Cost Element Structure for Cloud Migration Business Case Analysis

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INTRODUCTION:

What is Cloud Computing?

INTRODUCTION:

Agenda

- **Introduction on Cloud Migration**
  - What is Cloud Computing?
  - Why Is Cloud Computing So Important?
  - Benefits for Cloud Migration to Consumers
- **Cloud Migration Cost Element Structure (CES)**
  - Business Case Analysis (BCA)
  - Overview of Cost Element Structure (CES) vs Work-Breakdown Structure (WBS)
  - Overview of Major Cost Grouping Elements
    - 1.0 Investment
    - 2.0 Operations & Maintenance (O&M)
    - 3.0 Legacy System Disposition
    - 4.0 Legacy System Phase-Out
- **Major Cost Drivers**
- **Conclusion**

INTRODUCTION:

Abstract

- In 2011, the White House released its **"Cloud First" policy**.
- Agencies have since struggled to identify all of the costs associated with cloud migration, and recent audits have criticized agencies for not properly assessing cloud-related costs and benefits.
- We have developed a **cloud migration cost element structure (CES)**, which simplifies and standardizes cost data collection and estimating for any agency that wishes to effectively estimate cost for cloud migration projects.
- This structure provides a framework for **Business Case Analysis (BCA)** for a cloud migration project.
- We will present the structure and its applicability to business case and cost-benefit analyses.

INTRODUCTION:

What is Cloud Computing?

- **According to the National Institute of Standards and Technology (NIST) definition of cloud computing[1]:**

  *"**Cloud computing** is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction."*

- **This cloud model comprises five essential characteristics, three service models, and four deployment models. [1]**

Characteristics:	Service Models:	Deployment Models:
On-Demand Self-Service	Software-as-a-Service (SaaS)	Private Cloud
Broad Network Access	Platform-as-a-Service (PaaS)	Community Cloud
Resource Pooling	Infrastructure-as-a-Service (IaaS)	Public Cloud
Rapid Elasticity		Hybrid Cloud
Measured Service		

1 NIST Definition of Cloud Computing, September 2011: http://nvlpubs.nist.gov/nistpubs/Legacy/SP/nistspecialpublication800-145.pdf.

2 Graphic from Cloud News Daily: http://cloudnewsdaily.com/cloud-security/

INTRODUCTION:

What is Cloud Computing? (cont.)

CHARACTERISTICS:[1]

On-Demand Self-Service
Consumers (or end users) can choose "a la carte" what service they would like, as needed, and from one place, without having to interact directly with each service provider.

Broad Network Access
Information can be accessed over the network across many different platforms, such as via laptops, desktops, cell phones, tablets, etc.

Resource Pooling
By use of a "Multi-Tenant Model," the cloud service provider can serve multiple consumers in groups, even if they are in different locations and have different needs.

Rapid Elasticity
Services can be assigned and reassigned, even automatically at times, depending on need and demand.

Measured Service
Providers can measure, monitor and control services by such factors as bandwidth, storage, processing, usage, active accounts, etc.

- **A cloud computing model can provide consumers, whether civilian, government, etc., the ability to manage and store data, applications, platforms, infrastructures in a reliable, efficient, and rapid manner; while providing access to flexible, lower-cost IT resources.**

[1] NIST Definition of Cloud Computing, September 2011: http://nvlpubs.nist.gov/nistpubs/Legacy/SP/nistspecialpublication800-145.pdf.

INTRODUCTION:

What is Cloud Computing? (cont.)

When performing a Business Case Analysis for cloud migration, the consumer must determine the following to establish their cloud computing model:

SERVICE MODELS:[1]

Software-as-a-Service (SaaS)

Cloud Provider offers consumer software, which is accessible from web browser or program interface, but is not managed by consumer. Consumer has limited access to user-specific configuration settings, but does not manage cloud infrastructure (e.g. network, servers, operating systems, or storage).

Platform-as-a-Service (PaaS)

Consumer deploys proprietary or other acquired applications using programming languages, libraries, services, and tools supported by the provider. Consumer maintains control of the deployed application, but does not manage cloud infrastructure (e.g. network, servers, operating systems, or storage).

Infrastructure-as-a-Service (IaaS)

Consumer can access processing, storage, networks, and other fundamental computing resources, and they can deploy and run arbitrary software, which can include operating systems and applications. The consumer can control operating systems, storage, and deployed applications; and may have some limited control of select networking components (e.g., host firewalls), but does not manage or control the underlying cloud infrastructure.

DEPLOYMENT MODELS:[1]

Private Cloud

Exclusive cloud service is provided to consumer for one organization with multiple business units. It may be owned and operated by the consumer or third party, either on-site or off-site.

Community Cloud

Exclusive cloud service is provided to consumers across multiple organizations but with a similar mission and requirements. It may be owned and operated by one or more of the organizations in the community, a third party, or some combination of them, either on-site or off-site.

Public Cloud

Open use by general public. It may be owned, managed, and operated by a business, academic, or government organization, or some combination of them, on the site of the cloud provider.

Hybrid Cloud

Combination of two or more of the above infrastructures, remain distinct, but share technology that allows data and application portability, either standard or proprietary.

[1] NIST Definition of Cloud Computing, September 2011: http://nvlpubs.nist.gov/nistpubs/Legacy/SP/nistspecialpublication800-145.pdf.

INTRODUCTION:

Why is Cloud Computing So Important?

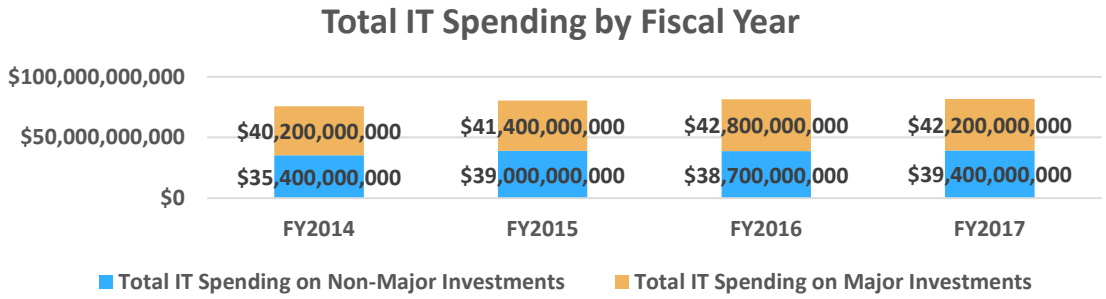
- **In 2011, the White House issued a Federal Cloud ComputingStrategy commonly known as the "Cloud First Policy."**
  - *"The Federal Government's current Information Technology (IT) environment is characterized by low asset utilization, a fragmented demand for resources, duplicative systems, environments which are difficult to manage, and long procurement lead times. These inefficiencies negatively impact the Federal Government's ability to serve the American public."* [1]
- **This policy was created to require agencies to evaluate safe, secure cloud computing options before pursuing any new investments.**
  - *"Cloud computing offers the government an opportunity to be more efficient, agile, and innovative through more effective use of IT investments, and by applying innovations developed in the private sector."* [1]
- **They are in need of cost analysts to evaluate the business case for cloud migration in order for the consumer to make the most informed, effective decision on whether to migrate to the cloud or not.**

1. White House Federal Cloud Computing Strategy, February 8, 2011: https://www.whitehouse.gov/sites/default/files/omb/assets/egov_docs/federal-cloud-computing-strategy.pdf.

INTRODUCTION:

Why is Cloud Computing So Important? (cont.)

- **Currently, there is an estimated $82 billion[1] in federal IT Spending and at least $20 billion[2] is a potential target for migration to cloud computing solutions.**



- **Despite the large amount of interest in cloud migration, there is still *"insufficient guidance regarding how to estimate the costs—and potential cost savings—related to cloud information storage and processing. Such estimates are needed to identify, prioritize, and justify cloud resource needs…"*[3]**

- **We have developed a Cost Element Structure (CES) that provides the framework for business case analysis and cost estimation for cloud migration projects.**

1. Total and bar graph based on 2016 Federal IT Dashboard: https://www.itdashboard.gov/drupal/summary/000.
2. Total based on OMB reported agency estimates from 2011.
3. Connor, Cook, Porche III, and Gonzales, Cost Considerations in Cloud Computing, RAND Corporation, 2014: http://www.rand.org/pubs/perspectives/PE113.html

INTRODUCTION:

Benefits of Cloud Migration to Consumer

- **There are several benefits to migration to the cloudto the consumer, however it is important to know that it may not always be the most cost-effective approach for an organization. The following are some monetary benefits:[1]**

COSTS

Reduced Investment Costs & Overhead

- **Investment-** With cloud computing, consumers no longer have to **invest** in hardware upfront and waste resources and time to manage the hardware. Instead of having to invest heavily in data centers and servers before you know how you're going to use them, you can only pay when you consume computing resources, and only pay for how much you consume.
- ***A La Carte* Selection of Services-** They can select the specific type and size of computing resources based on their need, and pay for only what they consume without the major **overhead** costs of managing hardware. They can either increase or decrease their usage to match requirements and budgetary constraints, and leverage the shared underlying capacity of IT resources via a network.

Benefit from greater economies of scale

- By using cloud computing, consumer can achieve a lower variable (depending on used bandwidth, required storage, # of users, etc.) cost than they can get by themselves. Providers can achieve higher economies of scale, which can potentially translate to lower "pay-as- you-go" pricing because usage from hundreds of thousands of customers is aggregated in the cloud.

1. The remainder of the non-cost-related benefits for cloud migration are in the Backup section at the end of the presentation.

INTRODUCTION:

Vehicle Purchase vs Lease Analogy

- **You are considering purchasing versus leasing a new car, however what do you need to look at to know if that is a reasonable and affordable option for you?**

CAR COSTS	COMPARABLE IT CLOUD COSTS	NEW PURCHASE- (ALL-CASH) (Akin to Non-Cloud Solution)	LEASE (Akin to Cloud Solution)
Loan Term	**Cloud Service Agreement (CSA) Term**	**None-** No Loan because you paid in cash	**Higher-** 3 Year Lease
Down Payment	**Activation Fees**	**Higher-** You are paying the most money out-of-pocket by purchasing in cash upfront	**Lower-** Unless you purchase for %0 down, lease down payment is usually lower than purchase down payment
Monthly Payment	**Cloud Subscription Fees**	**Lower-** no monthly payment because there is no loan, but main monthly payment is for insurance	**Higher**
Purchase Price	**Upfront Investment (one-time) Cost**	**Higher-** When you purchase new, you are typically paying the highest purchase price over a used or leased car	**Lower-** Purchase price is locked in at beginning of lease so you can leverage equity and protect against unexpected depreciation
Maintenance & Repairs	**Maintenance, Tech Refresh, Upgrades**	**Higher-** Most purchases include factory warranty, but you pay upfront for any repairs. Costs rise further if you purchase service plan through dealership	**Lower-** Built into monthly subscription fee, but dependent on Cloud Service Agreement (CSA)
Mileage	**Bandwidth, Capacity, Usage, etc.**	**Lower-** You get unlimited mileage because you own the car	**Higher-** You are limited to 10,000-12,000 miles per year, then 15 cents per mile on average thereafter
Insurance, Taxes, Extra Fees	**Built into Cloud Subscription Fees**	**Lower-** You pay insurance separately. You pay sales tax on the purchase price and, depending on your state, property tax	**Higher-** Although insurance for leases is built into monthly cost, it is typically higher. You only pay sales tax on the monthly payment, not the purchase price.

BUSINESS CASE ANALYSIS (BCA):

Background

- **Similar to a vehicle purchase vs rental comparison, a cost estimator needs to consider all costs and compare alternatives to determine the most reasonable option.**

- **A Business Case Analysis (BCA) is a comparative analysis among competing alternatives:**
  - Not to be confused with a budgetary estimate
  - Defines a Status Quo (SQ), As-Is, or Baseline Alternative (Alternative 1)
  - Defines one to three non-SQ To-Be Alternative(s)
  - Wherever possible, it monetizes costs and benefits associated with each alternative, *including* implicit costs, imputed costs, and (some) externalities
  - **Sunk costs** are excluded
  - **Wash costs** may be included or excluded at analyst discretion
  - Each alternative is subject to identical overarching **ground rules and assumptions** and **period of analysis**

- **Approaches must be in line with industry best practices, well-documented, traceable, and repeatable.**

BUSINESS CASE ANALYSIS (BCA):

WBS vs. CES: Which One for Cost Estimating?

- **In the Project Management Body of Knowledge (PMBoK) Guide, all costs are estimated at the Activity Level (rolled up to the work packages they support later).**

- **PMBoK, The Cost Estimating Body of Knowledge (CEBoK), and the GAO Cost Estimating and Assessment Guide state that WBS's should be product-oriented.**
  - **Each alternative is estimated using a common Cost Element Structure (CES). We need to quantify the costs and benefits of the Baseline and To-Be Alternatives, and monetize that value wherever possible.**
  - **It is a best practice to use a CES to breakdown elements of *cost*, just as it is a best practice to use a WBS to breakdown elements of *work*. Whether for a product or service, cost estimates should be oriented toward the ultimate aim of the program.**

- **For cloud migration projects, we have developed a CES to breakdown the service, however, our end item is not a product. It is a service. Ideally, we would like to set the standard for how cost estimates and comparative analyses are to be done for cloud migration projects.**

Business Case Analysis (BCA) Process

- **These elements are from the perspective of the consumer, not the provider; however, the CES can be adjusted to fit from the provider's perspective.**
  - It is important to note that if a cloud migration solution is determined to be the best fit for the consumer, it may not always imply it to be the cheapest alternative.

- **To develop our CES, we consulted various industry sources such as the following:**
  - DHS IT LCC WBS
  - OSD PA&E EA Guide
  - MIL-STD-881C
  - "Cloud Computing Starter Kit: Cost and Business Case Considerations," MITRE Corporation, 2013
  - "Cost Considerations in Cloud Computing," RAND Corporation, 2014

1. Will add link to DHS IT LCC WBS
2. OSD PA&E Guide: http://www.pae.osd.mil/
3. MIL-STD-881C: https://acc.dau.mil/adl/en-US/482538/file/61223/MIL-STD%20881C%203%20Oct%2011.pdf
4. Cloud Computing Starter Kit: Cost and Business Case Considerations, MITRE Corporation, 2013: http://www.washingtoniceaa.com/Presentations/Cloud%20ICEAA%20Paper%2022Mar2013%20v2-0.pdf
5. Connor, Cook, Porche III, and Gonzales, Cost Considerations in Cloud Computing, RAND Corporation, 2014: http://www.rand.org/pubs/perspectives/PE113.html

Business Case Analysis (BCA) Process

- **As the estimator performs the BCA, he/she must consider the following for every scenario in order to provide the consumers with an objective, unbiased analysis allowing the consumers to decide if a migration to the cloud is the best alternative:**

  - ✓ Define alternatives:
    - ✓ *Remain "as-is," or*
    - ✓ *Migrate to cloud, or*
    - ✓ *Hybrid scenario- mix of "as-is" and migration*
  - ✓ Estimate costs
  - ✓ Estimate benefits
  - ✓ Assess risks and response strategies
  - ✓ Select preferred alternative

CLOUD MIGRATION COST ELEMENT STRUCTURE (CES):

1.0 Investment

- **Investment is characterized by one-time and up-front costs.**
- **Costs can apply to an "as-is" scenario, cloud migration scenario, hybrid scenario, or any combination thereof.**
- **Certain Cost Elements are relevant for both Cloud and Non-Cloud solutions such as Program/Project Management while others are specific for a cloud solution (Cost Elements 1.7-1.12- such as Pilot/Prototype Development, Service Integration and Activation, etc.)**

1.0	Investment
1.1	Program/Project Management
1.1.1	Labor
1.1.1.1	Government Personnel
1.1.1.2	Contractor Personnel
1.1.1.3	Indirect Support
1.1.2	Travel and TDY
1.1.3	PMO Support Materials (PMO-Related HW/SW, Admin., Housekeeping, Ot
1.1.4	PMO Logistics
1.1.4.1	Facilities
1.1.4.2	Logistics Support
1.1.4.4	Other Logistics
1.1.5	Non-Labor Program Management
1.1.6	Other Program/Project Management
1.2	Systems Engineering (or Systems Analysis)
1.2.1	Labor
1.2.1.1	Government Personnel
1.2.1.2	Contractor Personnel
1.2.1.3	Indirect Support
1.2.2	Travel and TDY
1.2.3	Non-labor
1.2.3.1	Hardware
1.2.3.2	Software
1.2.3.3	Other Non-Labor
1.2.4	Other Systems Engineering
1.3	Business Process Re-engineering (BPR) / Change Management
1.3.1	Labor
1.3.1.1	Government Personnel
1.3.1.2	Contractor Personnel
1.3.1.3	Indirect Support
1.3.2	Travel and TDY
1.3.3	Non-labor
1.3.3.1	Hardware
1.3.3.2	Software
1.3.3.3	Other Non-Labor
1.3.4	Other BPR/Change Mgmt
1.4	Non-Cloud Hardware
1.4.1	HW Requirements Analysis
1.4.2	HW Investment
1.4.2.1	User Devices
1.4.2.1.1	PCS
1.4.2.1.2	Laptops & Tablets
1.4.2.1.3	Other
1.4.3	Other Non-Cloud Hardware
1.5	Non-Cloud Software
1.5.1	SW Requirements Analysis
1.5.2	SW Development/Design
1.5.2.1	Software Architectural Design
1.5.2.2	Software Detailed Design
1.5.2.3	Software Coding and Testing/Construction
1.5.2.4	Software Integration
1.5.2.5	Software Qualification Testing
1.5.2.6	Other Software Development
1.5.3	SW Testing & Evaluation
1.5.4	SW Procurement
1.5.4.1	SW Applications
1.5.4.2	Other SW Procurement
1.5.5	Other Non-Cloud Software
1.6	Non-Cloud Infrastructure
1.6.1	Servers
1.6.2	Network
1.6.3	Storage
1.6.4	Other Non-Cloud Infrastructure
1.7	Pilot/Prototype Development
1.7.1	System Integration Labs
1.7.2	Studies
1.7.3	Other Pilot/Prototype Development
1.8	Solution Procurement
1.8.1	System Hardware Procurement
1.8.1.1	Desktop Hardware
1.8.1.2	Peripheral Devices
1.8.1.3	Communications/Network Hardware
1.8.1.4	Other Hardware
1.8.2	System Software Procurement
1.8.3	Logistics Support Equipment
1.8.4	Warranties
1.8.5	Other Solution Procurement
1.9	Data Center Investment and/or Consolidation
1.9.1	Central Data Center Procurement
1.9.2	Hardware
1.9.3	Software (COTS)
1.9.4	One-Time Lease Fee (in lieu of Direct Investment)
1.9.5	Other Central Data Center Investment and/or Consolidation
1.10	Solution Integration
1.10.1	Interface Development
1.10.2	Service Integration
1.10.3	Legacy System Transfer & Migration
1.10.4	Independent Verification and Validation (IV&V)
1.10.5	Developmental Test & Evaluation
1.10.6	Operational Test & Evaluation
1.10.7	Other Solution Integration
1.11	Solution Deployment/Implementation
1.11.1	Initial Training
1.11.1.1	Initial Equipment
1.11.1.2	Initial Services
1.11.1.3	Initial Facilities
1.11.2	Deployment Support HW & SW
1.11.3	Initial Supplies
1.11.4	Site Test/Acceptance
1.11.5	New Service Activation
1.11.6	Other Solution Deployment/Implementation
1.12	Service Activation
1.12.1	New Service Activation
1.12.2	Initial Subscription Fees
1.12.2.1	Software-as-a-Service (SaaS)
1.12.2.2	Platform-as-a-Service (PaaS)
1.12.2.3	Infrastructure-as-a-Service (IaaS)
1.12.2.4	Other
1.13	Other Investment

The cloud CES should evolve with each cloud migration project, new technological cloud development, and align to any new federal policies.

CLOUD MIGRATION COST ELEMENT STRUCTURE (CES):

1.0 Investment (cont.)

- **1.1 Program/Project Management**
  - **1.1.1 Labor-** Government, contractor personnel and indirect support specific to Program/Project Management .
  - **1.1.2 Travel and TDY-** Required travel to/from data centers, clients, etc. specific to Program/Project Management.
  - **1.1.3 Non-Labor Management**- Other management costs excluding Labor such as PMO Support Materials- PMO-related HW, SW such as Microsoft Office, office supplies (printers/ink, etc.), housekeeping (janitorial supplies, etc.) and PMO Logistics such as facilities, building costs, etc. for employees.
  - **1.1.4 Other Program/Project Management**

- **1.2 Systems Engineering/Analysis**
  - **1.2.1 Labor-** Government, contractor personnel and indirect support specific to Systems Engineering/Analysis.
  - **1.2.2 Travel and TDY-** Required travel to/from data centers, clients, etc. specific to Systems Engineering/Analysis.
  - **1.2.3 Non-Labor-** Systems Analysis-related HW, SW, etc.
  - **1.2.4 Other Systems Engineering**

- **1.3 Business Process Re-engineering (BPR)/ Change Mgmt.**
  - **1.3.1 Labor-** Government, contractor personnel and indirect support specific to BPR/Change Mgmt.
  - **1.3.2 Travel and TDY-** Required travel to/from data centers, clients, etc. specific to BPR/Change Mgmt.
  - **1.3.3 Non-Labor-** Hardware (HW), Software (SW), other, etc.
  - **1.3.4 Other BPR/Change Management**

1.0	Investment
1.1	Program/Project Management
1.1.1	Labor
1.1.1.1	Government Personnel
1.1.1.2	Contractor Personnel
1.1.1.3	Indirect Support
1.1.2	Travel and TDY
1.1.3	Non-Labor Program Management
1.1.3.1	PMO Support Materials (PMO-Related HW/SW, Admin., Housekeeping, C
1.1.3.2	PMO Logistics
1.1.3.2.1	Facilities
1.1.3.2.2	Logistics Support
1.1.3.2.3	Other Logistics
1.1.3.3	Other Non-Labor
1.1.4	Other Program/Project Management
1.2	Systems Engineering (or Systems Analysis)
1.2.1	Labor
1.2.1.1	Government Personnel
1.2.1.2	Contractor Personnel
1.2.1.3	Indirect Support
1.2.2	Travel and TDY
1.2.3	Non-labor
1.2.3.1	Hardware
1.2.3.2	Software
1.2.3.3	Other Non-Labor
1.2.4	Other Systems Engineering
1.3	Business Process Re-engineering (BPR) / Change Management
1.3.1	Labor
1.3.1.1	Government Personnel
1.3.1.2	Contractor Personnel
1.3.1.3	Indirect Support
1.3.2	Travel and TDY
1.3.3	Non-labor
1.3.3.1	Hardware
1.3.3.2	Software
1.3.3.3	Other Non-Labor
1.3.4	Other BPR/Change Mgmt

The cloud CES should evolve with each cloud migration project, new technological cloud development, and align to any new federal policies.

CLOUD MIGRATION COST ELEMENT STRUCTURE (CES):

1.0 Investment (cont.)

- **1.4 Non-Cloud Hardware (HW)**
  - **1.4.1 HW Requirements Analysis** – Evaluation of HW needs (especially if not migrating to cloud).
  - **1.4.2 HW Investment** – Servers, computers, data centers, switches, hubs and routers, user devices (PCs, laptops, tablets), etc.
  - **1.4.3 Other Non-Cloud Hardware**
- **1.5 Non-Cloud Software (SW)**
  - **1.5.1 SW Requirements Analysis** – Evaluation of SW needs.
  - **1.5.2 SW Development/Design** – Architectural design, detailed design, coding, testing/construction, integration, qualification testing, etc.
  - **1.5.3 SW Testing & Evaluation** – Testing of software to determine suitability.
  - **1.5.4 SW Procurement** – COTS SW Applications, enterprise resource planning (ERP), customer relationship management (CRM), etc.
  - **1.5.5 Other Non-Cloud Software**

1.0	Investment
1.4	Non-Cloud Hardware
1.4.1	HW Requirements Analysis
1.4.2	HW Investment
1.4.2.1	User Devices
1.4.2.1.1	PCS
1.4.2.1.2	Laptops & Tablets
1.4.2.1.3	Other
1.4.3	Other Non-Cloud Hardware
1.5	Non-Cloud Software
1.5.1	SW Requirements Analysis
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1.5.2.1	Software Architectural Design
1.5.2.2	Software Detailed Design
1.5.2.3	Software Coding and Testing/Construction
1.5.2.4	Software Integration
1.5.2.5	Software Qualification Testing
1.5.2.6	Other Software Development
1.5.3	SW Testing & Evaluation
1.5.4	SW Procurement
1.5.4.1	SW Applications
1.5.4.2	Other SW Procurement
1.5.5	Other Non-Cloud Software

The cloud CES should evolve with each cloud migration project, new technological cloud development, and align to any new federal policies.

CLOUD MIGRATION COST ELEMENT STRUCTURE (CES):

1.0 Investment (cont.)

- **1.6 Non-Cloud Infrastructure**
  - **1.6.1 Servers-** Types: database, file, mail, print, web, application, etc.
  - **1.6.2 Network-** Network enablement, Internet connectivity, firewall and security, etc.
  - **1.6.3 Storage-** Memory, etc.
  - **1.6.4 Other Non-Cloud Infrastructure**
- **1.7 Pilot/Prototype Development**
  - **1.7.1 System Integration Labs-** Facilities and other costs to run pilot testing laboratories.
  - **1.7.2 Studies-** Costs associated with studies performed to document success/failure of Pilot .
  - **1.7.3 Other Pilot/Prototype Development**
- **1.8 Solution Procurement**
  - **1.8.1 System HW Procurement-** Desktop HW, peripheral devices, communications/network HW, etc.
  - **1.8.2 System SW Procurement-** Operating systems (OS), SaaS, etc.
  - **1.8.3 Logistics Support Equipment-** Equipment for maintenance, support, testing, training, technical data, computer resources, facilities, storage, transportation, etc.
  - **1.8.4 Warranties-** Coverage for all procurements, especially HW/SW.
  - **1.8.5 Other Solution Procurement**

1.0	Investment
1.6	Non-Cloud Infrastructure
1.6.1	Servers
1.6.2	Network
1.6.3	Storage
1.6.4	Other Non-Cloud Infrastructure
1.7	Pilot/Prototype Development
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1.8.1.4	Other Hardware
1.8.2	System Software Procurement
1.8.3	Logistics Support Equipment
1.8.4	Warranties
1.8.5	Other Solution Procurement

Sections 1.7-1.12 would be used for a cloud-solution

The cloud CES should evolve with each cloud migration project, new technological cloud development, and align to any new federal policies.

CLOUD MIGRATION COST ELEMENT STRUCTURE (CES):

1.0 Investment (cont.)

- **1.9 Data Center Investment and/or Consolidation**
  - **1.9.1 Central Data Center Procurement-** Investment in central data center to house computer systems and associated components (includes telecommunications, storage systems, redundant or backup power supplies, redundant data communications connections, environmental controls (e.g., air conditioning, fire suppression) and various security devices).
  - **1.9.2 Hardware-** Power sources, switches, cabling, etc.
  - **1.9.3 Software (Commercial-Off-The Shelf-COTS)-** Server management SW, Microsoft Office, SharePoint, Outlook Exchange, etc.
  - **1.9.4 One-Time Lease Fee (in Lieu of Direct Investment)-** Cost for leasing data center facility.
  - **1.9.5 Other Central Data Center Investment and/or Consolidation**

1.0	Investment
1.9	Data Center Investment and/or Consolidation
1.9.1	Central Data Center Procurement
1.9.2	Hardware
1.9.3	Software (COTS)
1.9.4	One-Time Lease Fee (in lieu of Direct Investment)
1.9.5	Other Central Data Center Investment and/or Consolidation

The cloud CES should evolve with each cloud migration project, new technological cloud development, and align to any new federal policies.

CLOUD MIGRATION COST ELEMENT STRUCTURE (CES):

1.0 Investment (cont.)

- **1.10 Solution Integration**
  - **1.10.1 Interface Development-** Making cloud solution "user-friendly."
  - **1.10.2 Service Integration-** Integration of cloud solution to legacy systems.
  - **1.10.3 Legacy System Transfer & Migration-** Migration of legacy systems in phases/groups based on pre-determined factors.
  - **1.10.4 Independent Verification & Validation (IV&V)-** Independent review of software solution performed by third party, quality management, ISO 9000, etc.
  - **1.10.5 Developmental Test & Evaluation (T&E)** Engineering-type testing to verify status of technical progress and assist in development of products/services.
  - **1.10.6 Operational Test & Evaluation (T&E)-** Field testing under realistic conditions to determine effectiveness or solution.
  - **1.10.7 Other Solution Integration**

1.0	Investment
1.10	Solution Integration
1.10.1	Interface Development
1.10.2	Service Integration
1.10.3	Legacy System Transfer & Migration
1.10.4	Independent Verification and Validation (IV&V)
1.10.5	Developmental Test & Evaluation
1.10.6	Operational Test & Evaluation
1.10.7	Other Solution Integration

The cloud CES should evolve with each cloud migration project, new technological cloud development, and align to any new federal policies.

CLOUD MIGRATION COST ELEMENT STRUCTURE (CES):

1.0 Investment (cont.)

- **1.11 Solution Deployment/Implementation**
  - **1.11.1 Initial Training-** Training for new cloud solution (including initial equipment, services and facilities for this training, etc.).
  - **1.11.2 Deployment Support HW & SW-** HW & SW specific for deployment of new cloud solution.
  - **1.11.3 Initial Supplies-** Any supplies required for solution deployment.
  - **1.11.4 Site Test/Acceptance- T**esting of cloud solution and evidence that it fulfills requirements and specifications of the procuring contract or agreements.
  - **1.11.5 Other Solution Deployment/Implementation**
- **1.12 Service Activation**
  - **1.12.1 New Service Activation-** Paid subscription of new service is activated by cloud service provider.
  - **1.12.2 Initial Subscription Fees-** Initial (one-time) subscription fees to activate service depending on consumer's cloud service package: Software-as-a-Service (SaaS), Platform-as-a-Service (PaaS), and/or Infrastructure-as-a-Service (IaaS).
- **1.13 Other Investment**

1.0	Investment
1.11	Solution Deployment/Implementation
1.11.1	Initial Training
1.11.1.1	Initial Equipment
1.11.1.2	Initial Services
1.11.1.3	Initial Facilities
1.11.2	Deployment Support HW & SW
1.11.3	Initial Supplies
1.11.4	Site Test/Acceptance
1.11.5	New Service Activation
1.11.6	Other Solution Deployment/Implementation
1.12	Service Activation
1.12.1	New Service Activation
1.12.2	Initial Subscription Fees
1.12.2.1	Software-as-a-Service (SaaS)
1.12.2.2	Platform-as-a-Service (PaaS)
1.12.2.3	Infrastructure-as-a-Service (IaaS)
1.12.2.4	Other
1.13	Other Investment

The cloud CES should evolve with each cloud migration project, new technological cloud development, and align to any new federal policies.

CLOUD MIGRATION COST ELEMENT STRUCTURE (CES):

2.0 Operations & Maintenance (O&M)

- ***Operations and Maintenance means the phase of an asset in which the asset is in operations and produces the same product or provides a repetitive service.[1]***
- *Operations and Maintenance (O&M) is synonymous with "steady state."[1]*
- **Costs can apply to an "as-is" scenario, cloud migration scenario, hybrid scenario, or any combination thereof.**
- **Certain sections are relevant for both Cloud and Non-Cloud solutions such as Program/Project Management while others are specific for a cloud solution such as Section 2.6 for Recurring Subscription Fees**

2.0	Operations & Maintenance
2.1	Program/Project Management
2.1.1	Labor
2.1.1.1	Government Personnel
2.1.1.2	Contractor Personnel
2.1.1.3	Indirect Support
2.1.2	Travel and TDY
2.1.3	PMO Materials
2.1.4	PMO Facilities
2.1.5	Non-Labor Program Management
2.1.6	Other O&M Program/Project Management
2.2	Systems Engineering (or Systems Analysis)
2.3	Business Process Re-engineering (BPR) / Change Management
2.4	Help Desk/Service Desk Support
2.5	Recurring Operations Procurement and Leasing
2.5.1	SaaS
2.5.2	PaaS
2.5.3	IaaS
2.5.4	Other Recurring Procurement
2.6	Central Data Center Operating Support
2.7	Technology Refresh/Upgrades
2.7.1	Hardware Upgrades
2.7.2	Software Upgrades
2.7.3	Data Center Upgrade
2.7.4	Other Technology Refresh/Upgrades
2.8	System Maintenance
2.8.1	Hardware Maintenance
2.8.1.1	Organic Hardware Maintenance
2.8.1.2	Contract Maintenance Support
2.8.1.2.1	Desktop Hardware
2.8.1.2.2	Peripheral Devices
2.8.1.2.3	Communications/Network Hardware
2.8.1.2.4	Other Hardware
2.8.1.3	Other System Hardware Maintenance
2.8.2	Software Maintenance
2.8.2.1	Developed Software (Non-COTS)
2.8.2.2	Government-off-the-Shelf (GOTS)/Commercial-off-the-Shelf (COTS)
2.8.2.3	Central Data Center Software
2.8.2.4	Other Software
2.8.3	Other System Software Maintenance
2.9	System Documentation/Data Analytics
2.10	System Data Maintenance
2.11	Site Operations
2.11.1	Labor
2.11.2	System Operation/Sustaining Engineering Personnel
2.11.2.1	Government Systems Operation Personnel
2.11.2.2	Contractor Systems Operation Personnel
2.11.2.3	Support to Systems Operation Personnel
2.11.3	Facilities Lease & Maintenance
2.11.4	Communications/Network
2.11.5	Recurring Training
2.11.5.1	Recurring Training Equipment
2.11.5.2	Recurring Training Services
2.11.5.3	Recurring Training Facilities
2.11.6	Environmental & Hazardous Material Storage & Handling
2.11.7	Miscellaneous Support
2.12	Other Operations & Maintenance

1. Office of Management and Budget (OMB) Guidance on Exhibit 300, 2011: https://www.whitehouse.gov/sites/default/files/omb/assets/egov_docs/fy13_guidance_for_exhibit_300_a-b_20110715.pdf

CLOUD MIGRATION COST ELEMENT STRUCTURE (CES):

2.0 Operations & Maintenance (O&M) (cont.)

- **2.1 Program/Project Management**
  - **2.1.1 Labor-** Government, contractor personnel and indirect support.
  - **2.1.2 Travel and TDY-** Required travel to/from data centers, clients, etc. for O&M work.
  - **2.1.3 PMO Materials-** PMO-related HW, SW such as Microsoft Office, office supplies (printers/ink, etc.), housekeeping (janitorial supplies, etc.), Other to support O&M work.
  - **2.1.4 PMO Facilities-** Facilities, building costs, etc. for employees.
  - **2.1.5 Non-Labor Management**- Other management costs excluding Labor.
  - **2.1.6 Other O&M Program/Project Management**
- **2.2 Systems Engineering (or Systems Analysis)**
- **2.3 Business Process Re-engineering (BPR)/Change Mgmt.**
- **2.4 Help Desk/Service Desk Support-** staff and equipment to support 24 hour help desk/service desk.

2.0	Operations & Maintenance
2.1	Program/Project Management
2.1.1	Labor
2.1.1.1	Government Personnel
2.1.1.2	Contractor Personnel
2.1.2	Travel and TDY
2.1.3	Indirect Support
2.1.4	PMO Materials
2.1.5	PMO Facilities
2.1.6	Non-Labor Program Management
2.1.7	Other O&M Program/Project Management
2.2	Systems Engineering (or Systems Analysis)
2.3	Business Process Re-engineering (BPR) / Change Management
2.4	Help Desk/Service Desk Support

Cost Elements 2.1 - 2.3 are the O&M (post-deployment) continuations of cost streams that started in 1.1-1.3

The cloud CES should evolve with each cloud migration project, new technological cloud development, and align to any new federal policies.

CLOUD MIGRATION COST ELEMENT STRUCTURE (CES):

2.0 Operations & Maintenance (O&M) (cont.)

- **2.5 Recurring Operations Procurement and Leasing-** Typically monthly leasing fees from provider for cloud service (see details above).
  - **2.5.1 SaaS-** Uses the internet to deliver applications that are managed by a third-party vendor and whose interface is accessed on the clients' side. Covers SW upgrades & releases that normally occur every two years. (Examples: Microsoft Exchange and Exchange ActiveSync, Google Apps, Salesforce, Citrix GoToMeeting, Cisco WebEx, etc.)
  - **2.5.2 PaaS-** Enterprise software as a self-service portal for managing computing infrastructure from centralized IT operations and the platforms that are installed on top of the hardware. (Example: Apprenda)
  - **2.5.3 IaaS-** Self-service model for accessing, monitoring, and managing remote datacenter infrastructures, such as compute (virtualized or bare metal), storage, networking, and networking services (e.g. firewalls). (Examples: Amazon Web Services (AWS), Microsoft Azure, Google Compute Engine (GCE), etc.)

- **2.6 Central Data Center Operating Support-** for recurring maintenance and management specific to central data center.

2.0	Operations & Maintenance
2.5	Recurring Operations Procurement and Leasing
2.5.1	SaaS
2.5.2	PaaS
2.5.3	IaaS
2.5.4	Other Recurring Procurement
2.6	Central Data Center Operating Support

The cloud CES should evolve with each cloud migration project, new technological cloud development, and align to any new federal policies.

CLOUD MIGRATION COST ELEMENT STRUCTURE (CES):

2.0 Operations & Maintenance (O&M) (cont.)

- **2.7 Technology Upgrades**
  - **2.7.1 Hardware Upgrades** – Installing additional memory (RAM), adding larger hard disks, replacing microprocessor /graphics cards, etc.
  - **2.7.2 Software Upgrades** – Installing new versions of software for operating systems, anti-virus, office suite, etc.
  - **2.7.3 Data Center Upgrades** – Data center- specific HW/SW upgrades.
  - **2.7.4 Other Technology Refresh/Upgrades**
- **2.8 System Maintenance**
  - **2.8.1 Hardware Maintenance** – Organic HW Maintenance, contract maintenance support (for desktop HW, peripheral devices, communications/network HW, etc.)
  - **2.8.2 Software Maintenance** – Developed Software (non-COTS), Government-off-the-shelf (GOTS)/Commercial-off-the-shelf (COTS), central data center software, etc.
  - **2.8.3 Other System Maintenance**

2.0	Operations & Maintenance
2.7	Technology Refresh/Upgrades
2.7.1	Hardware Upgrades
2.7.2	Software Upgrades
2.7.3	Data Center Upgrade
2.7.4	Other Technology Refresh/Upgrades
2.8	System Maintenance
2.8.1	Hardware Maintenance
2.8.1.1	Organic Hardware Maintenance
2.8.1.2	Contract Maintenance Support
2.8.1.2.1	Desktop Hardware
2.8.1.2.2	Peripheral Devices
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2.8.1.2.4	Other Hardware
2.8.1.3	Other System Hardware Maintenance
2.8.2	Software Maintenance
2.8.2.1	Developed Software (Non-COTS)
2.8.2.2	Government-off-the-Shelf (GOTS)/Commercial-off-the-Shelf (COTS)
2.8.2.3	Central Data Center Software
2.8.2.4	Other Software
2.8.3	Other System Software Maintenance

The cloud CES should evolve with each cloud migration project, new technological cloud development, and align to any new federal policies.

CLOUD MIGRATION COST ELEMENT STRUCTURE (CES):

2.0 Operations & Maintenance (O&M) (cont.)

- **2.9 System Documentation/Data Analytics-** Audits, documentation and security process evaluations, etc. Determines whether the current systems effectively protect data, operate efficiently and succeed in aligning to organizational strategic goals.

- **2.10 System Data Maintenance-** Monitors what is installed (the product and version), where or in which group that product is being used (test, development, QA) , what servers are in the enterprise, the most current patches installed, license keys or maintenance certificates, etc.

- **2.11 Site Operations**
  - **2.11.1 System Operation/Sustaining Engineering Personnel-** Government and contractor systems operation personnel, and support to systems operation personnel.
  - **2.11.2 Facilities Lease & Maintenance-** Lease and required maintenance for the actual buildings housing staff, equipment, HW, etc.
  - **2.11.3 Communications/Network-** telephone line and network communications, etc.
  - **2.11.4 Recurring Training-** consistent training for all operations on-site
  - **2.11.5 Environmental & Hazardous Material Storage & Handling-** storage and handling for all equipment.
  - **2.11.6 Miscellaneous Support**

- **2.12 Other Operations & Maintenance**

2.0	Operations & Maintenance
2.9	System Documentation/Data Analytics
2.10	System Data Maintenance
2.11	Site Operations
2.11.1	Labor
2.11.2	System Operation/Sustaining Engineering Personnel
2.11.2.1	Government Systems Operation Personnel
2.11.2.2	Contractor Systems Operation Personnel
2.11.2.3	Support to Systems Operation Personnel
2.11.3	Facilities Lease & Maintenance
2.11.4	Communications/Network
2.11.5	Recurring Training
2.11.5.1	Recurring Training Equipment
2.11.5.2	Recurring Training Services
2.11.5.3	Recurring Training Facilities
2.11.6	Environmental & Hazardous Material Storage & Handling
2.11.7	Miscellaneous Support
2.12	Other Operations & Maintenance

The cloud CES should evolve with each cloud migration project, new technological cloud development, and align to any new federal policies.

CLOUD MIGRATION COST ELEMENT STRUCTURE (CES):

3.0 & 4.0 Legacy System Phase-Out & Disposition

- The Legacy System Phase-Out and Disposition sections of the CES provide cost elements for the final stages of IT projects with regard to phase-out and disposal of legacy systems.
- Phase-Out & Disposition typically occurs in stages as grouped systems migrate to the cloud first. Once successful migration occurs, legacy systems are phased out.

3.0	Legacy System Phase-Out
4.0	**Legacy System Disposition**
4.1	Program/Project Management
4.2	Documentation
4.3	Backup/Tape Management
4.4	Decommission
4.4.1	Hardware
4.4.2	Software
4.4.3	Infrastructure
4.4.4	Other Decommission
4.5	Capital Recoupment
4.6	Retirement/Equipment Disposal
4.7	Environmental/Hazardous Equipment Disposal
4.8	Site Restoration/Closeout
4.9	Other Legacy System Disposition

The cloud CES should evolve with each cloud migration project, new technological cloud development, and align to any new federal policies.

CLOUD MIGRATION COST ELEMENT STRUCTURE (CES):

3.0 & 4.0 Legacy System Phase-Out & Disposition (cont.)

- **3.0 Legacy System Phase-Out**

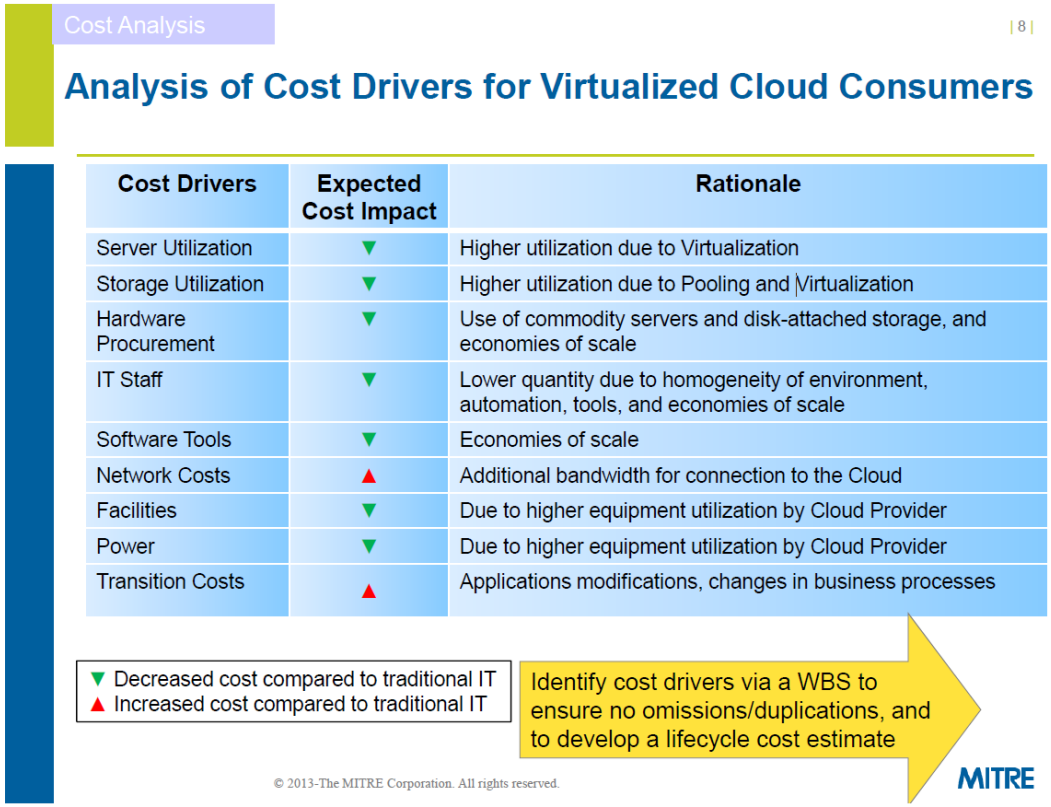
- **4.0 Legacy System Disposition**
  - **4.1 Program/Project Management-** Labor, materials, facilities, etc. pertaining to disposition.
  - **4.2 Documentation-** Thorough record-keeping of all legacy systems prior to phase-out.
  - **4.3 Backup/Tape Management-** Full backup and recording of legacy systems prior to phase-out.
  - **4.4 Decommission-** Deactivation of legacy systems.
  - **4.5 Capital Recoupment-** Recovery of costs by "recycling" any equipment that still has value.
  - **4.6 Retirement/Equipment Disposal-** Any costs associated with actual disposal of equipment.
  - **4.7 Environmental/Hazardous Equipment Disposal**
  - **4.8 Site Restoration/Closeout**
  - **4.9 Other Legacy System Disposition**

3.0	Legacy System Phase-Out
4.0	Legacy System Disposition
4.1	Program/Project Management
4.2	Documentation
4.3	Backup/Tape Management
4.4	Decommission
4.4.1	Hardware
4.4.2	Software
4.4.3	Infrastructure
4.4.4	Other Decommission
4.5	Capital Recoupment
4.6	Retirement/Equipment Disposal
4.7	Environmental/Hazardous Equipment Disposal
4.8	Site Restoration/Closeout
4.9	Other Legacy System Disposition

The cloud CES should evolve with each cloud migration project, new technological cloud development, and align to any new federal policies.

Major Cost Drivers

- The chart to the right *(from MITRE's March 2013 ICEAA Cloud Paper)* displays an excellent analysis of major cost drivers for a cloud project.
- You will notice the expected cost impacts that either increase or decrease from traditional IT costs, depending on the driver, along with the rationale.
- Although these may be true for many cloud projects, it is still necessary to evaluate costs in each case as cost drivers and other factors may vary from project to project.



Cost Analysis | 8 |

Analysis of Cost Drivers for Virtualized Cloud Consumers

Cost Drivers	Expected Cost Impact	Rationale
Server Utilization	▼	Higher utilization due to Virtualization
Storage Utilization	▼	Higher utilization due to Pooling and Virtualization
Hardware Procurement	▼	Use of commodity servers and disk-attached storage, and economies of scale
IT Staff	▼	Lower quantity due to homogeneity of environment, automation, tools, and economies of scale
Software Tools	▼	Economies of scale
Network Costs	▲	Additional bandwidth for connection to the Cloud
Facilities	▼	Due to higher equipment utilization by Cloud Provider
Power	▼	Due to higher equipment utilization by Cloud Provider
Transition Costs	▲	Applications modifications, changes in business processes

▼ Decreased cost compared to traditional IT
▲ Increased cost compared to traditional IT

Identify cost drivers via a WBS to ensure no omissions/duplications, and to develop a lifecycle cost estimate

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1. Image from ICEAA Cloud Paper, Cloud Computing Starter Kit: Cost and Business Case Considerations, Page 8, created by MITRE in 2013.

Major Cost Drivers: Future Trend That Could Affect Cloud Costs

- **Net Neutrality**
  - This concept was developed in 2003 by Tim Wu, a Columbia University media law professor.
  - It is the principle that Internet service providers and governments should treat all data on the Internet the same, not discriminating or charging differentially by user, content, site, platform, application, type of attached equipment, or mode of communication.

- **Since October 2007, President Obama has been in support of net neutrality, and on February 26, 2015, the FCC voted in favor of a strong net neutrality rule to keep the internet open and free. [1]**

- **Depending on the next elected president, however, this decision could be overturned and change the "playing field" for consumers (distribution of costs). [2]**
  - Supporters of net neutrality believe that net neutrality safeguards a level playing field ensuring that cloud service providers and cloud consumers both small and large have an equal stake on the pathways of the Internet regardless of what they are up to. [3]
  - Opponents, however, believe that it threatensto block businesses being able to buy and sell content and applications with greater speed and reliability. [3]

1. The White House, Net Neutrality: https://www.whitehouse.gov/net-neutrality
2. http://gizmodo.com/the-2016-presidential-candidates-views-on-net-neutralit-1760829072
3. Net Neutrality: Good for Cloud Computing?, May 2, 2014: http://www.comparethecloud.net/editor-recommends/net-neutrality-good-or-bad-for-

Major Cost Drivers: Cloud Service Agreement (CSA)

- **Another major cost driver to consider is the Cloud Service Agreement (CSA) (formerly known as the Service Level Agreement (SLA)).[1] The consumer will need to negotiate a CSA with the cloud service provider.**

- **The CSA sets the stage for the relationship between the consumer and cloud service provider. It can prevent or mitigate any legal disputes between the two parties as well as protect the consumer from hidden fees from the provider (similar to a real estate contract or Life Cycle Cost Estimate-LCCE)**
  - The CSA should capture all individual costs for the overall cloud service and should reflect the best "deal" for the consumer by creating a "package deal" versus multiple "a la carte" pay-as-you-go prices which can sometimes cost more than if the costs were built in upfront.

- **For cloud consumers (customers), the larger the deployment is, the more control they can have is structuring a favorable CSA, due to the higher setup and monthly fees.**
  - Smaller consumers may not have this same ability yet so they may be subject to higher pay-as-you go fees and costs. However the climate is changing so that the cost savings in a CSA for a large consumer can be shared with a smaller one.

1. Cloud Standards Customer Council, Practical Guide to Cloud Service Agreements, version 2.0, April, 2015: http://www.cloud-council.org/deliverables/CSCC-Practical-Guide-to-Cloud-Service-Agreements.pdf

CONCLUSION

Final Thoughts

- **Main takeaways:**
  - The White House instituted a "Cloud First Policy" requiring all agencies to ***consider*** cloud migration before any new investments, however it does not ***demand*** that they migrate.
  - Although there are many benefits to migrating to the cloud for a consumer, it is not always a panacea. In some cases, providers benefit more than the consumer.
  - In careful consideration after performing a **Business Case Analysis and cost estimate** for a cloud migration project, it may sometimes result in showing as a higher cost to the consumer. All alternatives must be considered and they must be unbiased and fair.
  - Cost savings ultimately depends on the type of activities & services supported and the type of infrastructure available in-house.
- **Cost Analysts play a crucial role by conducting independent Business Case Analyses (BCAs) and cost estimates to determine the most reasonable solution for cloud migration.**
- **The CES we have developed is a key part of the cost analysts' toolkit because it provides the framework for analyzing these alternatives to determine *best value* to private consumers and federal agencies**

Questions?

Authors

- **Lorena Aguilar, PMP, SSLP**
  - Lorena Aguilar is a Project Manager for Cost Estimation at ICF International,currently supporting Federal Deposit and Insurance Corporation (FDIC). She also recently acted as the Program Manager with the Department of Housing and Urban Development (HUD) leading a team of cost analysts in performing a full Independent Government Cost Estimate (IGCE) and Cost-Effectiveness Analysis (C-EA) for HUD's Enterprise Architecture Transformation System Integration group. Prior to that, she supported the Department of State Consular Affairs serving as the Portfolio Management lead for the Consular Systems Technology (CST) Program and Transportation Security Administration (TSA) Checked Baggage Deployment Program. During her career, she has supported various other civilian agencies in technology/IT, real estate (Commercial/Residential), mortgage, finance and healthcare, by providing management and financial support services and applied cost estimating as well as training, among other activities. Lorena is a certified Project Management Professional (PMP) and Six Sigma Lean Professional (SSLP) and will be obtaining her ICEAA- Certified Cost Estimator/Analyst (CCEA) certification in 2016.

BACKGROUND INFORMATION

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Backup Documentation

- **The following slides provide backup information in support of this topic.**

INTRODUCTION:

Additional Benefits for Cloud Migration to Consumer

Resources

Consumers can access as many low-cost IT resources as they need, almost instantly, and only pay for what they use. Resources can be better utilized and managed to support more mission critical capabilities versus management of in-house infrastructure, overhead and constant time-consuming interactions (now they can communicate with providers instantly and efficiently).

Access

Consumers can instantly access servers, storage, databases, applications/services and resources via the Internet. Cloud computing providers own and maintain the network-connected hardware required for these application services, while the consumer provisions and uses what they need via a web application. What would have previously taken weeks to be available to consumers' developers, is now instantaneous thus increasing organizational agility. Now consumers can experiment, test and implement much quicker and cheaper than before.

Capacity

Consumers now have the ability to measure infrastructure capacity needs prior to deploying an application. They can adjust/scale up or down accordingly within minutes and with utilizing minimal resources.

Reduction/Consolidation of Data Centers

Consumers can prioritize their efforts on their business versus infrastructure costs and operations of managing multiple data centers and servers.

INTRODUCTION:

Additional Benefits for Cloud Migration to Consumer (cont.)

Secure Multi-Tenant Data Hosting

Service provider hosts IT infrastructure for more than one tenant (consumer and/or business unit) at one time, while securely isolating the workloads and users on the shared system so that information from one tenant cannot be visible to any others. This can provide cost efficiencies through a shared infrastructure while still providing each tenant with the same access, isolation and control that they would have if they were on their own.

Secure Compartmentalization

Compartmentalization, originally developed for military/intelligence operations, refers to the limiting of information access to persons or others entities who have a "need to know" in order to perform their work/tasks. This benefit provides the consumers with an additional layer of security.

Metadata Management

Consumers can perform large scale data analysis (such as, but not limited to, indexing of contents, monitoring traffic logs, and mining usage patterns) via large-scale applications without the overhead and cost across multiple data centers.

Content Management

The consumers' Enterprise Content Management (ECM), such as, but not limited to, which performs natural language searches and analytics, document imaging and management processes, can be performed via cloud infrastructure.

Server Virtualization

Physical servers can be converted into several individual & isolated virtual spaces that can be taken up by multiple users as per their respective requirements via a software application. This provides server space consolidation and usage efficiency for the consumers.

CLOUD MIGRATION COST ESTIMATING STRUCTURE (CES):

Cost Element Structure (CES)

The CES follows many best practices of, but not to be confused with, a Work Breakdown Structure (WBS).

Attribute	CES	WBS [1]
Elements are…	Cost Elements	Work Packages
Follows general outlining principles, Follows 100% rule	✓	✓
Mutually Exclusive	✓	✓
No Orphans	✓	✓
No Single Children	✓	✓
May Contain Activities	✓	✘
Highest Level Is…	At least two phases	One Deliverable

1. Based on WBS best practices found in the Project Management Body of Knowledge (PMBoK) Guide, 6th edition.

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