolved capabilities (marketing campaigns, marketing communication creation and delivery automation).[14]

5. Advantages of Cloud Computing

The main benefits of CC are: [4][14]

- Cost reduction: the expenses of managing and maintaining IT infrastructure are outsourced to the cloud provider, there are no initial set up costs, no additional hardware costs and no update costs, energy consumption cost is rapidly decreased, company pays only for what it uses and thus it reduces waste resources (pay-as-you-go).
- Scalability and Flexibility: cloud services can be anytime adjusted (on-demand-services), in order to meet company's requirements.
- Location and Time Independence: managers have access to cloud services anywhere and at any time.

- Backup and Disaster Recovery: backup servers exist in two or more locations around the globe, data are distributed among a number of servers and there is no fear of losing them in case of a disaster or not accessing in case one server goes down.

All in all, CC creates a friendly and organizational data environment in the company, which improves companies' operation. People can communicate, collaborate and work effectively together in this cloud environment from various locations and at different time. Especially for small or startup businesses, CC is a cost- effective solution.[2]

6. Cost Analysis of Cloud Computing

In order to examine the effect of cloud computing in Greek companies we executed base cost analysis using Matlab. We compared a typical small scale business currently running a desktop grid format with some applications and services provided by Azure cloud and Amazon EC2. These two companies apart from being the leading experts in their field they provide different formats of services. Specifically Amazon cloud services are oriented in lending raw computation power and network accessibility, while Azure offers more integrated solutions targeted at management and software.

The yearly cost calculations are computed using the present value method. We assumed a 5 year useful life of the assets, and a technology growth rate of 5%.[17] Therefore the present value rate is computed as: PVR= $\frac{1-(1+0.05)^{-5}}{0.05}$.

The monthly cost of a business with a desktop grid was computed using the following parameters: server cost, network cost, power cost, the software cost, maintenance and support cost.

In more detail in the server cost computation we assumed for simplicity that all servers have similar configurations. This cost includes only the purchase cost of the servers in Euros and is calculated by multiplying the number of servers used with a typical price per server.[18]

The network cost includes the port cost, the cable cost and the switch cost. The port cost is calculated multiplying the number of network ports the business is using with a typical price per port. The cable cost can be calculated by multiplying the expected cable length with a typical price per meter. The switch cost is computed by multiplying the number of network switches used by the company with a typical price per port. The total network cost is the sum of all the aforementioned costs.[18]

The power cost is computed annually using as input the critical load of the company in kW, the power factor (typically between 0.9-0.95), and the price per kWh from PPC for low voltage companies (Business tariff Γ21 0.12 €/kWh). The IT infrastructure that contributes to the power consumption in an organization includes computing infrastructure (server, switches etc.), network critical physical infrastructure, transformers, uninterruptable power supplies, fans, air conditioners, pumps, lighting etc.[18]

In order to manage the data centers, it is required to install the operating system patches and resources for load balancing. The cost of software associated with the base cost estimation is due to license payment. There are two classes of software considered for cost analysis based on the license structure. Software that includes operating system and software that deals with other base software (Application Server, VM Software etc.). For a relatively small company we assumed that SQL Server 2012 Enterprise and Windows Server 2012 Standard Edition are typical examples of operating software. SQL Server Enterprise Edition costs about €6,500 per core (with a purchase requirement minimum of 4 cores per processor), so €26,000 in all. Note however that we need to purchase a second license in order to obtain a clustered environment if high availability is a requirement; so the SQL Server licenses come up to €52,000. Windows Server 2012 Standard edition costs about €880 for every 2 virtual machine, so we would need to purchase a total of 8 standard edition licenses for our 16 virtual machines, or about €7,000. In addition managing software such as ERP has a typical cost of around €5.000 per year.[19]

Finally for the support and maintenance cost we assumed that a dedicated company will handle the whole IT department, for both software and hardware, and will be paid annually. A typical salary for such a company is around 20% of the server and software cost.[19]

In our example we used the following values:

Component	Input Variable
Cost of server	3000
Cost per port	70
Cost per switch	30
Cost per meter	5
Operating software cost	68000

Table 1: Fixed Cost Used In Matlab[19]

In order to compare the monthly cost of desktop grid based companies we chose some of the most popular and matching services from Microsoft Azure[8] and Amazon EC2[21] and calculated the corresponding cost using the integrated Azure calculator and Amazon Simple Monthly Calculator.

We assumed that the server and network infrastructure is not existed, and therefore the corresponding costs are zero in the cloud computations. Moreover, we assumed that the critical load of the company will be decreased by the amount of the servers' power consumption (around 1.2 kW per server). In addition there is no need to purchase the Windows Server operating system. However the SQL Server Enterprise Edition license is still needed, but the company would also probably avoid the extra 20% maintenance discussed previously because all the activities related to this item are performed by the hosting provider. Last but not least according to other various results there would be a further 20% reduction in the managing software.[19]

Service type	Custom name	Description	Estimated Cost
Virtual Machines	Virtual Machines	1 standard virtual machine(s) windows type, a3 size	$267.84
Cloud Services	Cloud Services	1 instance(s), 744 hour(s), a0 size	$14.88
Batch	Batch	Free tier	$0.00
App Service	App Service	1 instance(s), 744 hour(s), size: b2, basic tier, 0 SNI connection(s), 0 IP connection(s)	$111.60
Notification Hubs	Notification Hubs	1 million(s) basic tier pushes	$10.00
SQL Database	SQL Database	1 basic database(s) b size	$4.98
DocumentDB	DocumentDB	1 DocumentDB(s) s1 level, 744 hours	$25.00
Storage	Storage	2 TB storage block type. basic tier, lrs redundancy, 1000 x100,000 transactions	$52.34
Data Transfers	Bandwidth	1 TB/Month Zone1, 5 GB/Month Zone2, 5 GB/Month Zone3	$88.65
IP Addresses	IP Addresses	classic type, 5 instance-level IP Address(es) x 744 hours, 1 load balanced IP Address(es) x 744 hours, 1 reserved IP Address(es) x 744 hours, 1 IP Address remap(s)	$14.88
Backup	Backup	1 instance(s) < 50GB, 0 instances 50-500GB, 0 instances > 500GB, 2 TB lrs of storage	$53.74
Site Recovery	Site Recovery	2 instance(s) of Recovery to customer-owned sites, 0 instance(s) of Recovery to Azure	$32.00
Service Bus	Service Bus	Basic tier, 0 million messaging operations	$0.00
Support		Developer level	$29.00
		Monthly Total	**$704.92**

Table 2: Cloud Services From Microsoft Azure: https://azure.microsoft.com/en-us/pricing/calculator/[8]

The cloud computing service taken for analysis in this paper is Amazon EC2. It provides a built-in calculator to provide a monthly bill based on the inputs given to calculator. The variables in this analysis are basically the inputs to the calculator. There are different families of Amazon EC2 instances including Standard, Micro, High-Memory etc. Each instance provides a predictable amount of dedicated compute capacity and is charged per instance-hour consumed. The organization can match their server configuration with these instance configurations. By default, one large instance is considered equivalent to one physical in house server.[20]

In the following table we summarize the selected options for the calculator

Service	Type	Number	Monthly Cost
Instances	Linux on t2.large	2	$ 152.26
EBS volumes	Storage 1024 GB Magnetic	2	$ 102.40
Data transfer	In/Out	2/2 TB	$ 184.23
IP addresses	Elastic	5	$ 18.30
		Total Monthly Cost	$ 457.19

Table 3: Cloud Services From Amazon EC2: http://calculator.s3.amazonaws.com/index.html[21]

Running the script with the above configuration we got the following results:

```
MATLAB Command Window

>> base_cost
How many servers are used ? 2
How many ports are used ? 20
How many meters of cables will be used ? 50
How many switches will be used ? 20
Please enter the critical load in kW 15
Please enter the average power usage 0.9
Please enter the annual cost of your software 5000

grid_total =

   2.3192e+05


azure_total =

   1.4895e+05


amazon_total =

   1.3608e+05

>>
```

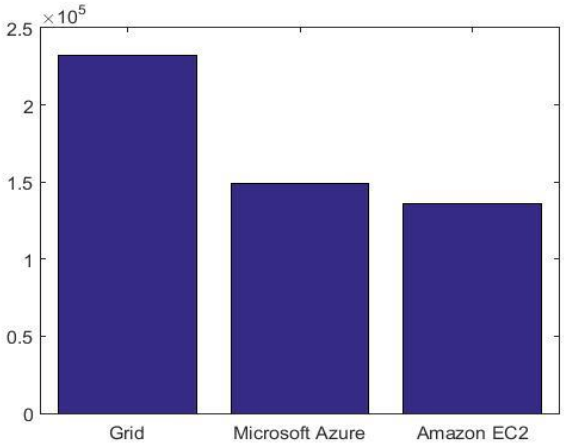

Table 4-5: Results From Matlab Code

	Grid		Microsoft Azure			Amazon EC2		
	€	%	€	%	DC%	€	%	DC%
grid*/ cloud cost	€ 91.071,00	39%	€ 36.623,00	25%	-60%	€ 23.753,00	17%	-74%
power cost	€ 51.200,00	22%	€ 43.008,00	29%	-16%	€ 43.008,00	32%	-16%
software cost	€ 89.647,00	39%	€ 69.318,00	47%	-23%	€ 69.318,00	51%	-23%
total cost for 5 years	**€ 231.920,00**	**100%**	**€ 148.950,00**	**100%**	**-36%**	**€ 136.080,00**	**100%**	**-41%**
total montly cost	**€ 3.865,33**	**100%**	**€ 2.482,50**	**100%**	**-36%**	**€ 2.268,00**	**100%**	**-41%**
**grid cost = server cost + network cost + support and maintance cost, where support and maintance cost is 36%*								

Table 6: Costs(€), Their Percentage In The Total Cost(%) And The Reduction Percentage(DC%) using excel

It is apparent that cloud computing services offer considerable cost reduction. Using the above assumptions we deduce that the main cost difference is due to the elimination of the support and maintenance cost. In addition we see the expected reduction in the power and software cost of the company. Microsoft's Azure has a slight elevated cost than Amazon's EC2 but they offer more utilities in the company's administration. The total cost reduction is 36% for Azure and 41% for Amazon.

7. Conclusion

To sum up, cloud computing offers a significant cost effective IT solution. It provides a wide variety of products and services, adjustable to each company's needs. In context of today's economic crisis, small to medium sized Greek companies shift to cloud computing could be a viable solution for not only their survival but also economic growth, competitiveness and prosperity. Furthermore, CC is still a rapidly growing field of technology, making it a possible investment for further cost reduction due to new services and products. Last but not least a government issued institutional framework would definitely facilitate the adoption of CC from Greek SME.

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