

# Cloud Computing Starter Kit: Cost and Business Case Considerations

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March 2013

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# Main Points

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- **Clouds enable new means of growth, innovation, and collaboration - however, barriers exist due to security, availability, and legal/compliance issues**
- **A detailed WBS should be used to capture full lifecycle costs, especially the “hidden costs”**
- **The focus should be on outcomes and value derived from cloud services - not just financial ROI but also “soft” benefits**
- **The business case analysis should include risk analysis and mitigation**
- **Several types of Clouds exist, each with different levels of cost, benefit, and risk**
- **ROI can vary greatly by situation – conducting a business case analysis can determine specific organizational benefit**

# Presentation Outline

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- **Definitions**
- **Business Case Overview**
- **Cost Analysis**
- **Benefits**
- **Risks**
- **Trends**
- **Summary**

# Introduction

***“Cloud computing is a model for enabling 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 promotes availability and is composed of five essential characteristics, three delivery models, and four deployment models”.***

## Five Key Characteristics

1. On Demand Service
2. Ubiquitous Network Access
3. Location Independent Resource Pooling
4. Rapid Elasticity
5. Measured Service

NIST - Definition of Cloud Computing, Draft version 14  
(<http://csrc.nist.gov/groups/SNS/cloud-computing/index.html>)

## Three Types of Services

### Software as a Service (SaaS)

- Bundled applications (e.g., customer relationship management)

### Platform as a Service (PaaS)

- Software platforms (e.g., database management)

### Infrastructure as a Service (IaaS)

- Hardware (e.g., servers and storage)

Cloud Computing is more than consolidation of IT assets into centralized data centers

# Variants of Cloud Services

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- **Based on the type of application, variants of cloud services exist. Two types discussed in this briefing are:**
  - Virtualized Clouds
    - Clouds consisting of virtual machines (or virtual servers), for time varying demand of IT resources
  - Big Data Clouds
    - Clouds for big data analytics – provide scalable services for data collection, storage, and analytics

# Steps in the Cloud Business Case Analysis

- 1. SWOT analysis**
- 2. Assess the status quo and define cloud-based alternatives**
- 3. Develop and analyze cost estimates**
- 4. Analyze qualitative benefits**
- 5. Analyze risks**
- 6. Compare costs, benefits, and risks of cloud-based solutions to the status quo**

This briefing focuses on the Cloud Service Consumer (not the Cloud Service Provider)

# SWOT Analysis

## Strengths

- Reduces capital investment
- Leverages economies of scale
- Ability to scale up capacity for variable demand
- Reduces the risk of a stranded investment
- Turns over IT operations to specialized groups of personnel

## Opportunities

- Latest tools, technology, and commercial best practices available
- New applications can be brought on faster and at lower cost
- Ability to allocate costs to internal users by access and usage

## Weaknesses

- Applications may require redesign
- Integration with on-premise systems and applications
- Complexity of managing external vendor via SLAs
- Data may be subject to laws where stored
- Security policies may become more complex
- Complexity of compliance with legal and regulatory record-keeping requirements

## Threats

- IA risk in the supply chain
- Potential for vendor lock-in
- Affected internal organizations may not buy-in to the concept
- Institutional knowledge may be lost over time
- Custody and control of data
- Acquisition policies may not allow flexibility in procurement
- Political pressures as workforce affected

# 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

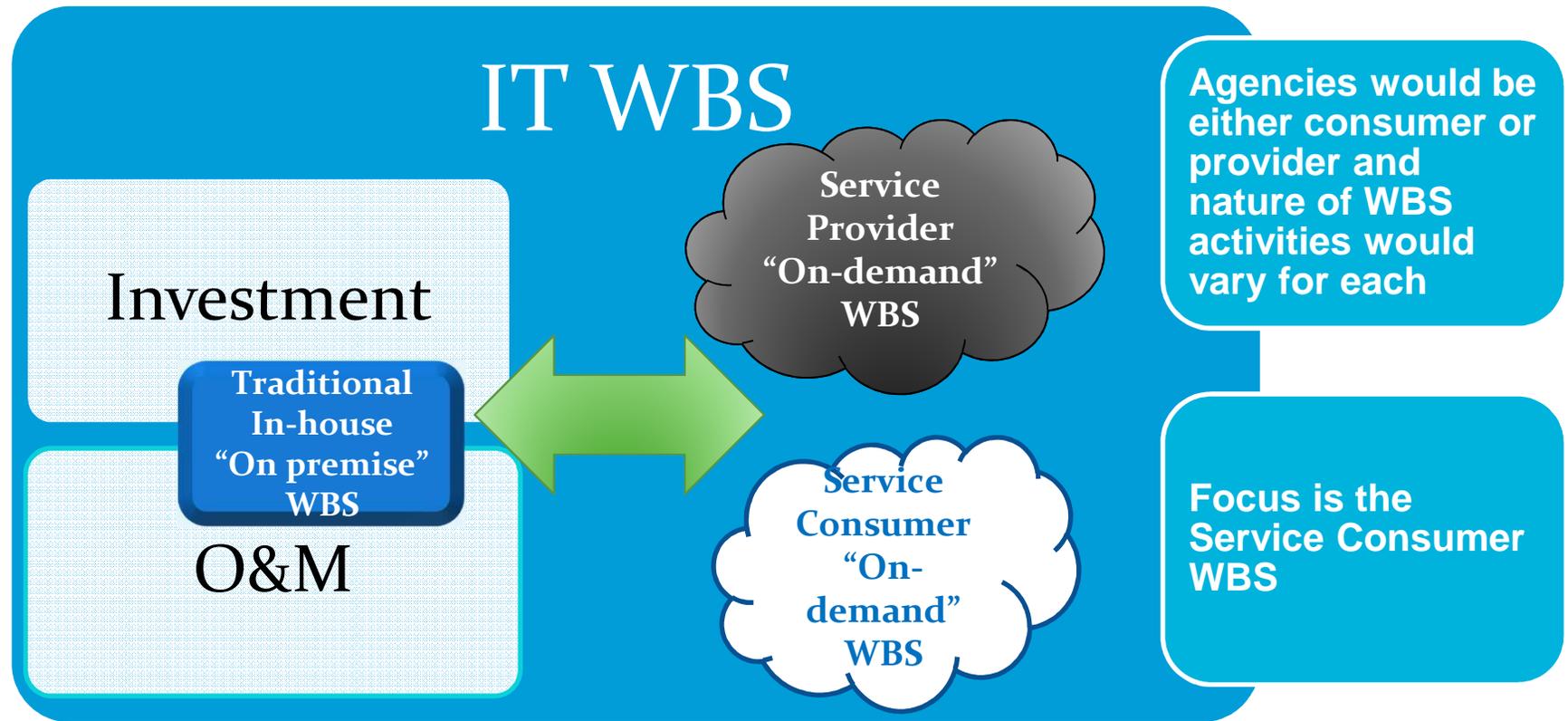
▼ Decreased cost compared to traditional IT  
 ▲ Increased cost compared to traditional IT

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

# WBS Development Overview

- **Goal: Develop a comprehensive Cloud Computing WBS Framework that identifies and describes the activities and cost drivers needed to develop, migrate, implement, and maintain a Cloud service consumer environment across the life cycle.**
- **Approach:**
  - Identify and review existing Industry and Government related cloud computing activity breakdowns and decompositions
  - Analyze, compile, modify, and augment reference sources with detailed activities to develop a comprehensive life cycle Service Consumer WBS Model and Dictionary
  - Augment and extend WBS Model with extensions relevant to cost analysis community (e.g., mapping to DoD and OMB overarching WBS structures and identifying key cost drivers)
- **Primary Purpose – provide insights to cost analysis and engineering communities on key activities to consider and evaluate when migrating to a cloud environment**

# WBS Framework Context



- **Service Provider WBS** would resemble an overarching IT system WBS
- **Service Consumer WBS** is a subset of overarching IT WBS and includes cost elements associated with the investment, migration, and Operations and Maintenance (O&M) of utilizing (or consuming) cloud services

# WBS Summary View of Service Consumer

- Existing Cloud Service Consumer activity breakdowns and decompositions were reviewed, analyzed, compiled, modified, and augmented to develop a comprehensive life cycle Cloud Service Consumer WBS Framework
- WBS Cost Extensions were added to provide additional insights for the cost analysis community including identification of cost drivers

WBS #	Activity
<b>1.0</b>	<b>Governance</b>
1.1	Governance Boards
1.2	Governance Operations
1.3	Develop Policies, Standards, and Procedures
1.4	Develop Service Management Processes
1.5	Data Management and Data Model
1.6	Enterprise Security and Policy Management
<b>2.0</b>	<b>Business Vision and Analysis</b>
2.1	Identify Candidate Services
2.1.1	Identify Infrastructure Services (IaaS)
2.1.2	Identify Platform Services (PaaS)
2.1.3	Identify Software Services (SaaS)
2.2	Identify Cloud Computing Deployment Model
2.3	Assess Impact to Business Processes
2.4	Assess Impact to Security & Policy Management
2.5	Assess Business Case
2.6	Identify Cloud Computing Requirements
<b>3.0</b>	<b>Migration Strategy and Planning</b>
3.1	Describe Existing Capability
3.2	Develop Migration Strategy
<b>4.0</b>	<b>Pilot Service</b>
4.1	Identify Pilot Project
4.2	Implement Pilot Project
<b>5.0</b>	<b>Service Planning and Procurement</b>
5.1	Service Planning
5.2	Service Procurement
<b>6.0</b>	<b>Service Development and Integration</b>
6.1	Develop Service Interfaces
6.2	Integrate Service
<b>7.0</b>	<b>Service Test and Evaluation</b>
7.1	Develop Test Plan
7.2	Evaluate and Setup Test Environment
7.3	Test Service
<b>8.0</b>	<b>Service Deployment</b>
8.1	Implement Business Process Changes
8.2	Train IT Support Staff
8.3	Train End Users
8.4	Transfer Applications to Cloud Provider
8.5	Migrate Data to Cloud Provider
8.6	Activate New Service
8.7	Deactivate Existing Service
<b>9.0</b>	<b>Service Operation and Maintenance</b>
9.1	Recurring Service Delivery and Maintenance
9.1.1	Recurring Service Delivery Costs
9.1.2	Maintain Custom Interfaces
9.1.3	Order Management
9.2	Service Monitoring
9.3	Service Lifecycle Management

# Significant WBS Cost Elements

## Investment

### 6.1 Develop Service Interfaces

- Cost Driver: Quantity & Complexity

### 6.2 Integrate Service

- Cost Driver: Quantity & Complexity

### 8.4 Transfer Applications to Cloud Provider

- Cost Driver: Quantity and Complexity

### 8.5 Migrate Data to Cloud Provider

- Cost Driver: Structure, Quality, and Quantity

## Operations & Maintenance

### 9.1 Recurring Service Delivery and Maintenance

- Cost Driver: Units contracted/consumed per month

### 9.2 Service Monitoring

- Cost Driver: Tools, Licenses, Labor Hours

**Scale is important – Economic benefit increases as more consolidation of underutilized assets takes place.**

# Overall Lifecycle Cost Assessment

- **Investment** – includes process changes, development, integration, transfer of applications, migration of data, deployment, network investment, and bandwidth charges.

Costs Higher than On-Premise Implementation	Costs Lower than On-Premise Implementation
Change of business processes in acquisition, SE, PM, and service level monitoring due to purchase of cloud services	Facility build-out
Integration with on-premise databases and applications	Equipment purchase, installation and test
Application and data migration to cloud-provider	Tech refresh
Procurement of technologies/services for additional network performance, security/monitoring, additional backup, escrow services	

- **O&M** – includes subscription, integration, training, change management, testing and certification, end user support and administration

Costs Higher than On-Premise Implementation	Costs Lower than On-Premise Implementation
Service level monitoring due to purchase of cloud services	Facility costs
Telecommunications bandwidth costs	Equipment maintenance and support
	Software Licenses

- ***Government acquisition regulations, security requirements, complexity of systems interconnections, and political considerations are expected to reduce industry cited cost benefits of moving to the Cloud***

# Key Benefits - Qualitative

- **Reduces capital expenditure since infrastructure is purchased by the Cloud Provider**
- **Enables organizations to reinvest in and concentrate on core mission objective**
- **Lets the organization tap into latest technology and business innovation - modernization of infrastructure is ongoing by the Cloud Provider**
- **Provides on-demand scalability and elasticity for new services and capabilities**
- **Potential for improved service quality by consolidation of IT assets and support from pool of specialists**
- **Enables agencies to focus IT resources on business-critical applications.**
- **Provides ability to allocate costs to internal users by access and usage**
- **Reduces the risk of stranded investments by “pay as you go” pricing models**

# Key Risks – Cost & Schedule

## ■ Cost Risk

- Cost estimates are based on assumptions that may not continue to hold, in areas such as;
  - Improving service availability may require additional effort by the Cloud consumer (e.g. local backup)
  - Increased vendor oversight may be needed
  - Possibility of future price instability
- Use of an incomplete inventory of existing IT assets for projection of IaaS/PaaS requirements may lead to inaccurate requirement of key cost drivers such as virtual servers, operating environments, and storage
- As more of the software application stack is outsourced to the cloud service provider (in the SaaS model), there is greater possibility of vendor lock-in which could lead to price increases
- Additional acquisition and migration costs to change vendors are possible if the service provider changes its service offering or has financial problems
- Schedule impacts may increase the costs of migration to the Cloud

## ■ Schedule Risk

- Organizations may not have a detailed and updated inventory of their IT assets and their interdependencies – this could extend the migration schedule
- The engineering and implementation effort by the service provider to turn on service may not be completely assessed due to lack of information and skills

# Key Risks – Technical & Governance

- **Information Assurance (IA)**
  - New attack surfaces are introduced (e.g., hypervisor or service provider infrastructure)
  - Vulnerabilities are amplified due to standardization by service provider
  - Additional failure points are created due to increased dependence on network connectivity
  - Cloud service providers may not provide the required level of data backup and disaster recovery
  
- **Data Security & Privacy**
  - In-house physical, logical, and personnel controls on data are no longer valid after move to the cloud
  - Increased risk in protection of intellectual property, employee, customer, and partner information
  - While the provider may be contractually obligated to ensure the privacy of data, this may conflict with local laws applicable in the location where the data physically resides
  - Possibility exists of data co-mingling in a multi-tenant environment
  
- **Regulatory Compliance**
  - Responsibility is split between the cloud consumer and provider for compliance with regulations (such as SOX, HIPAA, etc.) and thus requires a process of regular external audits
  
- **Governance**
  - As barriers to acquiring IT services are reduced, unapproved environments (within the IT department and by other business units) maybe stood up

# Trends in Cloud Computing

## ■ Cloud Broker

- Affects costs, benefits, and risks of Virtualized Clouds
- Provides customers with single, consistent interface to multiple providers
- Reduces lead times for acquisition, ordering, and provisioning
- Enables interoperability and portability through a consistent framework of standards, requirements, and practices
- Encourages on-going competition, driving dynamic pricing

## ■ Big Data Clouds

- Business case based on comparison to High Performance Computing, Relational Databases, and Massively Parallel Processing Databases
- Servers are treated as a single computing entity, unlike virtual machines in Virtualized Clouds
- Costs, benefits, and risk analysis is different from Virtualized Clouds

## Analysis of Cost Drivers for Consumers of Big Data Clouds

Cost Drivers	Expected Cost Impact	Rationale
Server Utilization	▼	Reduced equipment due to multi-tenancy
Storage Utilization	▼	Reduced equipment due to multi-tenancy
Hardware	▼	Use of commodity servers and storage
IT Staff	-	Lower quantity due to homogeneity of environment, automation, and tools is offset by additional developers with skills that are in high demand
Software Platforms	▼	Use of open source software
Network Costs	▲	Increased bandwidth to connect with Cloud
Facilities	▼	Due to higher equipment utilization by Cloud Provider
Power	▼	Due to higher equipment utilization by Cloud Provider
Transition Costs	▲	Development and training

- ▼ Decreased cost compared to traditional solutions
- ▲ Increased cost compared to traditional solutions

# Summary

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- **Clouds enable new means of growth, innovation, and collaboration - however, barriers exist due to security, availability, and legal/compliance issues**
- **A detailed WBS should be used to capture full lifecycle costs, especially the “hidden costs”**
- **The focus should be on outcomes and value derived from cloud services - not just financial ROI but also “soft” benefits**
- **The business case analysis should include risk analysis and mitigation**
- **Several types of Clouds exist, each with different levels of cost, benefit, and risk**
- **ROI can vary greatly by situation – conducting a business case analysis can determine specific organizational benefit**

Questions



- **Appendix**

# Abstract

- **Cloud computing is a major trend in the information technology (IT) industry that is affecting both commercial companies and Federal Government agencies due to its promise of agility, scalability, and cost savings.**
- **Prior to investing in cloud computing, decision makers are asking “what is my return on investment (ROI)?” However, there is no one size fits all answer to this question and caution should be exercised when applying generic rules of thumb and quick assessment cost and economic models.**
- **Costs, benefits, and risks must be carefully assessed for each situation. Developing a business case for cloud computing is essential in order to make an informed decision and derive value from a cloud-based IT investment.**
- **Performing an engineering and economic analysis to assess each specific situation is key to accurately estimate costs and potential returns.**
- **Each organization will likely have different goals and circumstances that make their analysis unique.**
- **The authors researched and examined this topic with subject matter experts resulting in a Cloud Computing Starter Kit comprised of developed models and methodology insights.**

## Abstract (cont.)

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- **The authors will present the usefulness of the Cloud Computing Starter Kit when conducting a business case analysis of traditional IT (status quo environment with minimal sharing of IT infrastructure) versus a cloud computing scenario, with a primary focus being from a service consumer perspective.**
- **Included in the Cloud Computing Starter Kit are an analysis of strengths, weaknesses, opportunities, and threats (SWOT); a work breakdown structure (WBS) framework model to aid identification of major activities that need to be considered; insights into key areas of cost increases, cost decreases, cost drivers, economic indicators, non-dollar benefits, risks, ROI, and tailoring of traditional cost-benefit analysis models. Also considered in the Cloud Computing Starter Kit are economic insights on emerging areas within cloud computing, such as big data analytics and cloud brokers.**
- **The Cloud Computing Starter Kit insights will be useful to both cost analysts and engineering communities in the development of a comprehensive business case and in providing a deeper and multi-disciplined understanding of the economic implications of implementing cloud computing.**

# WBS Framework Considerations

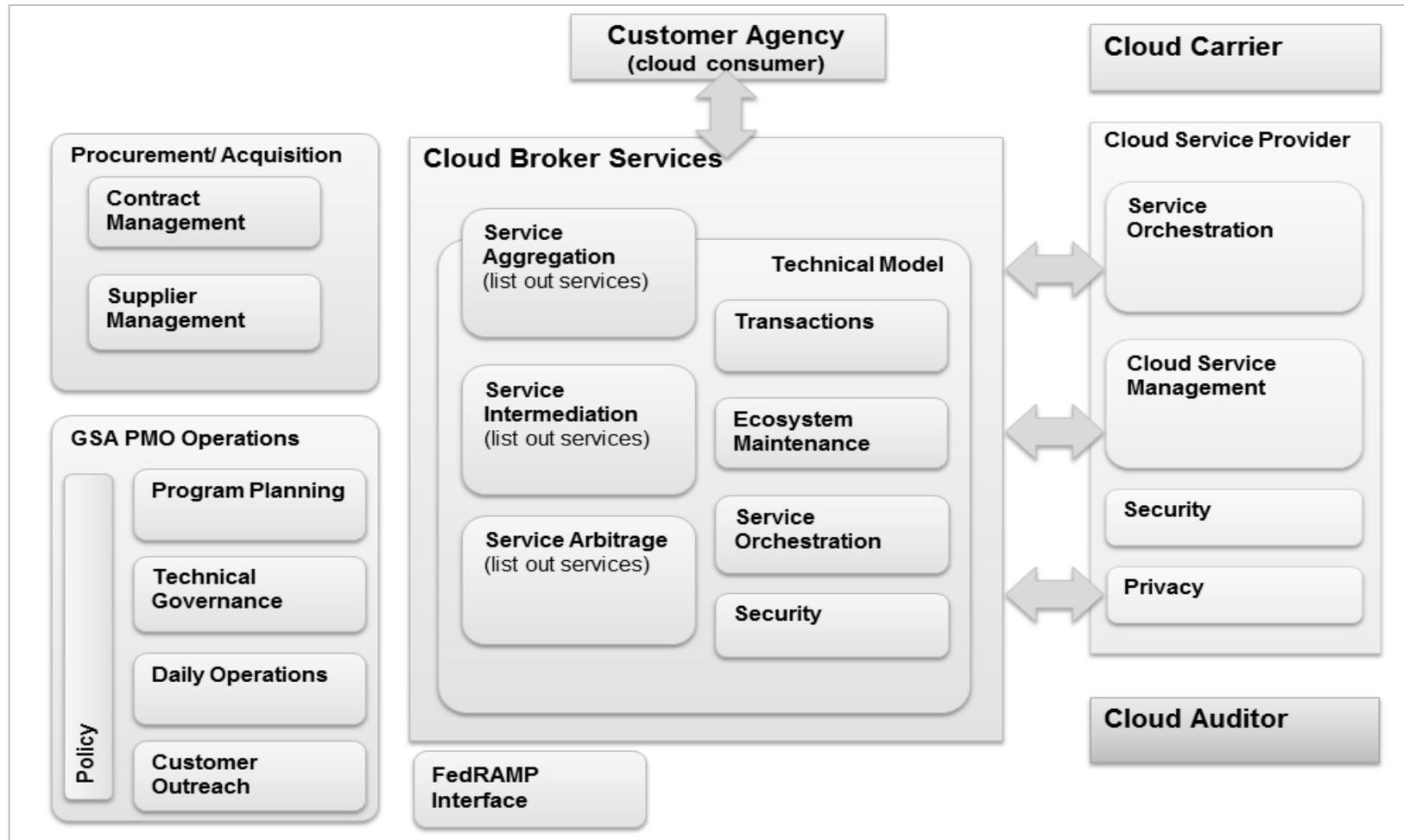
- **WBS Framework applicable across multiple cloud deployment models (public, private, hybrid) and service delivery models (IaaS, PaaS, and SaaS)**
  - Consumption of services from private /community clouds typically require negotiation of MOU and MOA
  - Consumption of services from public clouds require use of an acquisition process, including RFP and contract award
  
- **WBS Framework incorporates cloud computing business models of bundled pricing by service usage unit**
  - Typical bundling includes costs for: COTS software licensing, hardware purchase and warranties, tech refresh, IT operations and support
  - Traditional ('on premise') WBSs typically itemize these separately; however, this is likely not possible (or necessary) with Cloud model as long as equivalent comparison is ensured

*Memorandum of Understanding (MOU)/ Memorandum of Agreement (MOA)*

## WBS Considerations (cont.)

- **WBS Framework emphasizes integration of Enterprise processes and systems**
  - Governance
  - Security
  - Business process change
  - Service integration
- **WBS Framework has limited focus on end-user activities**
  - End-user hardware and software impacts are assumed to be transparent
  - Some training may be required as ‘look and feel’ of end-user applications may change
- **The primary WBS, while based on project activities, provides other views**
  - Primary Lifecycle Phase
  - DoD Cost Elements
  - OMB E-300 Investment Areas

# Example View of Cloud Broker



GSA Cloud Brokerage: RFI dated July 2012

# Big Data Clouds

## Challenge

“We have high volumes of data, in a variety of formats & sources, with variability of interpretation, being generated at an increasing rate (velocity) – how can we use it effectively and efficiently in a short decision window?”

- Complex analysis
- Results have to be timely (Action Time SLA)

## Solution – Big Data Analytics

**Requirements: Cost Effectiveness, Agility, and Scalability**