Systems Engineering at MITRE

CLOUD COMPUTING SERIES

Cost and Business Case Considerations

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Executive Summary

A business case for cloud computing is essential in order to derive value from a cloud-based IT investment. Each organization will likely have different goals and circumstances that make their analysis unique. The value they derive from cloud benefits such as increased utilization of hardware, location independent access, continuity of operations (COOP) or changed cost structures will be different.

Cloud computing options—There are multiple categories of cloud computing approaches that provide distinct trade-offs for a business case analysis. With a typical **private cloud**, the owning organization invests the capital and incurs development and operational costs. With this model, they are able to maximize control of their environment while realizing some of the benefits of cloud computing. With **community cloud** and **public cloud** models, the consuming organization can leverage another organization's capital investment, while the providing organization shares their costs over a greater pool of users. **Hybrid** is any combination of the previous three models.

Cloud Provider—In order to establish a business case for being a cloud provider, whether private or community, cloud-specific benefits and costs need to be estimated and analyzed. From a financial perspective, cloud ownership is similar to traditional data centers. The owning organization invests their resources into their own hardware and software and operates and controls their own infrastructure. Through more efficient use of physical servers, reductions in capital expense and ongoing operating costs, savings can be realized. Although, there is significant opportunity for savings, other factors should be considered. The value of new capabilities and costs for delivering the capabilities should

be included. Additionally, costs for meeting rigorous requirements for COOP, location independent access for users, security and "up time" should be incorporated.

The business case for establishing a community cloud requires additional analysis beyond the baseline needed for a private cloud. A community cloud business case should include a robust, in-depth analysis of the demand for services, funding opportunities, and costs. The costs for a community cloud include larger capacity infrastructure, increased operations support for users, and staff to manage business agreements (e.g., service level agreements and memorandums of understanding).

Cloud Consumer—When using public and community clouds, the acquiring government organization incurs a "pay for use" fee for leveraging the cloud provider's capability. The cloud provider can generally offer lower costs due to the economies of scale they realize across their large customer base. For additional cost savings, they can establish data centers where labor and electricity are comparatively low and build homogeneous infrastructure for reduced support costs.

Public and community cloud offerings can provide value to consuming organizations in many ways beyond cost savings. By leveraging the cloud provider's offering, the consuming organization no longer needs to procure and maintain the same level of infrastructure and can focus on solving business and operational challenges. The cloud provider may have a large suite of capabilities that can be easily accessed with minimal development and integration costs. Additionally, cloud vendors may employ sophisticated technologies for COOP to maintain their SLAs.

When leveraging a public or community cloud service, the acquiring government organization no longer needs to invest significant capital for building their own data center capability, which can include buildings, storage, servers, and heating, ventilation and air conditioning (HVAC) systems. Associated expenses such as electricity, maintenance contracts, software license costs and support personnel for data center infrastructure are reduced. These cost reductions driven by using public and community clouds need to be compared against the cost areas that will increase. In addition to monthly usage costs, there are increased acquisition costs (e.g., for the contract and systems engineering) and on-going costs to manage the relationship with the vendor. There can also be porting, integration, data migration, testing, security analysis and certification and accreditation (C&A) costs that impact the business case. High levels of security requirements can be a significant driver of costs.

The choice between a community and public cloud depends on an organization's specific considerations. A public cloud can provide increased value by offering a low usage cost that will be compelling for many organizations. In comparison, a community cloud may have higher monthly usage costs than a public cloud, but still provide value. They can offer capabilities tailored to the community coupled with reduced adoption costs, such as acquisition, security analysis and C&A.

In addition to the above factors, there are many considerations relevant to organization-specific business cases, such as schedule demands, network dependency, security requirements, and risk analysis. Putting an organization's specific considerations into a business case framework is necessary for accurately assessing the value that can be derived from a cloud computing investment.

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Cost and Business Case Considerations

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1.0 Introduction

Cloud computing offers new capabilities and potential cost savings but an analysis of each organization's goals and circumstances is essential to deriving the maximum value from a cloud computing investment. Each organization will likely have different goals and circumstances that make their analysis unique. For example, some data centers will have exceptionally low utilization rates for their servers, while others will be using their servers near optimal capacity. The opportunity for server reduction through private cloud computing technologies is very different for these two cases. Similarly some organizations may reap more value from public and community offerings than others. IT leadership may be seeking to reduce costs, but they may also be looking to leverage new features, such as location independent user access, computing agility, continuity of operations (COOP), and burst capacity. "Positive return on investment (ROI) from cloud computing can't be achieved as a blanket business case," states Forrester Research's James Staten, "because the benefits of cloud computing vary based on the application and use case."[1] Therefore, an analysis is essential to deriving the maximum value from a cloud computing investment.

Cloud Computing Options—There are multiple categories of cloud computing approaches that provide distinct trade-offs for a business case analysis. The National Institute of Standards and Technology (NIST) defines four deployment models, Private, Community, Public and Hybrid, and three service models, Infrastructure-as-a-Service (IaaS), Platform-as-a-Service (PaaS), and Software-as-a-Service

> *"Agency CIOs and CTOs will need to look at new ways to innovate—using things like cloud services, consolidating data centers—so they can take budget dollars and start innovating with new capabilities and technologies that will get them to the next level."*
>
> *– Teresa Carlson, Microsoft VP, Government Computer News, January 12, 2009*

(SaaS).[2] These models can be described based on their implications for a business case:

Deployment Models—
- With a typical **private cloud**, the owning organization invests the capital and incurs development and operational costs. They are able to maximize control of their environment while realizing some of the benefits of cloud computing.
- In a **community cloud** model, the consuming organization can leverage another organization's capital investment, while the providing organization shares costs over a greater pool of users. Community clouds may not have the same economies of scale and cost advantages as large-scale commercial cloud offerings, but they may be able to provide significant value through their targeted offerings and ease of adoption.
- In a **public cloud** model, the consuming organization can leverage the public cloud provider's capital investment and pay an on-going expense for usage. Given a very large customer base and a low cost structure, a public provider may be able to pass along significant cost savings to the user.

- The **hybrid cloud** model is a combination of the above models.

Service Models—

- A typical **IaaS** offering consists of a virtual server environment that can host a government organization's applications. Existing legacy applications can frequently be re-used in IaaS environments. Defense Information Systems Agency's Rapid Access Computing Environment is an example of a community IaaS offering to support Government development, testing and production environments.
- A **PaaS** offering is similar to IaaS, but can provide more comprehensive capabilities through proprietary application programming interfaces (APIs), distributed computation environments, and software development tools. APIs and platform specific features may significantly speed new development, but given the lack of current industry cloud standards the newly developed capabilities will not likely be portable to different providers.

Force.com is an example of a public PaaS offering to support a variety of business needs such as customer relationship management and human resource functions such as recruiting.

- **SaaS** offerings are complete applications that may be accessed by users via a wide area network. These offerings may be readily available with minimal development investment from Government. Google Apps for Business is an example of a public SaaS offering to support office applications such as email, document production and calendaring.

Structured Cloud Decision Process—As shown in Figure 1-0. below, the business case for cloud computing falls within a structured engineering approach. The figure, described in detail in A Decision Process for Applying Cloud Computing in Federal Environments by Geoffrey Raines and Lawrence Pizette, shows the steps for determining a cloud computing approach. This paper focuses on box 2.2 Business Case, shown in yellow on Figure 1-0.
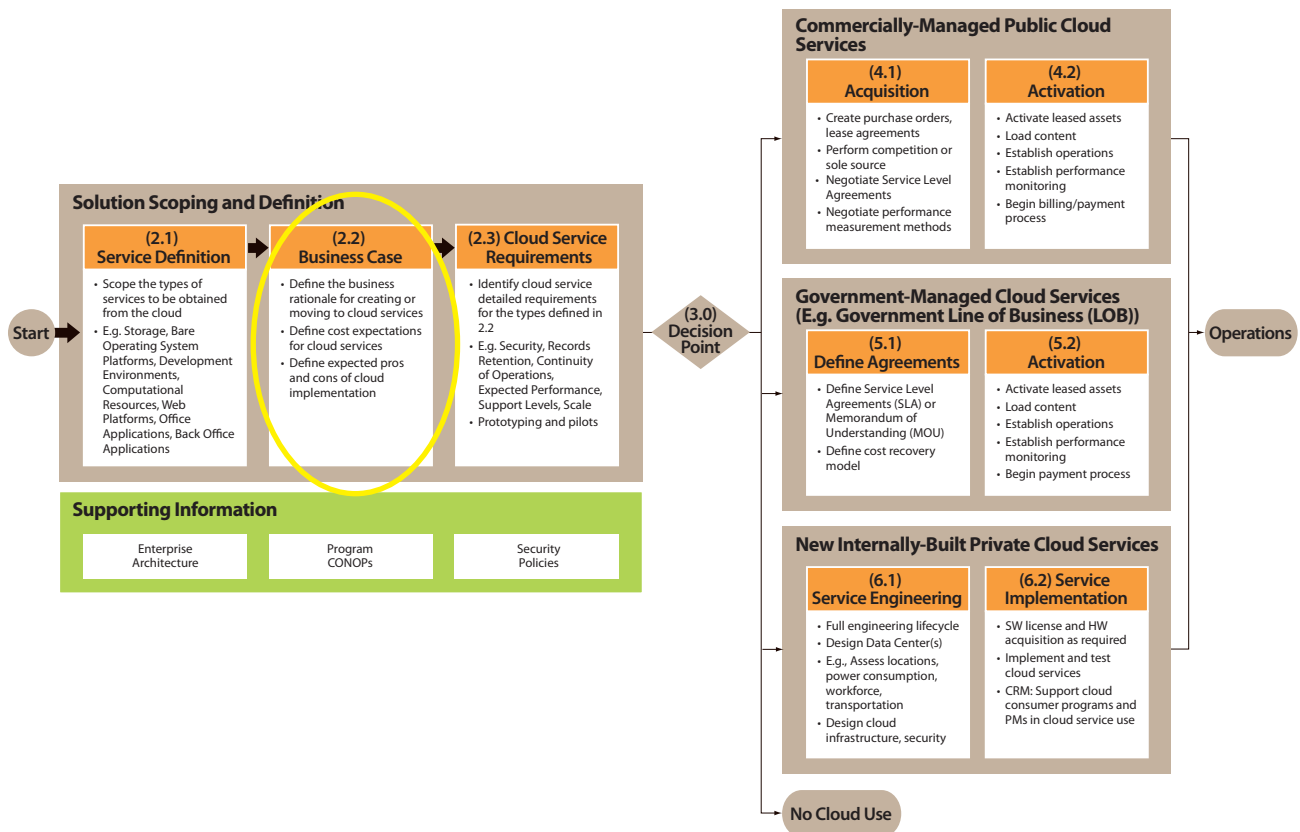

Figure 1-0. Structured Decision Process for Cloud Technologies

Within this structured decision process, the analysis should focus on the organization's business needs and objectives, clarifying the expected benefits of the effort, and ensuring that a cloud offering is an appropriate alternative. Federal IT leaders considering a cloud computing approach need to ensure that their investment delivers value commensurate with the size of the investment, risks, and investment characteristics (e.g., capital investment versus operating expense, fixed versus variable costs).

2.0 Business Case for Being a Cloud Provider

Benefits of private and community clouds include agility in provisioning environments, COOP, location independent user access, and the ability to standardize environments. These benefits can be coupled with increased utilization of infrastructure resulting in lower capital and operating costs.

In order to realize these benefits, the owning organization invests in hardware and software and operates and controls their own infrastructure. Private and community cloud ownership includes both an initial capital investment and ongoing operating expense. The provider invests in data centers and IT assets that include servers, networking equipment, HVAC, power systems, and other infrastructure. The providing organization's technical staff and binding support agreements ensure the proper operation of the physical infrastructure. A combination of commercial-off-the-shelf software (COTS), Government-off-the-shelf software (GOTS), open source software (OSS) and custom applications runs on this infrastructure. In order to reliably deliver application functionality to users, the technology stack needs to be integrated, tested, maintained (for software bug fixes and upgrades) and monitored. This activity has a financial tail of support costs that includes licensing, maintenance agreements, support staff, and electricity for servers and heating, ventilation and air conditioning systems (HVAC).

> *"A private cloud lets you capitalize on your existing investments while driving up utilization rates, increasing productivity and making IT more dynamic."*
>
> *– Network World Tech Debate summary of Dave Malcom position, 2010. Dave Malcom is CTO of Surgient (purchased by Quest Software)*

2.1 Private Cloud

The business case analysis for employing a private cloud will be unique for every organization, but there are considerations that are consistent across the Federal government. Significant considerations include:

Costs—Private clouds offer significant cost savings through reductions in hardware and associated expenses. By sharing infrastructure through a foundational layer of virtualization software, utilization of individual physical components can be increased, which decreases the total number of processors needed, reducing capital expense and ongoing operating costs. Savings accrue in the acquisition and maintenance of hardware and usage of electricity, building space, and HVAC. For example, the United States House of Representatives virtualized its data center to improve utilization from less than 7 percent to over 60 percent. The result, according to Jack Nichols, manager of the Enterprise Technology Branch for the House's Office of the Chief Administrative Officer (CAO) was a reduction in energy consumption of up to 75 percent.[3] In quoting Environmental Protection Agency (EPA) figures, Forrester Research's Doug Washburn notes "30 percent of server energy consumption is wasted by 'dead' servers—that is, servers consuming energy but with utilization rates at 3 percent or below. And when you add the energy costs from power distribution and cooling—typically one to three times the energy draw of the server itself—it's likely that the costs to power and cool a server over its life will exceed its purchase price."[4]

Another cost saving can come from reductions in administrative staff enabled by the standardization of environments. Alfred Rivera, director of computing services for the Defense Information Systems Agency notes, "The largest cost driver for us is probably labor. The more standardized your hardware and software solutions, the more efficient you can be with labor because fewer people can manage more environments."[5]

While many costs will decrease when comparing a private cloud to traditional data center IT, some costs will increase. For example, most private cloud infrastructures will include a layer of virtualization software that will need to be licensed and maintained. Virtualization features bring with them the need for upgraded security software, identity

management capabilities, and management software for provisioning and backups.

Acquisition Costs—Acquisition costs, such as program management, systems engineering, and contracting, can be assumed to be very similar to traditional data center acquisition activity.

Porting, Integration, and Testing—While many applications will seamlessly run in a virtualized environment, there will be integration and testing costs associated with moving applications to a virtualized environment. Depending on the types of legacy applications currently deployed, there may also be porting costs.

Data Migration—For a private cloud running in the same data center as the organization's existing capabilities, it is unlikely that there will be any data migration costs.

Cloud Features/Requirements—Private clouds enable new capabilities so each organization should assess the value of these capabilities to them and include this value in the business case analysis.

- **COOP:** The cloud provider should understand if their users require COOP across geographically separate data centers and, if so, ensure that they can provide this multi-site capability. Costs for providing this capability should be understood, as multiple data centers can affect economies of scale and add complexity to failover scenarios.
- **Location independent access for users:** The ability for a user to gain access to infrastructure and applications regardless of the user's location should be understood for its impact on costs, and for the service level dependencies on network capacity and latency that are introduced – factors that may not be fully under the cloud provider's control.
- **Scalability:** The ability to scale usage on-demand is a key feature that can require extra capacity.
- **Performance/throughput:** A cloud provider needs to understand their customers' needs for performance and throughput. These needs can not only affect the quantity and types of hardware and software purchased, but also significantly affect the type of networking capabilities that need to be provided.
- **Security:** Security impacts can be significant for a provider and a customer. Some customers may demand offerings at high classification levels on dedicated hardware and networks, which can

significantly impact the business case. Other users may have more flexibility in their security requirements which can allow for a more effective multi-tenant architecture with the associated economies of scale.
- **"Up time":** For a cloud provider, customers' needs for availability and stringent service level agreements (SLAs) can significantly impact the choices of hardware, software, and support. This can have an impact on provider costs. For example, disk storage systems may be used to distribute information to geographically disbursed data centers and significant networking capacity may be needed for maintaining throughput and response time during peak loads.

Fixed vs. Variable Costs—Increased server utilization can quickly reduce the need for electricity and HVAC, thereby reducing variable costs but reduction in fixed costs, such as data center buildings, will take longer to realize.

Timing of Decision—The financial analysis for private cloud technologies is impacted by the timing of the investment. For example, incorporating virtualization technologies into the systems engineering plans for a new data center can significantly reduce the number of servers that need to be purchased and the physical infrastructure of the data center. However, if there is a large building housing an existing data center, reducing the number of physical servers won't immediately reduce fixed costs for the building and associated infrastructure. Similarly, while there can be significant operating expenses that can be saved by shutting down physical servers, the current servers may already be owned and have limited resale value.

Financial Risks—The financial risks with a private cloud are similar in nature to a traditional data center. The owning organization makes the investment and has maximum control. They are making an investment in technology in advance of the need, so there's a financial risk in purchasing the correct capacity and technologies.

Recommendations—
- In combination with analyzing the above factors, the following recommendations can facilitate a private cloud business case analysis.
- Identify the reductions in physical servers and associated costs (e.g., electricity, HVAC, hardware maintenance). An analysis should be

conducted to determine the number of virtual servers that can run on each physical server and the applications that can be hosted in the virtual environments. This will form the basis of the anticipated costs savings.

- As shown in Figure 2-0., identify the new cost savings and increases. For example, identify the increase in costs for virtualization software and security products.
- Identify the value of new features (e.g., IT agility, location independent access for users, COOP)

Category	Increased Costs	Neutral	Decreased Costs
Software (e.g., Virtualization, security)	X		
Electricity, HVAC and building space			X
Data center labor			X*
Server hardware			X
Acquisitions and vendor management		X	
Porting, integration and testing	X		
Data migration		X	

* Over time, we anticipate that data center labor could be reduced.

Figure 2-0. Example Costs for Moving to a Private Cloud Compared with Traditional IT

2.2 Community Cloud

The business case for establishing a community cloud is similar to the business case for a private cloud at the basic level, but requires additional analysis to understand the impact of community usage. This deployment model can provide economic benefit by increasing economies of scale and provide opportunity for collaboration. The benefits and costs of building a community cloud will vary depending on the scope, size and needs of its users.

A community cloud business case should include a robust, in-depth analysis of the demand for services (similar to a commercial sales forecast), funding opportunities (similar to a commercial revenue forecast), and costs. For example, costs for a community cloud can be driven by increased infrastructure capacity and additional staff to manage operations, support, and business agreements (e.g.,

SLAs and MOUs). The need for infrastructure costs and support staff will increase based upon the usage, requirements (e.g., performance) and level of support required. From a business perspective, there may be significant time needed to understand the communities' needs and coordinate MOUs and SLAs.

3.0 Business Case for Using Cloud Computing Offerings

When using public and community clouds, the consuming government organization pays a fee commensurate with usage rather than making a large up front capital investment. The provider can offer favorable usage fees due to the economies of scale they realize across their large customer base and their ability to standardize platforms and reduce energy and labor costs.

Public and community cloud offerings can provide value to consuming organizations in many ways beyond cost savings. The cloud provider may have a large suite of capabilities—security services, development environments, application programming interfaces, and applications—that can be easily accessed with minimal development and integration costs. Additionally, cloud vendors may transparently provide scalability, COOP and location independent access for users that may enhance a consuming organization's mission assurance posture.

3.1 Public Cloud

A public cloud business case analysis is unique for each organization and depends on the particulars of the organization and cloud offering. Nevertheless, there are considerations that should be understood for each public cloud business case. These factors are listed below:

Costs—When leveraging a public or community cloud service, the acquiring government organization no longer needs to invest significant capital for building their own data center capability, which can include buildings, HVAC, storage, and servers. Capital investments are typically expended months or years before the benefit starts accruing to the users, so there is a "time value of money" component to the savings. (All else being equal, a cash payment today is more valuable than a future cash payment due to interest and opportunity costs.)

Associated expenses such as electricity, maintenance contracts, software license costs (e.g., operating system licenses, and for SaaS offerings, application licenses) and support personnel for data center infrastructure are also reduced.

Increased costs will include cloud provider fees and personnel to manage the relationship with the vendor. The monthly cloud fees depend on the contract signed with the vendor and are generally commensurate with usage in a monthly bill. In addition to the usage fees, additional resources will be needed to manage the relationship with the vendor. "There's a dirty underbelly to outsourcing that can't be denied," states Forrester Research's Paul Roehrig. "Some gain jobs, and others lose jobs."[6] While fewer people will be needed for administration of the data center infrastructure, some resources will need to be retained to work with the provider and to manage the applications.

Acquisition Costs—Acquisition costs, such as program management, contracting, and systems engineering, can vary substantially for cloud computing capabilities. For example, procuring a capability via Apps.gov will likely be relatively simple compared with negotiating a custom service level agreement and pricing with a vendor.

Porting, Integration and Testing—Moving applications to cloud environments may require porting and the use of proprietary application programming interfaces (APIs). For example, an application running on a legacy operating system may need to be ported. Similarly, some cloud providers do not support standard structured query language (SQL) for their database offerings. Applications that rely upon this standard would need to be ported.

Moving applications to the cloud will require funds for integration and testing, which could be substantial. "You need to test at many levels—including application development, deployment, database, and operational—before signing on the dotted line," states David Linthicum. "At the end of the day, the cost per hour is only part of the cloud computing cost equation you need to solve."[7] Other costs that can be anticipated include funding for security control reviews and supporting certification and accreditation C&A activities.

Data Migration—Data migration costs may be driven by the movement of vast amounts of data over a secure network and may require mapping

relational data to a non-relational database management system. Many cloud computing vendors charge a fee for uploads and downloads—uploading vast amounts of information could be costly. As an example, Amazon Elastic Compute Cloud (EC2) plans to charge $0.10 per GB after November 1, 2010.[8]

Cloud Features/Requirements—When acquiring new capabilities from a public cloud provider, system requirements can drive costs. Common requirements are:

- **COOP:** A significant advantage of a cloud offering can come from the provider's investment in COOP capabilities that are readily available to the consuming organization. The cost of obtaining this capability from the cloud should be compared against the cost of implementing COOP from other alternatives (such as a program specific investment.)
- **Location independent access for users:** The ability for geographically dispersed users to access cloud capabilities regardless of their location is an important requirement for many organizations.
- **Scalability:** The ability to scale quickly is a significant benefit of using a cloud provider with significant existing investments in infrastructure.
- **Performance/throughput:** A consumer of cloud services needs to be very aware of the limits of performance and throughput from a cloud offering. SLAs and network capabilities need to be understood in order for the business case to be viable.
- **Security/mission assurance:** The consumer organization needs to understand the security and mission assurance characteristics of the cloud and how that cloud offering would affect their business (i.e., what they would do if they lost access to a remote cloud). There is also a business aspect: program risks can be mitigated by choosing a cloud provider that has already been through a level of C&A with another Federal organization.
- **"Up time":** For a cloud consumer, SLAs that specify characteristics such as "uptime" reliability metrics should be considered as part of the business case.

Fixed vs Variable Costs—Traditional data center IT differs significantly from community and public clouds in the analysis of fixed versus variable costs.

Many private data center costs are fixed in nature (e.g., buildings, backup generators, server hardware) whereas most of the costs with "pay as you go" cloud platforms are variable in nature, commensurate with usage.

Timing of Decision—The financial implication of using a public or community cloud approach is impacted by the timing of the decision. For example, if a public cloud computing approach is adopted before a data center is built, it can reduce or potentially eliminate the need for the new construction-capital investment is markedly reduced. However, the government organization may already have an existing data center. In this case, incorporating public and community cloud offerings into IT plans won't immediately reduce fixed costs for the building, servers, and associated infrastructure.

Financial Risks—With public cloud computing, the financial risk is that there can be greater costs than anticipated with acquiring and certifying the service or integrating the capability. C&A may be less risky with a community offering, an offering that is targeted toward Federal customers, or one that has been previously certified and accredited by another Federal organization. The longer term financial risk is that service costs may increase and portability options may be limited.

Recommendations—
In combination with analyzing the above factors, the following recommendations can facilitate a business case analysis:

- As shown in the example cost categories in Figure 3-0., identify incremental costs and savings
  - Identify the reductions in physical servers and associated cost savings (e.g., electricity, HVAC, hardware maintenance)
  - Estimate reduced costs for administrators to maintain servers
  - Estimate increased network costs for additional bandwidth.
  - Estimate increased costs to maintain vendor relationship
  - Examine cost savings from avoiding technology refresh cycles

- Be aware of the timing of cash flows (e.g., capital investments in advance of actual usage)
- Identify full costs of acquiring new cloud capabilities (e.g., acquisition costs/negotiating SLAs, integration and testing)
- Consider the time and cost of C&A. New collaborations, such as FedRAMP, may enable Federal organizations to leverage each others' security reviews.[9]
- Identify the value of new features that may be included with the offering.

Category	Increased Costs	Neutral	Decreased Costs
Software licenses			X
Electricity, HVAC and building space			X
Data center labor (may change from server administration to vendor and application administration)			X*
Server hardware			X
Acquisitions and vendor management	X		
Porting, integration and testing	X		
Data migration	X		

* Over time, we anticipate that data center labor could be reduced.

Figure 3-0. Example Costs for Moving to a Private Cloud Compared with Traditional IT

Assessing Risks—The consumer business case needs to effectively weigh the benefits of cost reduction, scalability, COOP, and other benefits, against the additional exposures or risks. When a Federal organization adopts a cloud approach, they are trusting another organization to provide capabilities when they most need it. The consuming organization may also be opening up a new network attack vector and exposing themselves to other risks (e.g., performance). In a positive business case, the benefits of cost reduction would be coupled with an acceptable mission assurance posture that would make cloud computing a viable and appropriate choice.

3.2 Community Cloud

While Government community clouds may not have usage fees as low as large public cloud providers, they may offer benefits that add significant value to the consuming organization. For example, community clouds may result in lower adoption costs (e.g., reduced acquisition costs) and have products tailored to the community's needs. They may also facilitate a faster path toward certification and accreditation. For example, DISA states "The Rapid Access Computing Environment (RACE) service provides a streamlined process for the provisioning and subsequent development, testing, certification and accreditation and deployment of applications to a DISA Defense Enterprise Computing Center (DECC)." [10] RACE environments are compliant with DISA Security Technical Implementation Guides (STIGs) and payment options include a Military Interdepartmental Purchase Request. This type of government-unique service may provide significant value to the consuming organization.

4.0 Case Studies

Case studies can be helpful for understanding the dynamics of a business case and potential cost savings. The following examples of migrations from existing systems to cloud computing environments indicate very positive outcomes, but there are many considerations that could affect a given organization's analysis. For instance, the Brooking Institution's Darrell West advises, "One factor is the scope and timing of the migration. It matters how extensive the migration is and whether the cloud deployment focuses on applications, service delivery, or platform storage. The bigger the migration, the higher the expected transition costs and the more labor costs involved." [11] Specific details such as the costs for migrating data, contracting with a vendor, porting applications, and passing C&A are essential for fully understanding a business case, but are not generally made available as public information. The following cases should be viewed for an increased understanding of the opportunities and not to set specific cost savings expectations.

Cloud Provider Examples—
- The **U.S. Air Force's 45th Space Wing** at Patrick Air Force Base estimates that they save $180,000 annually through their use of virtualization technologies. They found that even at peak load times, very few of their servers were running at more than "5 to 6 percent of load" according to Glenn Exline, manager of enterprise networks at Computer Sciences Raytheon, which supports the 45th Space Wing. [12] To improve utilization and lower hardware and energy costs, the Wing reduced 60 physical servers to four physical servers running a VMware virtualization solution. "Commanders estimate that they save $180,000 per year in computing costs," writes West. "This includes $104,000 in hardware costs, $30,000 in power to cool what used to be 60 file servers, $28,000 in maintenance costs, and $18,000 in other expenses." [13]
- Over a four year period, the **Department of Energy Los Alamos National Laboratory** has removed 100 physical servers and replaced them with 13 servers running hundreds of virtual machines, resulting in a cost savings of $1.4 million. [14] Recently they launched private cloud capabilities that allow employees to request and provision Windows, Linux or Sun virtual server environments through a self-service portal. They've implemented management and charge-back capabilities as well. "Chargeback is also important because users have an idea that virtual servers are free," comments Anil Karmel, solutions architect at Los Alamos' engineering division in an interview with Federal Computer Week.

Cloud Consumer Examples—
- The Recovery, Accountability and Transparency Board moved **Recovery.gov** to Amazon.com's Elastic Compute Cloud (EC2) for a projected savings of $334,000 in 2010 and $420,000 in 2011. [15] Recovery.gov is the official website for Recovery Act data and EC2 is a commercial, publicly available IaaS cloud offering. The change to EC2 was led by prime contractor Smartronix and, according to Recovery.gov, will give the Board the opportunity to re-direct more than $1 million in funds from hardware and software to oversight operations. [16] Additionally, there is additional value to the Board in the capabilities EC2 provides, including uptime and backup capabilities. [17]
- The General Services Administration (GSA) migrated **USA.gov** to Terremark's IaaS cloud platform for an annual estimated cost savings of $1.7 million, a 72 percent reduction in costs. [18]

Prior to using the cloud offering, the GSA paid $2.35 million annually for USA.gov, including $2 million for hardware and software and $350,000 for personnel. Additionally, by moving to a cloud offering, the GSA receives value from new capabilities. They have been able to reduce monthly downtime from 2 hours to near zero and improve their ability to quickly upgrade the site.

More case studies on Government cloud computing can be found in *The State of Public Sector Cloud Computing, Vivek Kundra, Federal Chief Information Officer*.[19]

5.0 Conclusion

When analyzing proposed projects, Federal IT leadership should evaluate the investment in terms of their unique circumstances and cloud computing's capabilities, costs, and risks.

"Through our examination of more than 30 use cases of enterprise cloud computing deployments and countless inquiries with Forrester clients, it has become clear that cloud ROI hinges on the specific use case."

— James Staten, Forrester Research, Justifying Your Cloud Investment: Test and Development, August 26, 2010

Key Characteristics—While there are many variations for an organization's specific business case, the distinction between being a provider or consumer provides an important context for understanding the trade-offs. The key business case points of comparison are:

Cloud provider (Private cloud/Community cloud):

- Invest organization's own capital.
- Incur fixed costs similar to traditional data center IT.
- Maintain ownership and maximum control of system capabilities.
- Realize benefits from reduced electricity costs, quick provisioning of applications, COOP.
- Incur some extra costs for software (e.g., virtualization).
- Exposure to financial risks similar to traditional data center IT.

Cloud consumer (Community cloud/Public cloud):

- Incur variable costs for usage; reduce investment fixed infrastructure.
- Reduce user control of system capabilities.
- Realize benefits from provider's economies of scale.
- Incur costs for acquisition, vendor management, integration, testing, data migration, application porting, and certification and accreditation.
- Exposure to financial risks dependent on business relationship and the potential technical difficulty in moving to a different cloud provider.

In addition to the above factors, there are many organization-specific considerations such as schedule demands, network dependency, security requirements, and risk analysis. These considerations, coupled with the above characteristics, need to be included to determine how to best derive value from investment dollars and realize Federal IT leadership's objectives.

References

[1] Stanten, J., August 26, 2010, "Justifying Your Cloud Investment: Test and Development,"
http://www.forrester.com/rb/Research/justifying_cloud_investment_test_and_development/q/id/57704/t/2.

[2] Mell, P. and Grance, T., October 7, 2009, "The NIST Definition of Cloud Computing," Version 15,
http://csrc.nist.gov/groups/SNS/cloud-computing/cloud-def-v15.doc

[3] Tynan, D., September 12, 2008, "The Incredible Shrinking Data Center," FEDTECH™,
http://fedtechmagazine.com/article.asp?item_id=463.

[4] Washburn, D., August 26, 2010, "Maximize Your Energy Savings from Server Virtualization with Three Process Improvements,"
http://www.forrester.com/rb/Research/maximize_energy_savings_from_server_virtualization_with/q/id/57363/t/2.

[5] Tynan, D., September 12, 2008, "The Incredible Shrinking Data Center," FEDTECH™,
http://fedtechmagazine.com/article.asp?item_id=463

[6] Roehrig, P., November 18, 2009, "Status, Challenges, and Near-Term Tactics for Cloud Services in Enterprise Outsourcing Deals,"
http://www.forrester.com/rb/Research/statuspercent2C_challengespercent2C_and_near-term_tactics_for_cloud/q/id/55781/t/2.

[7] Linthicum, D., August 25, 2009, "Calculating the Real Costs of Cloud Computing," InfoWorld,
http://www.infoworld.com/d/cloud-computing/calculating-real-costs-cloud-computing-685.

[8] Amazon Elastic Compute Cloud,
http://aws.amazon.com/ec2/pricing/.

[9] Baxi, P., July 22, 2010, "An Introduction to FedRAMP,"
http://info.apps.gov/content/introduction-fedramp.

[10] Defense Information Systems Agency, "Rapid Access Computing Environment,"
http://www.disa.mil/computing/cloud/race.html.

[11] West, D. M., April 7, 2010, "Saving Money Through Cloud Computing,"
http://www.brookings.edu/papers/2010/0407_cloud_computing_west.aspx.

[12] Yasin, R., April 1, 2010, "Virtualization Takes Wing at Patrick Air Force Base," Government Computer News,
http://gcn.com/Articles/2010/04/05/USAF-virtualization-Patrick-AFB.aspx?Page=1.

[13] West, D. M., April 7, 2010, "Saving Money Through Cloud Computing," page 9,
http://www.brookings.edu/~/media/Files/rc/papers/2010/0407_cloud_computing_west/0407_cloud_computing_west.pdf.

[14] Yasin, R., September 8, 2010, "Los Alamos Lab Launches Private Cloud," Federal Computer Week,
http://fcw.com/articles/2010/09/08/los-alamos-lab-private-cloud.aspx.

[15] Hoover, J. N., May 13, 2010, "Recovery.gov Moved To Amazon Cloud," InformationWeek Government,
http://www.informationweek.com/news/government/cloud-saas/showArticle.jhtml?articleID=224701861&subSection=News.

[16] Recovery and Accountability Transparency Board, May 13, 2010, "Recovery.gov Moves to Cloud Computing Infrastructure,"
http://www.recovery.gov/News/mediakit/Pages/PressRelease05132010.aspx

[17] Kundra, V., "Case Study: Recovery.gov Cloud Computing Migration," CIO.gov,
http://www.cio.gov/pages.cfm/page/State-of-Public-Sector-Cloud-Computing--Recovery-Accountability-and-transparency-board.

[18] Kundra, V., "Case Study: General Services Administration (Office of Citizen Services)–USA.gov," CIO.gov,
http://www.cio.gov/pages-nonnews.cfm/page/State-of-Public-Sector-Cloud-Computing-USAgov.

[19] Kundra, V., May 20, 2010, "CIO Council, State of Public Sector Cloud Computing,"
http://www.cio.gov/documents/StateOfCloudComputingReport-FINALv3_508.pdf.

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