USING CLOUD COMPUTING TO UNITE
OUR UNIVERSITY

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Abstract: DeVry University has expanded over the years with five distinct colleges, more than ninety locations in the US, Canada, and Brazil. DeVry offers traditional face-to-face courses in the classroom, online courses and hybrid or blended courses, and uses technology to enhance the curriculum. The expansion presumably increased the number of students as well as DeVry faculty and staff. Each student, instructor, manager, and staff member is different, yet each is striving towards the same goal: success.   It is important to create a unique learning environment regardless of the culture or language.

Technology plays a key role in this objective, and with the advancements in technology, it is important for our university to aim to use the newest and most efficient technology in order to encourage collaboration between learners, instructors and others in the academic community. Being more efficient is important, but being cost effective is equally important.

Cloud computing is a technology that can be used to streamline the learning process and infrastructure, making it easier for students, teachers and administrators to strive towards academic success. It is the technical means by which everything can be delivered as a service over the internet, accessible from any device, any place, anytime. By providing access to education and the academic community anytime and anywhere, DeVry can emerge as a leader in the academic world. DeVry is made up of many voices but is one university, and cloud computing could be the tool used to unite our vision, objectives, and values for many different audiences.

Key words: Cloud Computing, Cloud Services, Integrated Services, DeVry University, Hosted Services, Hybrid Learning

Introduction:
Obtaining a high quality education is one of the most important decisions an individual can make in his or her lifetime, and in today's current economy, there is a need for people to re-educate themselves due to a change in the types of jobs that are in demand. DeVry University has offered quality education for more than eighty years, where it started out offering degrees related to technology in Chicago, Illinois and has expanded to a wide variety of degrees not only in the United States, but also in Canada and Brazil. DeVry has answered the demand for quality education in the classroom and online as well, which provides many flexible options for students as they pursue their educational goals.

The buzz about cloud computing is everywhere; on the TV, Internet, and in conferences/workshops being promoted as a business solution. But what is cloud computing and what makes it attractive to businesses regardless of the type of business? It has emerged to be the latest and greatest trend for businesses that are looking to expand their Information Technology to keep up with the ever increasing demand of doing business via the internet in order to provide better services to customers and streamline business processes.

In this paper, the author will discuss how cloud computing could provide DeVry University the ability to keep up with the demand of its expanding IT infrastructure needs, and to provide enhanced options for their students to communicate, collaborate, trouble-shoot and adapt in the classroom and online, whether it be the physical or virtual classroom.

What Makes DeVry University Unique?
DeVry has existed for more than eighty years where it established its humble beginnings in Chicago, Illinois. DeVry has expanded to establish campuses in over 95 locations within the United States and Canada, as well as offering online education. Over the years DeVry deems itself as more than a school of technology, and now has five colleges within the DeVry family: Business & Management, Engineering & Information Sciences, Health Sciences, Liberal Arts & Sciences, and Media Arts & Technology. In 2003 DeVry acquired Ross University of Medicine and Ross University of Veterinary Medicine. In 2009, DeVry Brazil became a part of DeVry Inc. DeVry has a wide span of locations and educational degrees which makes it unique and creates a great demand to create a way for collaboration amongst their students, instructors and the academic community.

Delivery of Education:
By expanding the method of delivering education to students, DeVry has strived to use the best technology to meet the current needs of its wide array of students and campuses. Yet, the technology changes so rapidly and there is an increased need to collaborate virtually, and this is where cloud computing comes in.

What is Cloud Computing?
Cloud computing is essentially virtual servers that are available over the internet [1]. It is the technical means by which everything can be delivered as a service over the internet, accessible from any device, any place, anytime. For example, if you log onto Gmail, iTunes or Facebook, you are on the cloud. In figure 1 you will see how cloud computing is designed to work with different technical devices and this is what makes it very appealing, and it can also be attractive to businesses, DeVry in particular, in the following ways [2]:

- Provides Flexibility – ability to work from anywhere
- Cost Savings- document storage, fewer severs, operating systems
- Good for the Environment – businesses use 30% less energy

According to the National Institute of Standards and Technology (NIST), in an article by Peter Mell and Timonty Grance, cloud computing models "enable 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"[3]. Mell and Grance describe that cloud model consists of five fundamental characteristics, three service models, and four deployment models and they are describe in more detail in figure 2.

Gartner, which is a trustworthy information technology research and advisory firm that provides technology research to global technology business leaders to make informed decisions on key initiatives, released a priority matrix report that ranked certain technologies in two dimensions – "benefit" and "years to mainstream adoption" for 2009 – 2011, and it listed cloud computing was in each of those reports, see figure 3. In 2012, Gartner released another report about the top ten strategic technologies that had the potential for considerable impact on the enterprise and cloud computing came in at number ten [4].

Using Cloud Computing at DeVry:
DeVry University is a very broad educational institute, offering online and hybrid classes, and having the ability to use a cloud computing is advantageous for several reasons. Cloud computing is designed to work with different types of technical devices from any location, yet it is just as important for the technology and infrastructure of the university to be strong, efficient, reliable, and cost efficient.

There are three different types of cloud computing models; public, private and hybrid, and each offer different features, costs and benefits. We will now discuss each one to help determine which one would be meet the overall needs of DeVry. The public model allow an organization to get cloud services with less upfront costs in hardware and skills that would allow quicker start up time and greater flexibility, yet it could still have security and reliability issues, as well as vague long-term costs. It would be critical to compare the total cost of ownership with the existing IT and with potential private cloud models. The private model offers advantages to security and control, but also comes with a higher initial cost when it comes to skills and hardware since the IT department would

be responsible to buy, build and manage their cloud. The hybrid model allows the IT of an organization to make the best use of and benefit from both public and private cloud services while evading some of the disadvantages. Hybrid models could provide increased flexibility and scalability using fewer resources, yet still comes with concerns about privacy and security [5].

Finding ways to save money is important to any organization and businesses face economic and market changes that often prove difficult if not impossible to forecast. This tends to leave companies susceptible to swings in demand and either under- or over-investment in IT. Finding more effective and less expensive tools to do the job is a main goal for every organization. Cloud computing is a new approach to IT that isn't just a cost of doing business but potentially something more [6].

The ideal cloud model for DeVry to implement would be hybrid cloud computing. For with cloud computing, DeVry management could rapidly make decisions such as moving applications out to a hybrid cloud or taking them back in-house. The hybrid model would allow DeVry to continue paying for the IT resources which already exist in house and are functioning.

Is Cloud Computing Secure?
Security often tops the list of cloud user concerns. Cloud computing presents different risks to organizations than traditional IT solutions. There are a number of security issues for cloud computing, some of which are new, some of which are exacerbated by cloud models and others that are the same as in traditional service provision models. The security risks depend greatly upon the cloud service and deployment model. For example, private clouds can to a certain extent guarantee security levels, but the economic costs associated with this approach are relatively high [7].

Since I recommend DeVry use the Hybrid cloud model, security is a concern between the Internal IT of DeVry and the Cloud Service Provider (CSP) who will share the responsibility of accessing the information as the IT. Usually, it is hard to control the access between two different entities at the same time. Also, the cloud API is not standardized yet.

DeVry University has no time limit to retaining documents on their network, such as student assignments, case studies, labs, research documents and faculty resources and teaching material. This extensive collection of documents can be accessed by authorized DeVry users. Keeping these documents secure is critical and any new implementation of technology must provide security to protect the integrity of students and instructors work. Student data security raises a number of concerns, including the risk of loss, unauthorized collection and usage and generally the CSP not adequately protecting data. Also, the data backup is another concern for DeVry's IT as well.

According to the Cloud Security Alliance [50] , the top threats to cloud computing are abuse and nefarious use of cloud computing, insecure interfaces and APIs, malicious

insiders, shared technology issues, data loss or leakage, account or service hijacking and unknown risk profile. They were unable to reach a consensus on ranking the degree of severity of these risks [8]. However, the good news here is that DeVry IT is a well trained department, and employees follow a standardized process for qualification of working with the DeVy IT department. With a strong policy and standard procedures, DeVry can benefit from the hybrid cloud and make it available for all IT departments to share the resources and follow problem solving technique.

Since DeVry is teaching other countries, there is another challenge: Cloud computing may actually increase the risk of access to confidential information. This may be by foreign governments: there can be increased risks due to government surveillance over data stored in the cloud, as the data may be stored in countries where previously it was not. One example of this is the US Patriot Act, which is an important concern for many businesses considering switching to CSP models. I suggest that DeVry keep the sensitive information locally for better confidentiality, and the general information in the cloud. In general, cloud storage can be more at risk from malicious behavior than processing in the cloud because data may remain in the cloud for long periods of time and so the exposure time is much greater. On the other hand, there is more potential for usage of encryption in cloud storage [9].

Conclusion:
DeVry University provides high quality education to students and a main method of delivering that education is via the use of technology. Creating an environment for students to achieve their academic goals is imperative to DeVry, and this can be accomplished via the use of technology, where students from California can interact with students from Brazil, allowing them to interact, collaborate and share their experiences. The IT infrastructure of DeVry is adequate, but in order to keep up with the latest technology and growing demands, cloud computing can benefit the overall IT needs of DeVry by allowing it to maintain a robust network, while saving money and operating more efficiently. Overall, moving to a cloud computing environment will be a great benefit for DeVry and it must establish a secure environment that will be reliable and trusted by management and the IT department.

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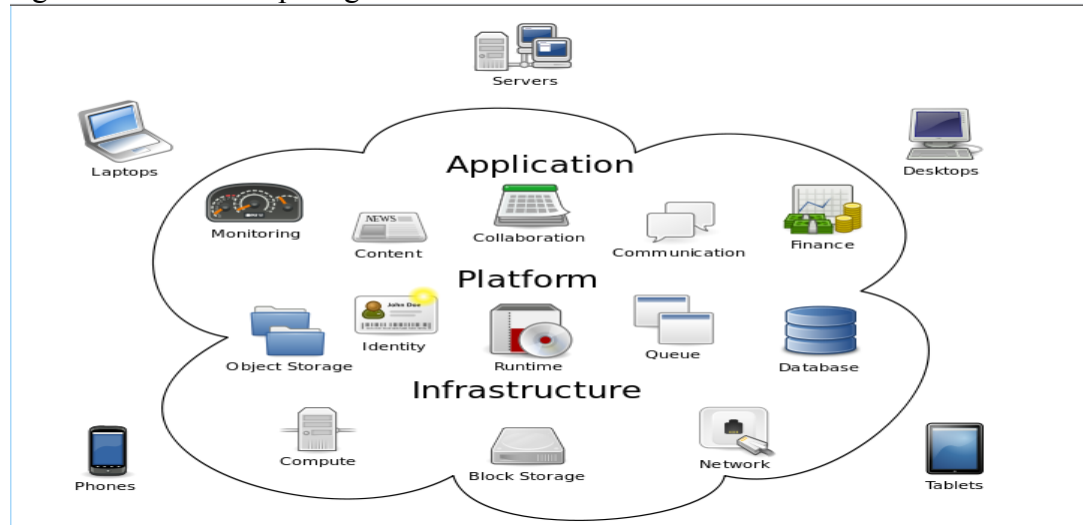
Figure 1: Cloud Computing

Figure 2: Cloud Computing Models

Essential Characteristics:	Description:
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.
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).
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 datacenter). Examples of resources include storage, processing, memory, and network bandwidth.
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.
Measured Service	Cloud systems automatically control and optimize resource use by leveraging a metering capability1 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.
Service Models:	*Description:*
Software as a Service(SaaS)	The capability provided to the consumer is to use the provider's applications running on a cloud infrastructure2. The applications are accessible from various client devices through either a thin client interface, such as a web browser (e.g., web-based email), or a program interface. The consumer does not manage or control the underlying cloud infrastructure including network, servers, operating systems, storage, or even individual application capabilities, with the possible exception of limited user-specific application configuration settings.
Platform as a Service (PaaS)	The capability provided to the consumer is to deploy onto the cloud infrastructure consumer-created or acquired applications created using programming languages, libraries, services, and tools supported by the provider.3 The consumer does not manage or control the underlying cloud infrastructure including network, servers, operating systems, or storage, but has control over the deployed applications and possibly configuration settings for the application-hosting environment.
Infrastructure as a Service (Iaas)	The capability provided to the consumer is to provision processing, storage, networks, and other fundamental computing resources where the consumer is able to deploy and run arbitrary software, which can include operating systems and applications. The consumer does not manage or control the underlying cloud infrastructure but has control over operating systems, storage, and deployed applications; and possibly limited control of select networking components (e.g., host firewalls).
Deployment Models:	*Description:*
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.
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.
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.
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 3: Gartner Priority Matrix