The Benefits of Cloud Computing
Evidence from Greece

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Abstract: Cloud computing is gaining ground in the global ICT market and day by day a significant number of Small and Medium Enterprises (SMEs) are adopting cloud services with sole purpose to improve their business environment and become more efficient, competitive and productive. Migrating a business IT infrastructure to the cloud offers reduction on server and storage costs, software maintenance expenditures, network and energy expenses as well as costs associated with disaster recovery. Since the cloud computing model works on a "pay-as-you-go" basis, it provides the option to pay for what is used. Thus, its adoption can offer slow start-up or expansion costs, creating an environment for rapid innovation and development. Into that context, this paper presents the Greek side of cloud evolution through two representative case studies, the migration of an IT system of a Greek industry, from an in-house data center to Google Cloud and the study of the "in-house" IT infrastructure of the National Confederation of Hellenic Commerce. Findings from the Greek industry, indicate that the cloud proposal could cost 50%, or 24% less per month (depending on the solution). As far as the National Confederation of Hellenic Commerce is concerned, the paper proposes only a new measure of security using Cloud services for reasons that will be discussed at the case study. Both case studies take into account the present costs of the IT system (energy consumption, third party contracts and maintenance) and propose alternatives through cloud migration. Results indicate that cloud computing offers benefits and significant cost savings for both studied cases, showing promising ways for the successful adoption of the cloud.

1. INTRODUCTION:

According to (Mell & Grance, 2011) cloud computing is a model for enabling ubiquitous, 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. At this time of its expansion, everybody should be familiar with the benefits and risks cloud computing bears. Before this paper analyses the two Greek adoption case studies, a short introduction to the cloud is included, for the sake of completeness. Briefly, according to (Hassan, 2011) these attributes characterize cloud computing:

On-demand Computing Model: Organizations are able to escape from complex and expensive in-house infrastructure and choose the amount of resources they require for their operation.

Autonomous: Clients are separated from the technical details of the cloud services they use.

Predefined Quality of Service: Cloud providers state QoS terms in their service level agreements to inform clients about expected level of service.

Internet-based: All cloud services are hosted beyond organizations and delivered over the Internet.

Easy-to-use: Cloud providers offer easy-to-use interfaces that enable clients to make use of their services.

Scalable: Clients are not limited with fixed amounts of resources. They can scale up and down at free will.

Inexpensive: Cloud computing offers small-and-medium-sized enterprises (SMEs) a significantly lower-cost option than building an in-house infrastructure.

Subscription-based Model: Clients subscribe to services they are interested in, and they are charged accordingly.

The architecture of cloud computing is pyramid shaped, starting with IaaS as a foundation and on top, SaaS (Varia, 2010). The main logic behind the pyramid shape, is that on the road to the top, the user is not required to know in detail how things work in the cloud.

Infrastructure-as-a-Service (IaaS): IaaS provides hardware such as CPUs, memory, storage, networks, and load-balancers. The next architectures are based on IaaS in order to work.

Platform-as-a-Service (PaaS): Supplies users with development and administration platforms that provide on-demand access to available hardware resources. Many PaaS platforms are available to enable access to IaaS resources.

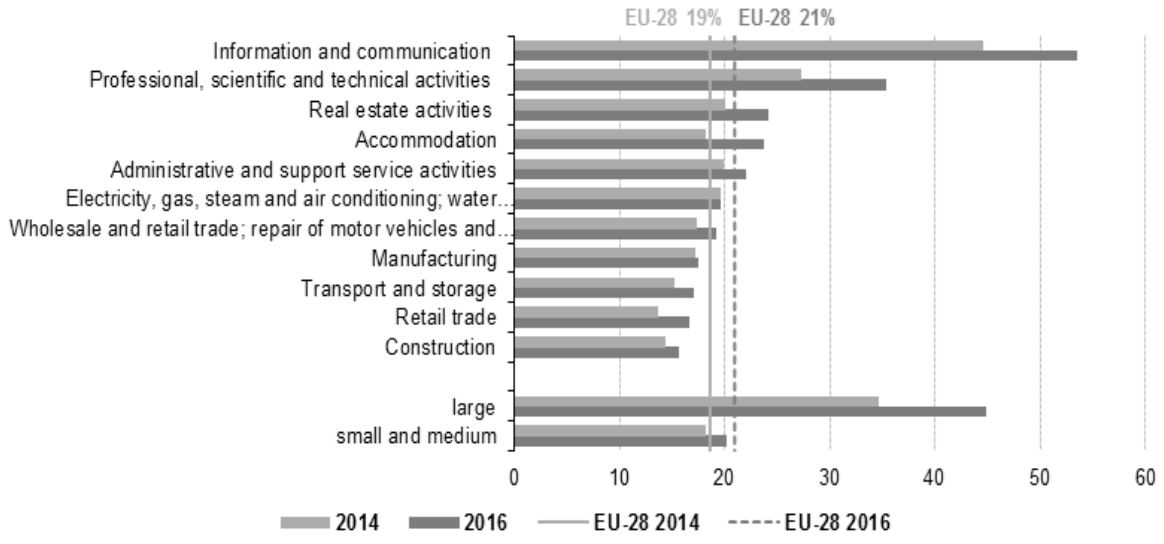
Data-as-a-Service (DaaS): Frees organizations from buying high-cost database engines and mass storage. This service offers database capabilities for storing client information.

Software-as-a-Service (SaaS): The ultimate form of cloud resources that delivers software applications to clients in terms of accessible services. With SaaS, clients subscribe to applications offered by providers rather than building or buying them.
If the first pillar of this paper is the cloud computing, the second is the enterprises. The cloud services offer great amount of options, so every organization can enjoy the aspects of cloud it needs.

According to (Eurostat, 2016), 19 % of EU enterprises proceeded with the adoption of cloud computing in 2014, mostly for hosting their e-mail systems and storing files in electronic form. 46 % of those firms used advanced cloud services relating to financial and accounting software applications, customer relationship management or to the use of computing power to run business applications. In 2014, almost twice as many firms used public cloud servers (12%) as private cloud servers (7%), i.e. infrastructure for their exclusive use. Four out of ten enterprises (39%) using the cloud reported the risk of a security breach as the main limiting factor in the use of cloud computing services. A similar proportion (42%) of those not using the cloud reported insufficient knowledge of cloud computing as the main factor that prevented them from using it.

As shown in Figure 1, between two years (2014-2016) the EU-28 countries have increased their use of cloud computing by 2%. Greece should make an honest effort to untie itself from the 9% and harvest the potential of cloud computing.

Figure 1: Use of cloud computing services, by economic activity and size, EU-28, 2014 and 2016



2. THE CLOUD(Y) GREECE:

Around the world other case studies have tried to estimate the cloud adoption diffusion in the private as well as the public sector. Additionally new frameworks are proposed for a better understanding on the ways cloud computing can be encapsulated in every organization. In Australia for example, 24% of regional government councils around the country have implemented some adoption of cloud computing on their services. 14% have already made a full adoption of some public services (Ali, Soar, & Yong, 2016). In England efforts were made for the development of a cloud computing adoption model for SMEs (Alshamaila, Papagiannidis, & Li, 2013).

According to Eurostat, Table 1, in 2014 Greece has the 27th place among the European countries that buy Cloud services used over the internet. Unfortunately, 8% of Greek enterprises have adopted cloud computing on 2014. 2015 gave a spark of hope, with a small increase of 1% from 2014, but it is still stuck even in 2016. Greece is struggling to recover from the economic wounds that the Great Recession caused. It is only logical that many Greek enterprises are not paying any attention to new technological advances and they try avoid extra costs in order to survive.

Table 1: Eurostat Findings (2016).

Country	2014	2015	2016
Finland	51	53	57
Iceland	43	-	-
Italy	40	-	22
Sweden	39	-	48
Denmark	38	37	42
Norway	29	38	40
Ireland	28	35	36
Netherlands	28	-	35
United Kingdom	24	-	35
Croatia	22	22	23
Belgium	21	25	28
Slovakia	19	20	18
Malta	17	25	28
Czech Republic	15	-	18
Estonia	15	-	23
Slovenia	15	17	22
Spain	14	15	18
Lithuania	13	16	17
Luxembourg	13	-	19
Portugal	13	-	18
France	12	-	17
Austria	12	-	17
F.Y.R.O.M	12	-	7
Germany	11	-	16
Cyprus	10	13	15
Bulgaria	8	5	7
Greece	8	9	9
Hungary	8	11	12
Latvia	6	8	8
Poland	6	7	8
Romania	5	8	7
Serbia	4	-	-

According to the Foundation for Economic and Industrial Research (Danchev, Tsakanikas, & Ventouris, 2011) cloud computing can bring substantial gains to the Greek economy. Cloud computing can generate savings amounting to € 4.8 billion over the next 10 years with the reduction of costs for equipment and maintenance. Through increased scalability and reduced barriers for new markets, cloud computing can boost Greek economy by € 5 billion. As a result of Cloud Computing adoption, more than 38,000 job openings by the end of 2020 will be created. In order to achieve these benefits, Greek businesses (and the public sector as a facilitator) should adopt cloud computing at least as fast as the country's major competitors in the global markets. If Greece achieves a 5-year transition to the cloud, while its competitors follow a 10-year transition path, the cloud dividend can reach € 21 billion with substantial employment gains over the medium term. In contrast, if technophobia and self-pity continues, the competitive position of Greece will continue to slide down and the cloud dividend will only extend to about € 5 billion with little employment gains during the difficult 6-7 years that lie ahead.

"Diffusion of cloud computing can potentially change the way business information systems are developed, scaled up, maintained and paid for. This not only applies to large organizations, but also increasingly to small and medium-sized businesses" - (Alshamaila, Papagiannidis, & Stamati, 2013). Although, a large number of Greek enterprises do not adopt cloud services. According to Eurostat, the lack of technical

knowledge regarding the cloud computing, creates an obstacle large enough to obstruct any kind of cloud migration. Unfortunately, this situation is not limited only to one sector but to the majority of Greek businesses and organizations. The technology is not the only "black box" that enterprises are skeptical and hesitant about. The legal and contractual aspects as well as the final way to the implementation of a cloud migration are enemies of any change towards the cloud. Furthermore, the security of cloud computing poses a great threat on adopting cloud services and migrating business-critical applications and data, especially when a business is not very familiar with the concept and function of cloud.

Greece needs to put a great amount of effort in order to leverage the benefits of the cloud computing in both the public and the private sectors, despite the fact that cloud adoption may face substantial difficulties.

3. CASE STUDIES:

After gathering useful data from (Katsantonis, Filiopoulou, Michalakelis, & Nikolaidou, 2015) with a startup case study, this paper advanced into actual organizations. As mentioned earlier, two organizations were studied and evaluated for the context of this work. The first is a bookbinding, newspaper-wrapping company, sharing the same industrial premises with a para-pharmaceutical wholesale dealer. The second organization is the National Confederation of Hellenic Commerce (ESEE). The National Confederation of Hellenic Commerce is a confederate organization representing Greek commerce on both domestic and international levels. In order to evaluate the research, this study is using guidelines from the C.A.T "Cloud Adoption Toolkit" (Khajeh-Hosseini, Greenwood, Smith, & Sommerville, 2012). Briefly, the steps are the following.

- **Technology Suitability Analysis:**
  Supports decision makers in determining whether cloud computing is the right technology to support their proposed system (Services, Leader, Capex, & Spend, 2016).

- **Risk and Benefit Analysis:**
  The potential cost savings of using cloud computing have to be examined in the wider context of other benefits and risks. (Lock, Storer, & Sommerville, 2009).

- **Cost Modeling:**
  Cost modeling gathers all the useful information about the company's CAPEX, OPEX and compares it with the corresponding cost of a potential it infrastructure. (Services et al., 2016)

- **Energy Consumption Analysis:**
  The purpose of Energy Consumption Analysis is to support decision makers in determining the optimum energy consumption of their own private cloud infrastructure. Additional information on energy consumption was found in (De Alfonso, Caballer, Alvarruiz, & Moltó, 2013). For the study of the companies, only the consumption of the present IT infrastructure was measured.

- **Stakeholder Impact Analysis:**
  The purpose of Stakeholder Impact Analysis is to support decision makers in determining the socio-political viability, or benefits and risks, of a proposed IT system. (Khajeh-Hosseini, Greenwood, & Sommerville, 2010)

- **Responsibility Modeling:**
  The purpose of responsibility modeling is to support decision makers in determining the operational viability of a proposed IT system.

3.1 General Pack S.A / SPM Pharma:

General Pack S.A. operates since 1984, achieving great success in the industry of magazine and newspaper wrapping, as well as at the services of direct mail and press products finishing. SPM Pharma operates in the wholesale and retail of consumable items for pharmacies, medical clinics and medical stores.

The companies' current requirements for their IT services are:

- ERP (Enterprise Recourse Planning) software.
- Mass storage for user files.
- Two websites, one for each company, which are outsourced and hosted by a third-party company.

These requirements are quite representative for a large part of businesses in Greece. It is obvious that the companies have great mobility prospects to the Cloud. The reason of such a claim is the attempt -to be made- in order to integrate all services for cost

saving and optimization of services. Besides the cost advantages, the companies can update the ERP system with new lower-cost options and additional functionality. The next picture shows the companies' server room. The companies have three servers that were purchased a decade ago (the fiscal year 2006-2007):

- Server 1:
  - SEN E.R.P (used by General Pack)
  - File Server
- Server 2:
  - File Server Backup (this server is out of order)
- Server 3:
  - SEN E.R.P (used by SPM)

Using the Cloud Adoption Toolkit, the cost of the IT equipment of the companies is shown below.

Costs:
Energy costs (€/kWh) were calculated based on the energy bill of the factory. The calculation where based on the companies' invoice from the Public Power Corporation (P.P.C Useful Customer Information, 2014). The total costs are shown in Table 2.

Table 2: IT Infrastructure Cost.

Item / Serv	Watt	75% *	kWh / day	Cost (€)	Cost (€) / Month
Maint.	-	-	-	-	175.00
Site GP	-	-	-	110.00	9.17
Site SPM	-	-	-	108.00	9.00
SEN (Lic.)	-	-	-	2,000	166.67
Pc1	650	487.5	11.7	-	27.75
Pc2	500	375	9	-	21.35
Pc3	500	375	9	-	21.35
A/C	633	474.75	11.39	-	27.02
UPS	910	60**	1.44	-	3.42
Total Cost:					**460.73**

* Making the assumption that the PC's were using 75% of the total power.
** The specific UPS on idle uses around **60W.**

3.1.1 Findings / Proposal:

The companies rely on legacy IT system that needs to be entirely replaced. An in-house IT system is not cost efficient, because the needs of the organization are fairly basic. Research findings indicate that for a successful cloud migration the companies should add an IoS (Internet over Satellite) connection. The reason is that area has really poor internet connection (1.5 mb/s). This problem is caused by the old and badly maintained copper lines of OTE (Organization of Telecommunications of Greece). In the industrial zone of Koropi (where the companies are located) there are no plans for optic fiber expansion, so the satellite internet is an inevitable step for cloud migration. The cost of IoS from Cosmote (Greek telecommunication Company) is € 80 per month without any additional costs of installation.

The companies' proposal insisted on moving the 10 emails that are used at the moment to Google in order to gain additional cloud storage (Google Drive 30GB) for file sharing between employees. In addition, Google offers the capability to mask the "…@gmail.com" with the companies' website name like "…@generalpack.gr". The cost is € 1.77 per user and per month.

The sites will be hosted on a server chosen between competitors (Table 3). Google is the best choice for the case study, because of the low cost, high availability prices and competitive server specs. The suitability analysis of the Cloud adoption toolkit helped on deciding about the Cloud Provider. Also, the decision involved the SLA's (Hoehl, 2015) of the candidate providers. Table 3 sums up the specs of the most prevalent cloud providers for this case study. The prices are based on the website Cloudorado (cloudorado.com, 2015).

Table 3: Cloud Costs.

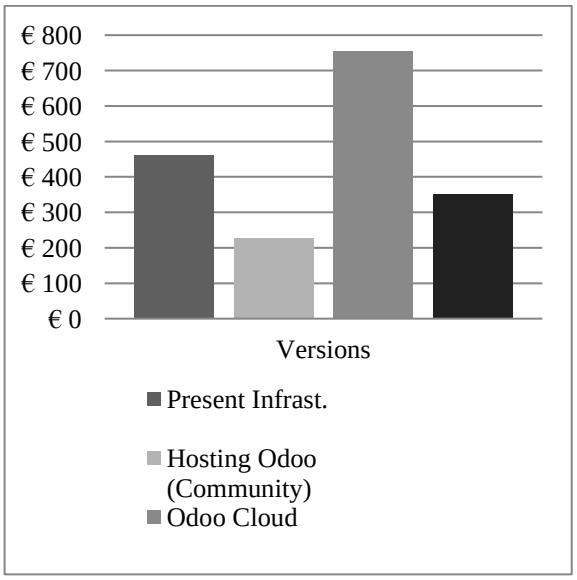
Providers	RAM (GB)	CPU (unit)	Storage (GB)	Cost (€) / Month
Google	**5.5**	**6**	**200**	**114.00**
GoGrid	4	4	200	118.00
Cloud Sigma	4	4	200	152.30
Elastic Hosts	4	4	200	199.00

The last pillar of the companies' cloud migration proposal included a new ERP/CRM software that has new capabilities than the legacy that is being used. The suggested option is Odoo (formerly known as OpenERP). Odoo offers three different software editions Free Odoo, Odoo Enterprise, Odoo Cloud. The first is the free version of the Software that adds

no extra cost providing the basic functionality needed. The Enterprise version is a complete version that can be hosted by any server and Odoo Cloud is similar to the Enterprise version but it is hosted in Odoo's cloud servers.

The final costs are displayed in Figure 2. It is easily observable, that two out of three solutions are below the maintenance costs of the IT infrastructure of the companies. The study has concluded that the companies are able to support their business activities even with Odoo Community, without spending extra capital on another version of ERP. Present IT cost is € 460.71, Hosting Odoo (Community) € 227.90, Odoo Cloud € 755.40, Hosting Odoo (Enterprise) € 350.90.

Figure 2: Price Comparison
(Odoo Pricing, 2015)



3.2 National Confederation of Hellenic Commerce:

ESEE is the higher, nationwide and internationally, representative organization of Greek trade. It is based on the cooperation of large local trade associations active in the Greek society from the 19th and early 20th century. The effort for nationwide representation went through several stages, initially taking informal forms. Thus, in 1961 the Coordinating Council of Trade Associations was established.

ESEE has its offices in the city of Athens. The IT department has developed a well-designed and successfully maintained IT infrastructure, with the specifications shown in Table 4.

Table 4: ESEE IT Infrastructure.

Model	CPU	RAM	Storage	Software
HP - DL350 Gen10	Intel Xeon	32 GB	600 GB	Windows Server 2012 (Hyper Visor)
HP - DL350 Gen10	Intel Xeon	32 GB	600 GB	Windows Server 2012 (Hyper Visor)
EMC - VNXe 1600	Intel Xeon	16 GB	10 TB	Operating Environment 3.1.3

Before April 2016 ESEE used instead of the equipment above, three Hewlett Packard ML350 Gen5. The organization's current requirements for their IT services are: Mail Server, Storage, Antivirus and ERP.

A NAS (Network Attached Storage) is also available, used to back up all the business-critical documents. Unfortunately, the size quickly becomes insufficient. The current IT infrastructure operating without any flaws and the required functionality for all the business processes has been achieved. As mentioned before, one of the major factors that causes some problems on the company's operation and IT expansion is the internet connection bandwidth. The company is forced to use five different internet connections (5 different modem-routers), each one only achieves 24 Mbp/s. The result is that the end users can only achieve a bandwidth of about 4 Mbp/s on their desktop. Using the Cloud Adoption Toolkit, the cost of the IT equipment of the company is estimated and shown in the Table 5.

Table 5: ESEE IT Costs.

Info	Watt (60%)	Cost (€)	Cost (€) / Month
Internet Connections	-	1,500.00	125.00
Major Events *	-	1,500.00	125.00
www.esee.gr	-	400.00	33.33
www.kaele.gr	-	400.00	33.33

www.inemy.gr	-	-	-
ERP License	-	1,500.00	125.00
HP - DL350 Gen10	300	-	21.93
HP - DL350 Gen10	300	-	21.93
EMC - VNXe1600	240	-	17.54
A/C (24.000 BTU)	4,219.80	-	308.47
A/C (24.000 BTU)	4,219.80	-	308.47
Total / Month	-	-	**1,120.00**

Costs:
Energy costs (€/kWh) were calculated based on the energy bill of the organizations.
* Major events consist of disk failures, offline server and any other malfunction that may occur.

3.2.1 Findings / Proposal:

ESEE has a "rock-solid" infrastructure and at the moment because the new equipment is not yet amortized, from a financial point of view the cloud migration is not wise choice. A partial migration could be a feasible solution though (hybrid cloud). The monthly cost of a complete migration of the servers into the Cloud is displayed below in Table 6. As before, for the calculations the pricing data from Cloudorado.com were used.

Table 6: Cloud Providers Costs.

Provider	Cost (€) / Month
Google	**204.12**
Amazon Web Services	319.49
Windows Azure	474.80

According to the calculations above, the best solution is the Google Cloud Platform. As far as the EMC server is concerned, the cost is at a level of **€ 243.13**. In the case of a complete cloud migration the yearly cost will be:

2 * Cost_HP_Cloud_Equivalent +
1 * Cost_EMC_Cloud_Equivalent = 4,898.88 + 2,917.56 = € **7,816.44** / year (€ 651.37 / month)

From Table 5, a large part of the monthly expenses is fully eradicated with the use of cloud computing. The power consumption of the servers is no longer a concern. The cloud bandwidth of these servers is capable of hosting the three websites, reducing the monthly bill of ESEE. The comparative Table 7 was created to compare the two configurations.

Table 7: ESEE Cloud IT Costs.

Info	Watt	Watt (60%)	Cost (€)	Cost (€) / Month
Internet Connections	-	-	1,500.00	125.00
ERP License	-	-	1,500.00	125.00
Cloud Servers			7,816.44	651.37
A/C (24.000 BTU)	7,033	4,219.80	-	308.47
Total / Month	-	-	-	**1,209.84**

As shown in the Table 4, the major malfunctions are no longer a concern. The second air condition is now superfluous so it will not be needed. The server room will still keep the telephone line switches and additional equipment this is why the usage of the A/C is required.

Comparing the two Tables (7 – 5), switching to a cloud infrastructure will cost € 1,078.08 (difference between total/month multiplied by 12) more annually. Although the cost difference for an enterprise might be insignificant additional training for the cloud and the migration procedure itself could induce additional costs that are not measured in this paper.

According to (Andrikopoulos, Strauch, & Leymann, 2013) decision support is of great importance as well as the C.A.T mentioned before any step towards cloud migration. Especially for a migration that has not clear financial benefits such as this. An additional consideration is also the effort required for the adaptation from the IT department, the staff and the management in order for. Following the C.A.T a risk and benefit analysis was conducted with a questionnaire from PlanForCloud.gr. The results indicate that the full scale adoption for cloud had more risks than potential benefits.

After interviewing the IT management of ESEE, the solution that was proposed was not a complete cloud migration, but a hybrid cloud implementation for backup purposes. The cloud infrastructure that will be setup as a backup server for business-critical data. The data will be safely stored in an encrypted form using a Google Storage server.

At the moment, the IT administrators need about 1.5 TB for the data, so a solution based on these figures was created.

Table 8: Backup Server Costs.

Duration (month)	Storage (TB)	Bandwidth (TB)	Class A	Class B	Cost (€)
1	3	1.5	0.1	1	228.85
9	3	0.5	0.05	0.7	1,123.29
2	4	0.7	0.08	0.9	340.18
Total:	-	-	-	-	**1,692.32**

Each class consists of the commands shown below (Table 9). The commands are calculated per million. The first month, when the first backup requires a major bandwidth in order to be completed. During the next 9 and 2 months, only the storage size changes. The calculations were made based on an annual contract.

The total cost of this backup server is € 141.10 per month. Also, the IT stuff already know how to schedule backups on Windows Server 2012 so no training or additional cost is required.

Table 9: Commands Classification.
(Google Storage Pricing, 2016)

Operation	Class
GET Service GET Bucket (when listing objects in a bucket) PUT POST	Class A
GET Bucket (when retrieving bucket configuration) GET Object HEAD	Class B
DELETE	Free

4. CONCLUSIONS:

Greece due to its crisis, can have some very important benefits with the proper leverage of cloud computing. After the thorough examination of two completely different enterprises and their needs, it is only reasonable to say that cloud computing is something that every company needs. Some companies can harvest and enjoy all of the benefits cloud computing provides and others -due to their well-maintained IT infrastructure- only need some extra functionality that can be achieved with the use of cloud.

The findings point out clearly that the cloud proposal could cost 50%, or 24% less per month for the General Pack. As far as ESEE is concerned, the complete cloud migration is not necessary. Also, the costs have not significant differences. Although a hybrid cloud solution for a backup server could be ideal. With a monthly cost that does not exceed € 150, ESEE can maintain a backup of business-critical data out of the boundaries of the organization for greater security and availability. The significance of the cloud adoption should be a major concern for all companies, especially Greek. Reduced income and a small budget for investment IT make Greece a very prosperous ground for cloud to expand and help SMEs to reduce internal costs and be more competitive to the European and the Global market as well.

Future research can focus on the additional cost that a migration to the cloud can hide. Analysis for the impact that affects stakeholders and the responsibility modeling is needed in order to better understand cloud migration. Costs like training and disruption of the company's operation.
An additional research like this, can help decision-makers to conduct an in-depth cloud migration assessment for the enterprise that they represent. The star of cloud computing shines bright and hopefully every company will embrace some of its aspects.

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