Cloud Computing Deployment: What Have We Learned from Real Life Implementations and Practices

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Cloud computing is the fastest area of application within the information systems field. Most computer and networking companies are trying to either enter into this area or increase their existing market share. The adoption of cloud computing by businesses and academic institutions is on the rise. Cloud computing platforms could reduce cost and increase information systems responsiveness for those organizations that are adopting it properly. This paper first examines the existing opportunities and challenges in cloud computing environment, examines four current case examples, and then offers nine learning outcomes for managers to consider before adopting this technology.

LITERATURE SURVEY: THE LANDSCAPE OF CLOUD COMPUTING

A recent survey on the status, applications, deployment, challenges, and opportunities presented by using cloud computing platforms reveals interesting facts as follows:

According to Forrester Research, the global cloud computing market will grow from a $40.7 billion in 2011 to $241 billion in 2020 (Dignan, 2011).

According to InformationWeek's latest research, 75% of large businesses now consider software-as-a-service essential to what they do (Nicola, 2017).

Enterprise IT managers have to accept that cloud outages will occur and must establish strategies to keep core systems running (Froehlich, 2017).

Amazon Web Services (AWS) outage on March 2, 2017 proved that one cloud isn't enough, and organizations must plan for this and have an alternative (Oliver, 2017).

Infographic provides a snapshot of key data points for 2017 under, "State of the Cloud." This report compares and contrasts private and hybrid clouds and argues that private cloud may be losing its appeals in favor of hybrid cloud (Johnson, 2017).

InformationWeek's 2017 report on "State of Cloud" finds private cloud losing its viability and hybrid cloud operations too complex; and reports that public cloud adoption is advancing (Babcock, 2017).

In an interesting article, David Linthicum, explains that migration to cloud is less about technology and more about people, their acceptance, and their attitudes about this new platform. There are some actions that managers can take in order to make the migration a successful venture (Linthicum, 2016).

Cloud applications have created a global collaboration platform, for example, scientists around the world can share and collaborate on research in platforms such as Amazon's AWS (Gaudin, 2016).

A new report from 451 Research published in October 19, 2016 reveals that two of the most critical factors that influence the cost of a public versus a private cloud deployment are an organization's ability to efficiently manage infrastructure and utilization of hardware resources. Generally speaking, if any organization has the expertise to manage a large number of servers at a high level of utilization then on-premises, customer-managed private clouds can have a total cost of ownership (TCO) advantage compared to public clouds (Butler, 2016).

New services and pricing models make cloud computing more powerful, complex, and cheaper than it was a few short years ago (Wayner, 2016).

In 2015 all the leading cloud players added major new capabilities as adoption ramped up (Knorr, 2015).
With all the variations in design, construction, and features, benchmarking and performance measurement of public clouds remains a challenge for key decision makers (Yegulalp, 2015).
A study conducted in 2015 shows that a public cloud is more secure than a data center (a-Linthicum, 2015).

A move to the cloud is no simple calculation, services like email are easy to justify moving to the cloud. It will be more challenging for the rest of the infrastructure migration to the cloud (Bruzzese, 2015).
Lack of funding and failure to win over hearts and minds of key users and decision makers are among the top mistakes that could kill cloud initiative (b-Linthicum, 2015).

General Electric is pitching a cloud service for the Internet of Things market, but its focus is primarily on heavy industries like aviation, healthcare, energy, and transportation (Ribeiro, 2015).

In 2015, after years and years of competitive price cuts, Microsoft started hiking prices on its cloud computing service. IBM was also adjusting prices upward (c-Linthicum, 2015).

When the ROI argument is not enough, key decision makers should use better security, no lock-in, and better performance among the advantages of cloud computing to convince those that are not sure about the cloud adoption (d-Linthicum, 2015).

In 2014, Cisco, Google, Amazon, and Microsoft all made major cloud computing announcements and investments with significant implications for businesses and consumers. Microsoft Office 365 and Google Apps for Work now compete to win desktop in the business world (Knorr, 2014).

IBM is steadily decreasing its involvements with hardware and increasing its involvements with all sorts of cloud computing initiatives (Snyder, 2014).

Even financial executive support deployment of cloud computing for more than just its cost saving advantage, they also include increased productivity and security among its advantages, although others argue "security" as one of the disadvantages of this platform (Linthicum, 2012).

According to experts it makes no sense for smaller enterprises to operate their own data centers. Cloud computing will be both cost effective and also environmentally safer and cleaner for such organizations (Krill, P. (2010).

Despite millisecond delays cross-ocean cloud applications are gaining in popularity because of major cost saving and other advantages (a-Thibodeau, 2011).

Former president Barack Obama relied heavily on cloud computing and data center consolidation to keep IT costs under control (Ribeiro, 2010). The Obama administration cut costs by embracing the cloud in place of in-house, proprietary technology (Samson, (2010).

The department of defense (DoD) could run more effectively using cloud technologies. It could become a model and show other large organizations how it should be done (c-Linthicum, 2010).

China is building a city-sized cloud computing and office complex that will include a mega data center. Cloud computing is among the projects supporting that country's double-digit growth in IT spending (c-Thibodeau, 2011).

Cloud computing platforms certainly support the growing phenomenal of green computing and could help organizations to achieve their "green" goals (Bidgoli, 2018).

INTRODUCTION AND BACKGROUND

Cloud computing is the fastest area of application within the information systems field. Most computer and networking companies are trying to either enter into this area or increase their existing market share. Even during the economic down turn, cloud computing related jobs have been in high demand (Krill, 2010). Some experts believe that cloud computing could save the economy. In a survey conducted by CRN, 68% of the respondents indicated that cloud computing will help their businesses recover from the recession. More than 600 IT and business decision makers in the United States, the United Kingdom, and Singapore participated in the survey (a-Linthicum, 2010).

The adoption of cloud computing by businesses and academic institutions is on the rise. Cloud computing platforms could reduce cost and increase the information systems responsiveness for those companies that are properly adopting it. TABLE 1 summarizes the advantages of cloud computing (Brodkin, (2010).

TABLE 1
ADVANTAGES OF CLOUD COMPUTING

Reduced cost	Cloud computing cost is paid incrementally, saving organizations money. Also, because the software development cost is divided among many participants, it is generally cheaper than traditional computing methods.
Increased storage	Organizations can store more data than on private computer systems and storage can grow as the organization grows.
Highly automated	No longer do IT personnel need to worry about keeping software up to date. The "what version of the software do I need" syndrome is eliminated.
Flexibility	Cloud computing offers much more flexibility than traditional computing methods. It can offer vertical as well as horizontal flexibility.
More mobility	Employees can access information wherever they are, rather than having to remain at their desks. It offers a true portability for both data and applications.
Allows IT to shift focus	No longer having to worry about constant server updates and other computing issues, the adopting organization will be free to concentrate on innovation and growing the business. Mission critical applications become the main focus.

The following four case studies set the stage for our presentation:

Cloud Computing in Action: Case #1

Cloud computing could put small businesses on the same footing as large corporations by offering flexibility and scale to grow. In a way, cloud computing gives small businesses a competitive advantage by not spending all monies upfront for IT services and infrastructure—businesses can get what they need from the cloud providers and pay as they go. However, security and downtime are among the fears that small businesses have regarding cloud deployment. Cloud computing gives small businesses cheaper, faster, and easier access to tools and applications that they need. Twitter for marketing and Google's Gmail are among the early applications used by small businesses. According to a survey conducted by Emergent Research, 74 percent of small businesses (companies with fewer than 50 employees) use some cloud-based applications such as online banking and social media. Julia Suriano, co-owner of Kebroak BBQ Company, a seven-person operation based in Hialeah, Florida, was expecting a baby. The company imports and distributes charcoal to retailers and restaurants across the country. She needed access to company data at any time and from anywhere. Cloud computing was the answer. In addition to using Gmail and social media, the company switched from Intuit QuickBooks' desktop software to the company's cloud-based accounting software. Kebroak BBQ also adopted Dropbox for storage. Now Suriano has access to critical data from anywhere. According to the Emergent survey report, cloud computing will change how small businesses run by 2020(Gaudin, 2014).

Cloud Computing in Action: Case #2

Jeff Bezos, the founder of Amazon.com, says, "You don't generate your own electricity. Why generate your own computing?" (Mcfedries, 2008). Amazon has established a computing platform that companies can use, regardless of their location. This platform provides storage and processing power on demand, and companies pay only for the resources they use. By using this service, companies don't have to invest in technology that might become obsolete quickly (Dignan, 2008). With decreasing prices and better offerings, Amazon.com has become a major cloud infrastructure provider (Linthicum, 2011). Google Apps for Work, a cloud platform, introduced in February 2007, is competing with Microsoft's Office suite, and many companies use it now, including universities such as Arizona State University and Northwestern University (Brodkin, 2009).

Cloud Computing in Action: Case #3

Queensland University of Technology in Australia implemented cloud computing to provide enterprise software to more than 140 universities in the Asia Pacific. According to Glenn Stewart, Professor of Information Systems, a cloud computing platform not only has reduced cost it has also provided greater reliability and scalability. Professor Stewart is in charge of the SAP University Competence Centre (UCC), which provides the SAP suite of business software to over 800 academics and 42,000 students from 140 universities in the Asia Pacific and Japan. If a university chooses to run this suite of software without the help of UCC it has to invest in hardware, software, backup facilities, and so forth. The upfront investment would be over $300,000, which is a major undertaking for any university. By migrating the services into a private cloud, each university pays $6,760 for that same package, which is more than a 74% reduction in cost (Ng, 2010).

Cloud Computing in Action: Case #4

InterContinental Hotels Group (IHG) is an international hotel company that operates over 4,000 hotels across 100 countries under 7 brands including Holiday Inn and InterContinental. IHG is the largest Western supplier of hotel rooms in China (IHG. (2017). IHG is using several types of cloud computing platforms in order to improve the efficiency and effectiveness of its operations. According to IHG, cost saving is not the only reason for moving into the cloud. Other factors such as finding a faster and more flexible way to get a new system up and running and the ease of integration of various applications under one platform also play an important role. According to Bryson Koehler, senior VP of Revenue and Guest Information today, the savings come in other ways, he says, "such as improved flexibility and the ability to deliver a more tailored experience to end users." IHG is building a private cloud for its CRM applications using Salesforce.com's CRM. It is also building another private cloud called Camelot for its loyalty program. Camelot is in charge of several major functions and tasks. It first provides analysis of current guest activity and it also maintains historical records for future use. Secondly, it is used for targeted promotions tailored to individual guests. Thirdly, the system is responsible to run revenue management and room yield operations which calculates room rates. The public cloud at IHG is used for application development and testing. The platform chosen for this operation is Amazon Web Services' Elastic Compute Cloud infrastructure. At least three cloud delivery models are in use at IHG including SaaS (software-as-a-service), Infrastructure as a Service (IaaS), and a private cloud (Babcock, 2012).

However, many organizations do not follow a systematic approach before adopting this technology, and to be able to better understand the many opportunities and challenges that this fast-growing platform offers. This paper presents nine learning outcomes that if followed should increase the chances of success when introducing cloud computing into your organization. These learning outcomes provide managerial literacy as well as checklists that organizations could use before introducing this technology into their organizations. The learning outcomes include: (1) understanding grid computing, (2) understanding application service providers, (3) understanding utility (on-demand) computing, (4) understanding the components of a cloud platform, (5) understanding public, private, hybrid, and community clouds, (6)

understanding the security issues in cloud computing, (7) understanding cloud computing failures and challenges, (8) understanding the ROI of cloud computing, and (9) preparing a cloud computing plan for implementation.

LEARNING OUTCOMES #1: UNDERSTANDING GRID COMPUTING

Grid computing involves connecting all the different computers combining their processing power to solve a particular problem. With this configuration, users can make use of other computers' resources to solve problems involving large-scale, complex calculations, such as circuit analysis or mechanical design, that a single computer is not capable of solving. Each participant in a grid is referred to as a "node." Cost savings is a major advantage of grid computing because companies don't have to purchase additional equipment. In addition, processing on overused nodes can be switched to idle servers and even desktop systems. Grid computing has already been used in bioinformatics, oil and gas drilling, and financial applications. Other advantages of grid computing include the following:

- Improved reliability—If one node in the grid fails, another node can take over.
- Parallel processing nature—Complex tasks can be performed in parallel, which improves performance. In other words, a large complex task can be split into smaller tasks that run simultaneously on several nodes.
- Scalability—If needed, more nodes can be added for additional computing power without affecting the network's operation. Upgrades can also be managed by segmenting the grid and performing the upgrade in stages without any major effect on the grid's performance.

Grid computing does have some drawbacks, however. Some applications cannot be spread among nodes, so they are not suitable for grid computing, and applications requiring extensive memory that a single node cannot provide cannot be used on a grid. In addition, licensing agreements can be challenging, synchronizing operations in several different network domains can be difficult, and require sophisticated network management tools. Finally, some organizations are resistant to sharing resources, even if doing so benefits them.

LEARNING OUTCOMES #2: UNDERSTANDING APPLICATION SERVICE PROVIDERS

Internet service providers (ISPs) provide access to the Internet for a fee. A more recent business model called application service providers (ASPs) provides access to software or services for a fee. Software as a service (SaaS), or on-demand software, is a model for ASPs to deliver software to users for a fee; the software might be for temporary or long-term use. With this delivery model, users do not need to be concerned with new software versions and compatibility problems because the ASP offers the most recent version of the software. Users can also save all application data on the ASP's server so that the software and data are portable. This flexibility is convenient for those who travel or work in different locations, but it can also create privacy and security issues. Saving data on the ASPs' servers instead of users' own workstations might leave this data more exposed to theft or corruption by attackers (Bidgoli, 2018).

Here is a simple example of how SaaS might work: say you want to edit a document, TEST.doc, and you need word-processing software for this task. With SaaS, you do not need the software installed on your computer. You simply access it from the SaaS provider site. You can then run the software from the provider's server (and not take up your computing resources) or on your computer. The location of the TEST.doc file does not matter. You make use of the provider's SaaS service to edit the document, which stays on your hard drive (or wherever you had it stored—a flash drive, for example). The word-processing application is not stored on your computer, so the next time you access the word-processing software from the provider's SaaS site you might get a newer version of the word-processing software. SaaS deals only with software, not with data and document storage or with hardware resources, such as processing power and memory. The SaaS model can take several forms, such as the following:

- Software services for general use, such as office suite packages

- Offering a specific service, such as credit card processing
- Offering a service in a vertical market, such as software solutions for doctors, accountants, and attorneys

Generally, the advantages of outsourcing, such as being less expensive and delivering information more quickly, apply to the ASP model, too. However, ASPs have some specific advantages, including the following:

- The customer does not need to be concerned about whether software is current.
- IT personnel time is freed up to focus on applications, such as customer relationship management and financial information systems, which are more important strategically to the organization.
- Software development costs are spread over several customers, so vendors can absorb some expenses of software development and develop more improved software.
- Software is kept up to date, based on users' request.
- The ASP contract guarantees a certain level of technical support.
- An organization's software costs can be reduced to a predictable monthly fee.

Some disadvantages of ASPs are as follows:

- Generally, users must accept applications as provided by ASPs; they are not customized for users' needs.
- Because the organization has less control over how applications are developed, there is the risk that applications might not fully meet the organization's needs.
- Integration with the customer's other applications and systems might be challenging.

Google, NetSuite, Inc., and Salesforce.com are three companies that offer software as a service. Google Apps (*www.google.com/apps*) is a service from Google with several Google products. It features several Web applications with similar functionality to traditional office suites, including: Gmail, Google Calendar, Talk, Docs, and Sites. The standard edition is free. In addition, Basecamp (*basecamphq.com*) and Mint.com (*www.mint.com*) also offer SaaS. Basecamp is a web-based project collaboration tool that allows users to share files, meet deadlines, assign tasks, and receive feedback. Mint.com is a free web-based personal financial management service. SaaS is also common for human resources applications and has been used in ERP systems with vendors such as Workday (*www.workday.com*).

LEARNING OUTCOMES #3: UNDERSTANDING UTILITY (ON-DEMAND) COMPUTING

Utility (on-demand) computing is similar to the SaaS model and provides IT services on demand. Users pay for computing or storage resources on an as-needed basis, similar to paying for utilities. Convenience and cost savings are two main advantages of utility computing, but this service does have drawbacks in the areas of privacy and security. Because the service is outside the company's location, theft or corruption of data is a concern.

Utility computing can work with the SaaS discussed earlier. Returning to the example of editing a Word document, suppose the TEST.doc file is very large because it contains a lot of images. You notice that your computer is running slowly because it has an older CPU and does not have enough RAM to handle the file size adequately. With utility computing, you can request computing power and memory from the provider. It is like leasing a more powerful computer just for the period you need it. So to compare utility computing with SaaS, utility computing handles hardware resources, such as CPU processing and memory, not software.

Utility computing has been available at universities and research centers that need to run complex programs and do not have the necessary resources. For example, NASA has offered to lease its supercomputer for a fee, which ensures the supercomputer is being used and adds income for NASA. Other organizations, such as Sun Microsystems (a part of Oracle now) and IBM, offer this service in the form of storage and virtual servers. Some companies offer virtual data centers with services that enable users to combine memory, storage, and computing capabilities. Liquid Computing's LiquidIQ is one

example (*www.liquidcomputing.com*). Enki (*www.enkiconsulting.net*), Joyent (*www.joyent.com*), and Layered Technologies (*www.layeredtech.com*) are other vendors.

LEARNING OUTCOMES #4: UNDERSTANDING THE COMPONENTS OF A CLOUD PLATFORM

Cloud computing is a platform incorporating many recent technologies under one platform, including the SaaS model, Web 2.0, grid computing, and utility computing, so that a variety of resources can be provided to users over the Internet. Business applications are accessed via a Web browser, and data is stored on the providers' servers (Bidgoli, 2018).

In addition, cloud providers, such as Amazon, set up an environment that enables the user to subscribe to SaaS, utility, grid, and other services the user needs and coordinates all these services for the user. Nearly all tech vendors are involved in cloud computing. BTC Logic, an IT consulting firm, has classified seven areas within cloud computing and has identified some of the top players in each category. The summary is provided in TABLE 2 (Brodkin, 2010).

TABLE 2
MAJOR CATEGORIES AND PLAYERS IN CLOUD COMPUTING

Cloud Categories	Cloud Players
Foundations (tools and software that make it possible to build cloud infrastructure)	VMware, Microsoft, Red Hat
Infrastructure	Amazon
Network Services (the communication components that combine with cloud foundation and infrastructure to form cloud architecture)	Amazon, Level 3 Computing Services, Cisco, Citrix
Platforms	Amazon, IBM
Applications	Google, Salesforce.com, Oracle, DROPBOX
Security	EMC/RSA, Symantec, IBM
Management	Amazon, IBM

Going back to the example of editing the TEST.doc file, say you are using your iPhone instead of your computer. Clearly, your iPhone doesn't have the storage space to save such a large file, and it does not have the necessary computing power or Word installed. With cloud computing, you can subscribe to Word at the provider's SaaS site, store the document on an external storage unit provided by the vendor, and run Word on a multiprocessor system the vendor provides. You might even get extra RAM from another computer available in the cloud, and the cloud provider coordinates all these tasks for you. Your iPhone is simply the device for viewing the document while you are editing it, and because it is a mobile device, you can do your work anywhere. In other words, the document, the software, and the computing resources are like a cloud that surrounds you wherever you go and is available whenever you need it. Generally, cloud computing includes components in the form of infrastructure as a service (IaaS), platform as a service (PaaS), and software as a service (SaaS).

Cloud computing offers many of the advantages and disadvantages of distributed computing. With this platform, users can request services, applications, and storage. For small and medium businesses, it means they do not have to invest in expensive equipment to compete effectively with large companies and can concentrate on the services and products they provide. Cloud computing services typically require a fee, although some are free. Google Apps, which includes Gmail, Google Talk, and Google Docs, provides commonly used applications accessed via a Web browser; software and data are stored on Google's servers, not on the user's computer. The standard edition for personal use is free (Jackson, 2011).

LEARNING OUTCOMES #5: UNDESTANDING PUBLIC, PRIVATE, HYBRID, AND COMMUNITY CLOUDS

There are four options available when using cloud computing: public, private, hybrid, and community clouds. Organizations usually choose one of these alternatives based on the following two factors:

- Security requirement and the sensitivity of data
- IT management requirement

When using a public cloud services, infrastructures are provided off-site over the Internet. Because services and the infrastructure are shared by a large number of users, a public cloud offers the highest cost saving and it is the most popular type. At the same time, it is more prone to security and privacy risks. This alternative is more suitable for organizations that need scalability (add or drop resources), do collaboration projects over the Web, and are offering standard applications over the Web such as e-mail. This option needs the least amount of IT management involvement. Security and reliability are the main concerns when choosing this option. Examples of public cloud providers include Amazon Elastic Compute Cloud (EC2), IBM's Blue Cloud, Google AppEngine, and Windows Azure Services Platform.

In a private cloud the services and infrastructure are run on a private network. Naturally this option offers higher security and privacy than a public cloud. Because the organization purchase and maintain all the software and infrastructure, this option offers less cost saving than a public cloud. This option is recommended for those organizations that operate on highly secure data. It is important to mention that some providers of public cloud offer private versions of their public clouds. Also, some providers of private cloud offer public versions of their private cloud with the same capabilities. A private cloud achieves cost savings by integrating fragmented infrastructures, automating common data center tasks, and providing financial accuracy and responsibility. In addition, an organization gains a greater degree of automation through the standardization of previously custom configured services into pre-defined infrastructure products offered in a controlled self-service manner. Major providers of private cloud include Eucalyptus, Elastra Enterprise Cloud Server, VMware private-cloud architecture, and Microsoft Azure.

Organizations that operate on both private and public data may choose a hybrid cloud. A hybrid cloud is a collection of at least one private and at least one public cloud. In a hybrid cloud environment there are a variety of public and private options with multiple providers. An organization may run its sensitive data on a private cloud and the public information with less security and privacy consequences may run on the public cloud. A hybrid cloud allows an organization to take advantage of the scalability and cost-effectiveness that a public cloud computing environment offers without exposing mission-critical applications and data to the outside world. However, this option may require multiple security platforms and making sure that all systems communicate with each other in an efficient manner might be a challenge

With the community option, the cloud infrastructure is designed for exclusive use by a specific community of users from organizations that share common concerns (e.g., security requirements, policy, mission, and compliance considerations). This infrastructure may be owned, managed, and operated by one or more of the organizations in the community, a third party, or some combination; and the infrastructure may exist on or off premises. With this alternative, the costs are spread over fewer users than with a public cloud (but more than with a private cloud) to realize its full cost-saving potential. Allocation of costs and responsibilities, governance, and the implementation of a tight security system are among the challenges that must be overcome when choosing this option.

LEARNING OUTCOMES #6: UNDERSTANDING THE SECURITY ISSUES IN CLOUD COMPUTING

Most experts believe that security is a concern when using a cloud computing platform and users play an important role in its success (Bidgoli, 2016). The organization that uses cloud computing should provide end-user education, force software updates, and work with the cloud computing providers in order to spot unusual activities.

Gartner has identified seven cloud-computing security risks (Brodkin, 2008):

- Privileged user access- who has access to your data
- Regulatory compliance- availability of external audits and security certifications
- Data location- specific jurisdictions and commitment to local privacy
- Data segregation-how your data is kept separate from other data in the cloud
- Recovery- what will happen to your data in case of a disaster
- Investigative support- contractual commitment to support specific forms of investigation
- Long-term viability- what will happen to your data if the provider goes under

These seven risks directly and or indirectly are related to one another. For a sound cloud computing policy, all of these seven risks must be carefully analyzed and then choose a cloud provider. Choosing a cloud provider is similar to choosing any IT vendor. Not all the vendors all equal. The organization must make sure that a cloud provider has a clear policy regarding these seven security risks and indicates in writing how the provider deals with each specific security risk. Additionally, some level of trust between the provider and the user is important. Without some level of trust between the two, the acquisition of could computing becomes a risky venture.

In a cloud computing environment there are two types of security issues: The client side (the user) and the server side (the provider). The organization that uses the cloud services basically does not have much control over the security issues of the server side. The provider of the cloud services is responsible for that. However, the client-side security is the responsibility of the organization that uses cloud services. TABLE 3 lists common client-side threats. TABLE 4 lists important client-side security measures.

TABLE 3
COMMON CLIENT-SIDE THREATS

Viruses
Worms
Trojan programs
Logic bombs
Backdoors
Blended threats (e.g., worm launched by Trojan)
Rootkits
Denial-of-service attacks
Social engineering

TABLE 4
IMPORTANT CLIENT-SIDE SECURITY MEASURES

Biometric security measures
Nonbiometric security measures (firewalls and intrusion detection systems)
Physical security measures
Access controls
Virtual private networks
Data encryption
E-commerce transaction security measures

The mobile users in particular play an important role in improving the security of cloud computing environment.

Generally speaking mobile devices pose additional threats to the network security because anyone walking or driving within the range of an AP (even outside of homes and offices) could connect and use the network (Bidgoli, 2018).

An AP (access point) is a part of a wireless LAN (WLAN) that connects the WLAN to other networks. Finding WLANs is an easy task. A user can walk or drive around different office buildings or homes with a WLAN-equipped computer and see if it can pick up a signal. There are free software tools available on the Internet that can teach you more about the network that was just broken into. Wireless signals can also be intercepted, and they are susceptible to DoS attacks similar to wired networks.

There are several techniques that could improve the security of wireless networks and mobile devices in a cloud environment as follows:

1) Using SSID (Service Set Identifier) - This technique requires all client computers that try to access the AP to include a SSID in all of their packets, a packet without a SSID will not be processed by the AP. The major weakness of using SSID is that it can be picked up by other devices in the range with the right software.
2) Using WEP (Wired Equivalent Privacy) - This technique uses a key that must be manually entered into AP and the client computer. This key encrypts the message before transmission. Because of the manual process this technique is not suitable for large networks as the key management becomes a complex and time-consuming task.
3) Using EAP (Extensible Authentication Protocol) - This technique dynamically generates the WEP keys based on the user's ID and password. When the user logs out of the system the key is discarded. A new key will be generated when the user logs back into the network.
4) Using WPA (Wi-Fi Protected Access) - This technique combines the strong features of WEP and EAP. Keys can be fixed such as in WEP or dynamically changed as is in EAP. However, the WPA key is longer than the WEP key; therefore, it is more difficult to break. Additionally, the key is changed for every frame (a distinct and identifiable data set) before transmission.
5) Using WPA2 or 802.11i - This technique uses EAP to obtain a master key. With this master key a user's computer and the AP negotiates for a key that will be used for a session. After the session termination the key is discarded. This technique uses Advanced Encryption Standard, which is more complex than WPA and much harder to break.

LEARNING OUTCOMES #7: UNDERSTANDING CLOUD COMPUTING FAILURES AND CHALLENGES

Similar to other IT projects some cloud computing projects fail, and organizations must be aware of that. According to International Working Group on Cloud Computing Resiliency (IWGCR) between 2007 to 2012 cloud computing has been responsible for a total of 568 hours of downtime at 13 well-known cloud services and an economic impact of more than $71.7 million dollars (Essers, 2012).

In recent years several major cloud computing services have failed. The list below highlights some of these failed services (Price, 2014, Vaughan-Nichols, 2012, Williams, 2012 & Froehlich, 2015):

Hosting.com (2010)
Twitter (2010)
Skype (2010)
Hotmail (2010)
Gmail (2011)
Intuit (2011)
Epsilon (2011)
Amazon's Web services (2011, 2012, 2015, and 2017)
Microsoft's Azure cloud (2012)
Dropbox (2015)
CloudFlare (2015)
Apple's iCloud (2015)
Office 365 (2015)
LastPass (2015)

Generally speaking the following are the five top reasons for cloud computing failures:

1. Inadequate managing and monitoring of applications
2. Inadequate understanding the link between new technology and legacy systems
3. Inadequate understanding of requirements upfront
4. Inadequate skills available for cloud deployment
5. Inadequate screening of the cloud vendors

Similar to other IT projects, there is no way to completely eliminate cloud computing failures. However, a careful examination of the above five factors and responding to each requirement would certainly reduce the chances of failures. Also, the organizations should accept some degree of failure and they should be prepared to deal with it. Deployment of a mix of private, public, hybrid, and community cloud should also be helpful.

LEARNING OUTCOMES #8 UNDERSTANDING THE ROI OF CLOUD COMPUTING

According to the article "Microsoft Economics of the Cloud" published in November 2010, a company can improve TCO (total cost of ownership) by up to 80% by using applications in public cloud versus on-premise deployment (Microsoft,2010).

Most studies and experts believe that the ROI of cloud computing is positive, and it is justified in the majority of cases (Skilton, 10, Su, 2011 & Hewlett Packard Enterprise, 2012). To calculate the ROI of a cloud computing deployment, in many cases the Amazon capacity and utilization metrics are used (Skilton, 2010).

The ROI calculation of private versus public cloud would be different. In a private cloud environment traditional capital budgeting technique could be applied. To do this all the costs and benefits (tangible and intangible) are identified and quantified and then the ROI is calculated. As mentioned earlier in the paper when an organization deploys a private cloud, all the hardware and software are purchased.

It becomes more challenging when public clouds are deployed. In such case the decision maker should consider business agility and scale that make cloud deployment different than traditional hardware and software acquisitions. To calculate ROI in public cloud environment different types of matrices should be employed. Below are the listings of eight such matrices (a-Linthicum, 2015).

1. The speed and rate of change -Cost reduction and cost of adoption /de-adoption is faster in the cloud compared to traditional deployment.
2. Total cost of ownership optimization-Organizations and customers are allowed and have the flexibility to choose and not to choose those applications that are best suited for business needs.
3. Rapid provisioning- Resources are scaled up and down to follow business activity and need as it expands and grows or is redirected. Deployment time can go from weeks to hours.
4. Increased margin and cost control - Organizations are able and have the flexibility to get involved in new customers and markets for business growth and service improvement.
5. Dynamic usage - Organizations are able to target key end users and concentrate on key business success factors.
6. Risk and compliance improvement - Cloud computing green capabilities and substitutability principle can be leveraged through shared services.
7. Enhanced capacity utilization - Cloud deployment will enable organizations to avoid over- and under- utilization of IT services in order to improve and offer key business services.
8. Access to business skills and capability improvement - Cloud deployment enable organizations to access new skills and solutions regardless of the geography.

Which metric should be chosen depends on the application and a particular company that is deploying the cloud.

LEARNING OUTCOMES #9: PREPARING A CLOUD COMPUTING PLAN FOR IMPLEMENTATION

An organization's employees are an essential part of the success of any cloud computing initiatives, so training and education on strengths and weaknesses of this platform and security awareness and security measures are important. End users lack knowledge and awareness of cloud computing policies and procedures is a key issue and it must be addressed (Samson, 2012).

Some organizations use a classroom setting for training, and others conduct it over the organization's intranet. Tests and certificates should be given to participants at the end of training sessions. In addition, making sure management supports the training program is important to help promote the adoption of this new technology throughout the organization. The following steps should be considered when developing a cloud computing implementation plan (Bidgoli, 2008):

1. Set up a cloud computing committee with representatives from all departments as well as upper management. The committee's responsibilities include the following:
   - Developing a clear, detailed cloud computing acquisition and use plan
   - Providing cloud computing awareness for key decision makers and users
   - Conducting a basic cost/benefit analysis and calculating an ROI for the cloud computing acquisition
   - Overseeing enforcement of the cloud computing policy
2. Force software updates and work with the cloud computing provider in order to spot unusual activities.
3. Define the organization's needs. A clear definition of needs will assist the organization to decide on the following:
   - Does the organization need SaaS?
   - Does the organization need utility (on-demand) computing?
   - Does the organization need a full featured cloud platform?
   - Does the organization need a public, private, hybrid or community cloud?
4. Examine the providers of cloud platforms (see TABLE 2) and match their offerings against your needs, not all vendors are equal. Choose the provider (s) whose offerings are the closest to your needs.
5. Examine the providers of cloud platforms for their past failures and successes and review how they have responded to the failures. How is your organization supported during the down time?
6. Post the security policy in a visible place, or post copies next to all workstations.
7. Raise employees' awareness of security problems in a cloud environment.
8. Revoke terminated employees' passwords and ID badges immediately to prevent attempts at retaliation.
9. Exit programs and systems promptly and never leave logged-on workstations unattended.
10. Limit computer access to authorized personnel only.
11. Examine security threats outlined in Table 3 and offer a countermeasure outlined in Table 4.
12. Examine wireless security threats and implement measures outlined in the paper.
13. Examine the top five reasons for cloud computing failures outlined under LEARNING OUTCOMES #7 and respond to its requirements before cloud computing deployment.

CONCLUSION

This paper introduced nine learning outcomes for introducing cloud computing into your organization. The nine learning outcomes include: (1) understanding grid computing, (2) understanding application service providers, (3) understanding utility (on-demand) computing, (4) understanding the components of a cloud platform, (5) understanding public, private, hybrid, and community clouds, (6) understanding the security issues in cloud computing, (7) understanding cloud computing failures and

challenges, (8) understanding the ROI of cloud computing, and (9) preparing a cloud computing plan for implementation. If these learning outcomes are carefully analyzed and followed, they should increase the chances of success for the introduction and utilization of this fast-growing technology.

REFERENCES

Babcock, C. (2017, January 19). *Private Cloud In Retreat, Public Cloud To Fore: Report*. Accessed 08 December 2017. http://www.informationweek.com/cloud/infrastructure-as-a-service/private-cloud-in-retreat-public-cloud-to-fore-report/d/d-id/1327926.

Babcock, C. (2012). *4 Companies Getting Real Results From Cloud Computing*. InformationWeek. January 14, 2011. Accessed 08 December 2017. https://www.informationweek.com/4-companies-getting-real-results-from-cloud-computing/d/d-id/1095455.

Bidgoli, H. (2018). *Management Information Systems*, Eight Edition. Cengage Learning, Mason, OH.

Bidgoli, H. (2016). Integrating Real Life Cases Into A Security System: Seven Checklists For Managers. *American Journal of Management*, 16(4), 9-25.

Bidgoli, H. (2008). *Global Perspectives in Information Security: Legal, Social, and International Issues*. John Wiley & Sons, Inc., Hoboken, NJ

Brodkin, J. (2010, July 15). *Amazon and IBM are the cloud's biggest players*. Accessed 08 December 2017. http://www.infoworld.com/d/cloud-computing/amazon-and-ibm-are-the-clouds-biggest-players-484?page=0,0&source=IFWNLE_nlt_wrapup_2010-07-16.

Brodkin, J. (2009, May 18). *10 cloud computing companies to watch*. Accessed 08 December 2017. https://www.networkworld.com/article/2268033/virtualization/virtualization-10-cloud-computing-companies-to-watch.html?page=5.

Brodkin, J. (2008, July 2). *Gartner: Seven cloud-computing security risks*. Accessed 08 December 2017. http://www.infoworld.com/d/security-central/gartner-seven-cloud-computing-security-risks-853?page=0,0,.

Bruzzese, J.P. (2015, October 21). *A move to the cloud is no simple calculation*. Accessed 08 December 2017. http://www.infoworld.com/article/2995519/cloud-computing/moving-to-the-cloud-is-no-simple-calcula-tion.html?phint=newt%3Dinfoworld_daily&phint=idg_eid%3Da74f01173c5d192b6e17e3ba45b5c85f#tk.IFWNLE_nlt_daily_am_2015-10-21&siteid=&phint=tpcs%3D&phint=idg_eid%3Da74f01173c5d192b6e17e3ba45b5c85f.

Butler, B. (2016, October 19). *Which is cheaper: Public or private clouds?* Accessed 08 December 2017. http://www.networkworld.com/article/3131942/cloud-computing/which-is-cheaper-public-or-private-clouds.html.

Dignan, L. (2011, April 22). *Cloud computing market: $241 billion in 2020.* Accessed 08 December 2017. http://www.zdnet.com/article/cloud-computing-market-241-billion-in-2020/.

Dignan, L. (2008, April 14). *Amazon's cloud computing will surpass its retailing business*. Accessed 08 December 2017. http://www.zdnet.com/blog/btl/amazons-cloud-computing-will-surpass-its-retailing-business/8471.

Essers, L. (2012, June 19). *Cloud failures cost $70M-plus since 2007, researchers say*. Accessed 08 December 2017. http://www.computerworld.com/s/article/9228227/Cloud_failures_cost_70M_plus_since_2007_researchers_say?taxonomyId=158.

Froehlich, A. (2017, March 24). *No Cloud is Perfect, So Be Prepared*. Accessed 08 December 2017. http://www.informationweek.com/cloud/no-cloud-is-perfect-so-be-prepared/d/d-id/1328482.

Froehlich, A. (2015, July 15). *9 Spectacular Cloud Computing Fails*. Accessed 08 December 2017. http://www.informationweek.com/cloud/9-spectacular-cloud-computing-fails/d/d-id/1321305?image_number=1.

Gaudin, S. (2016, December 1). *American Heart Association looks for cure in the cloud*. Accessed 08 December 2017. http://www.computerworld.com/article/3146566/cloud-computing/american-heart-association-looks-for-cure-in-the-cloud.html.

Gaudin, S. (2014, August 21). *Small businesses seek to take off with the cloud*. Accessed 08 December 2017. http://www.computerworld.com/article/2598503/cloud-computing/small-businesses-seek-to-take-off-with-the-cloud.html.

Geelan, J. (2008, November 3). *Six Benefits of Cloud Computing*. Accessed 08 December 2017. http://web2.sys-con.com/node/640237.

Hewlett Packard Enterprise. (2012, September 18). *The Business Value of Cloud – ROI and Agility*. Hewlett-Packard Development Company. Accessed 09 December 2017. http://h30507.www3.hp.com/t5/Cloud-Source-Blog/The-Business-Value-of-Cloud-ROI-and-Agility/ba-p/121613#.U0LiezNOXb0.

IHG. (2017). *About InterContinental Hotels Group*. Accessed 08 December 2017. https://www.ihg.com/content/us/en/about.

Jackson, J. (2011, January 31). *IBM to offer cloud office suite*. Accessed 08 December 2017. http://www.computerworld.com/s/article/9207238/IBM_to_offer_cloud_office_suite.

Johnson, E. (2017, January 30). *Infographic: 2017 State of the Cloud*. Accessed 08 December 2017. http://www.informationweek.com/cloud/infographic-2017-state-of-the-cloud-/d/d-id/1327974.

Knorr, E. (2015, December 14). *2015 was a banner year for the cloud*. Accessed 08 December 2017. http://www.infoworld.com/article/3014613/cloud-computing/2015-was-a-banner-year-for-the-cloud.html.

Knorr, E. (2014, March 31). *What the latest cloud explosion really means*. Accessed 08 December 2017. http://www.infoworld.com/t/cloud-computing/what-the-latest-cloud-explosion-really-means-239460?source=IFWNLE_nlt_daily_am_2014-04-05.

Krill, P. (2010, November 3). *VMware exec: Cloud computing is a certainty*. Accessed 08 December 2017. http://www.infoworld.com/d/cloud-computing/vmware-exec-cloud-computing-certainty-166?source=IFWNLE_nlt_cloud_2010-11-08.

Raphael, J.R (2011, June 27). *The 10 worst cloud outages (and what we can learn from them)*. Accessed 08 December 2017. https://www.infoworld.com/article/2622201/cloud-computing/the-10-worst-cloud-outages--and-what-we-can-learn-from-them-.html.

Linthicum, D. (2016, December 13). *How to handle the politics of cloud resistance*. Accessed 09 December 2017. http://www.infoworld.com/article/3149521/cloud-computing/how-to-handle-the-politics-of-cloud-resistance.html.

a-Linthicum, D. (2015, December 1). *The public cloud is more secure than your data center*. Accessed 09 December 2017. http://www.infoworld.com/article/3010006/data-security/sorry-it-the-public-cloud-is-more-secure-than-your-data-center.html?phint=newt%3Dinfoworld_network&phint=idg_eid%3D91294756a0e437074af2b88ac7d3cb7c#tk.IFWNLE_nlt_networking_2015-12-01&siteid=&phint=tpcs%3D&phint=idg_eid%3D91294756a0e437074af2b88ac7d3cb7c.

b-Linthicum, D. (2015, September 18). *3 dumb mistakes that will kill your cloud initiative*. Accessed 09 December 2017. http://www.infoworld.com/article/2984427/cloud-computing/3-dumb-mistakes-that-will-kill-your-cloud-initiative.html?phint=newt%3Dinfoworld_daily&phint=idg_eid%3Da74f01173c5d192b6e17e3ba45b5c85f#tk.IFWNLE_nlt_daily_am_2015-09-18&siteid=&phint=tpcs%3D&phint=idg_eid%3Da74f01173c5d192b6e17e3ba45b5c85f.

c-Linthicum, D. (2015, July 10). *The era of ever-cheaper cloud services is over*. Accessed 09 December 2017. http://www.infoworld.com/article/2946019/cloud-computing/the-era-of-ever-cheaper-cloud-services-is-over.html?phint=newt%3Dinfoworld_daily&phint=idg_eid%3Da74f01173c5d192b6e17e3ba45b5c85f#tk.IFWNLE_nlt_daily_am_2015-07-10&siteid=&phint=tpcs%3D&phint=idg_eid%3Da74f01173c5d192b6e17e3ba45b5c85f.

d-Linthicum, D. (2015, June 9). *3 key facts to help sell the cloud in your company*. Accessed 09 December 2017. http://www.infoworld.com/article/2932772/cloud-computing/3-key-facts-to-help-sell-the-cloud-in-your-company.html?phint=newt%3Dinfoworld_daily&phint=idg_eid%3Da74f01173c5d192b6e17e3ba45b5c85f#tk.IFWNLE_nlt_daily_am_2015-06-09&siteid=&phint=tpcs%3D&phint=idg_eid%3Da74f01173c5d192b6e17e3ba45b5c85f.

Linthicum, D. (2012, August 14). *Wake up, IT: Even CFOs see value in the cloud*. Accessed 09 December 2017. http://www.infoworld.com/d/cloud-computing/wake-it-even-cfos-see-value-in-the-cloud-199929?source=IFWNLE_nlt_daily_2012-08-14.

a-Linthicum, D. (2012, March 16). *Gartner: Forget PCs, the 'personal cloud' will rule in 2 years*. Accessed 09 December 2017. http://www.infoworld.com/d/cloud-computing/gartner-forget-pcs-the-personal-cloud-will-rule-in-2-years-188760?source=IFWNLE_nlt_blogs_2012-03-16, Accessed July 29, 2017.

Linthicum, D. (2011, January 11). *Cloud infrastructure: Soon there'll be just one that counts*. Accessed 08 December 2017. http://www.infoworld.com/d/cloud-computing/cloud-infrastructure-soon-therell-be-just-one-counts-052?source=IFWNLE_nlt_daily_2011-01-11.

a-Linthicum, D. (2010, July 27). *Will cloud computing save the economy?* Accessed 08 December 2017. http://www.infoworld.com/d/cloud-computing/will-cloud-computing-save-the-economy-794?source=IFWNLE_nlt_blogs_2010-07-27.

b-Linthicum, D. (2010, July 1). *The cloud job market: A golden opportunity for IT pros*. Accessed 08 December 2017. http://www.infoworld.com/d/cloud-computing/the-cloud-job-market-golden-opportunity-it-pros-817?source=IFWNLE_nlt_blogs_2010-07-01.

c-Linthicum, D. (2010, May 14). *Military could run more effectively using cloud technologies*. Accessed 08 December 2017. http://www.infoworld.com/d/cloud-computing/how-and-why-the-military-should-adopt-the-cloud-484?source=IFWNLE_nlt_daily_2010-05-14.

d-Linthicum, D. (2010, May 4). *Users are the largest cloud computing security threat*. Accessed 08 December 2017. http://www.infoworld.com/d/cloud-computing/users-are-the-largest-cloud-computing-security-threat-489?source=IFWNLE_nlt_daily_2010-05-04.

Mcfedries, P. (2008, August). *The Cloud Is The Computer*. Accessed 09 December 2017. http://spectrum.ieee.org/computing/hardware/the-cloud-is-the-computer.

Microsoft. (2010, November). THE ECONOMICS OF THE CLOUD. Accessed 09 December 2017. http://www.microsoft.com/en-us/news/presskits/cloud/docs/the-economics-of-the-cloud.pdf.

Miller, C. C. (2011, April 21). Amazon Cloud Failure Takes Down Web Sites. *The New York Times*. Accessed 09 December 2017. http://bits.blogs.nytimes.com/2011/04/21/amazon-cloud-failure-takes-down-web-sites/.

Ng, K. (2010, July 19). *Cloud helps universities cut costs by 74%*. Accessed 09 December 2017. http://www.futuregov.asia/articles/2010/jul/19/cloud-helps-universities-cut-costs-74-cent/.

Nicola, A. (2017, May 1). *Software-as-a-Service is Eating Your Business*. Accessed 08 December 2017. http://www.informationweek.com/software-as-a-service-is-eating-your-business-/a/d-id/1328769?

Oliver, A. C. (2017, March 2). *AWS outage proves one cloud isn't enough*. Accessed 09 December 2017. http://www.infoworld.com/article/3176098/cloud-computing/aws-outage-proves-one-cloud-isnt-enough.html.

Price, D. (2014, May 20). *Five High Profile Cloud-Based Failures*. Accessed 08 December 2017. https://cloudtweaks.com/2014/05/five-high-profile-cloud-based-failures/.

Prigge, M. (2012, March 05), Learning from the cloud's failings. Accessed 09 December 2017. http://www.infoworld.com/d/data-explosion/learning-the-clouds-failings-187869?source=IFWNLE_nlt_blogs_2012-03-05.

Ribeiro, J. (2015, August 5). *GE launches cloud for the industrial Internet*. Accessed 09 December 2017. http://www.infoworld.com/article/2957192/internet-of-things/ge-launches-cloud-for-the-industrial-internet.html?phint=newt%3Dinfoworld_cloud_computing&phint=idg_eid%3Da74f01173c5d192b6e

17e3ba45b5c85f#tk.IFWNLE_nlt_cloud_2015-08-06&siteid=&phint=tpcs%3D&phint=idg_eid%3Da74f01173c5d192b6e17e3ba45b5c85f.
Samson, T. (2012, November 08). *End-users admit ignorance of corporate cloud policies*. Accessed 09 December 2017. http://www.infoworld.com/t/cloud-security/end-users-admit-ignorance-of-corporate-cloud-policies-206692?source=IFWNLE_nlt_daily_2012-11-08.
Samson, T. (2010, December 8). *Feds take cloud-first approach to IT*. Accessed 09 December 2017. InfoWorld, http://www.infoworld.com/t/cloud-computing/feds-take-cloud-first-approach-it-829?source=IFWNLE_nlt_blogs_2010-12-08.
Skilton, M. (2010, May 26). *8 Ways to Measure Cloud ROI*. Accessed 09 December 2017. http://www.cio.com/article/595179/8_Ways_to_Measure_Cloud_ROI.
Snyder, B. (2014, February 25). *IBM says bye-bye to hardware and hello to the cloud*. Accessed 09 December 2017. http://www.infoworld.com/d/the-industry-standard/ibm-says-bye-bye-hardware-and-hello-the-cloud-237043?source=IFWNLE_nlt_daily_pm_2014-02-25.
Su (2011, April 13). *ROI: Justifying the Cloud. The Armada Group*. Accessed 09 December 2017. http://www.thearmadagroup.com/business-technology/roi-justifying-the-cloud.
a-Thibodeau, P. (2011, March 1). *Cross-ocean clouds gain despite millisecond delays*. Accessed 09 December 2017. http://www.computerworld.com/s/article/9211778/Cross_ocean_clouds_gain_despite_millisecond_delays.
b-Thibodeau, P. (2011, February 16). *Obama banks on cloud, consolidation, to hold down IT costs*. Accessed 09 December 2017. http://www.computerworld.com/s/article/9209862/Obama_banks_on_cloud_consolidation_to_hold_down_IT_costs.
c-Thibodeau, P. (2011, February 7). *China building a city for cloud computing*. Computerworld. Accessed 09 December 2017. http://www.computerworld.com/s/article/9208398/China_building_a_city_for_cloud_computing.
Vaughan-Nichols, S. J. (2012, March 2). *Microsoft's Azure cloud leap-day meltdown*. Accessed 09 December 2017. http://www.zdnet.com/blog/open-source/microsofts-azure-cloud-leap-day-meltdown/10482.
Velagapudi, M. (2012, April 11). *5 Top Reasons Why Cloud Computing Projects Fail*. Accessed 09 December 2017. http://blog.bootstraptoday.com/2012/04/11/5-top-reasons-why-cloud-computing-projects-fail/.
Wayner, P. (2016, February 8). *13 ways the cloud has changed (since last you looked)*. Accessed 09 December 2017. http://www.infoworld.com/article/3030138/cloud-computing/13-ways-the-cloud-has-changed-since-last-you-looked.html.
Williams, A. (2012, October 27). *Amazon Web Services Outage Caused By Memory Leak And Failure In Monitoring Alarm*. Accessed 09 December 2017. http://techcrunch.com/2012/10/27/amazon-web-services-outage-caused-by-memory-leak-and-failure-in-monitoring-alarm/.
Yegulalp, S. (2015, December 4). *How sound is your cloud? Good luck measuring it*. Accessed 09 December 2017. http://www.infoworld.com/article/3012026/cloud-computing/how-sound-is-your-cloud-good-luck-measuring-it.html?phint=newt%3Dinfoworld_cloud_computing&phint=idg_eid%3Da74f01173c5d192b6e17e3ba45b5c85f#tk.IFWNLE_nlt_cloud_2015-12-07&siteid=&phint=tp.