Modeling the Cloud
Methodology for Cloud Computing Strategy and Design

Daniel Spar, Ph.D., CEA
Lance Morimoto
May 17, 2011
Modeling the Cloud. Methodology for Cloud Computing Strategy and Design

17 MAY 2011

00-00-2011 to 00-00-2011

Deloitte, 1633 Broadway, New York, NY, 10019

Approved for public release; distribution unlimited

Presented at the 23rd Systems and Software Technology Conference (SSTC), 16-19 May 2011, Salt Lake City, UT. Sponsored in part by the USAF. U.S. Government or Federal Rights License

1. REPORT DATE  
17 MAY 2011  
2. REPORT TYPE  
3. DATES COVERED  
00-00-2011 to 00-00-2011  

4. TITLE AND SUBTITLE  
Modeling the Cloud. Methodology for Cloud Computing Strategy and Design  

5a. CONTRACT NUMBER  
5b. GRANT NUMBER  
5c. PROGRAM ELEMENT NUMBER  
5d. PROJECT NUMBER  
5e. TASK NUMBER  
5f. WORK UNIT NUMBER  

6. AUTHOR(S)  

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)  
Deloitte, 1633 Broadway, New York, NY, 10019  

8. PERFORMING ORGANIZATION REPORT NUMBER  

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)  

10. SPONSOR/MONITOR’S ACRONYM(S)  

11. SPONSOR/MONITOR’S REPORT NUMBER(S)  

12. DISTRIBUTION/AVAILABILITY STATEMENT  
Approved for public release; distribution unlimited  

13. SUPPLEMENTARY NOTES  
Presented at the 23rd Systems and Software Technology Conference (SSTC), 16-19 May 2011, Salt Lake City, UT. Sponsored in part by the USAF. U.S. Government or Federal Rights License  

14. ABSTRACT  

15. SUBJECT TERMS  

16. SECURITY CLASSIFICATION OF:  
a. REPORT  
unclassified  
b. ABSTRACT  
unclassified  
c. THIS PAGE  
unclassified  

17. LIMITATION OF ABSTRACT  
Same as Report (SAR)  

18. NUMBER OF PAGES  
48  

19a. NAME OF RESPONSIBLE PERSON  

Standard Form 298 (Rev. 8-98)  
Prescribed by ANSI Std Z39-18
Table of Contents

Introduction

Where to Begin: Technology Strategy

Current State Analysis

Future State Analysis

Transition Planning (Incorporating Cloud Computing)

Conclusion
Introduction
Let's implement cloud computing so I have something to talk about at the executive meeting.

Tell them we're evaluating it. That way neither of us needs to do any real work.

I like it when you do real work.

Sorry. I thought you were leading by example.
Demystifying cloud, what cloud is and is not...

<table>
<thead>
<tr>
<th>Cloud is…</th>
<th>Cloud is not…</th>
</tr>
</thead>
<tbody>
<tr>
<td>…on-demand</td>
<td>…simply virtualization</td>
</tr>
<tr>
<td>…scalable and elastic</td>
<td>…just applying SOA principles</td>
</tr>
<tr>
<td>…pay-as-you-use</td>
<td>…traditional hosting</td>
</tr>
</tbody>
</table>

Cloud computing offers increased agility through faster time to market, lower upfront IT capital expenditure and the ability to easily scale up / down and reallocate resources. However, technical, operational and financial hurdles need to be overcome before cloud can be used extensively by large enterprises.
Cloud services offer multi-tenant, on-demand, scalable, elastic, pay-as-you-go building blocks to deploy IT solutions

### Cloud Service Types

<table>
<thead>
<tr>
<th>Service Type</th>
<th>Definition</th>
<th>Cloud Candidates</th>
<th>Sample Vendors</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Software-as-a-Service (SaaS)</strong></td>
<td>Provider licenses an application to customers for use as a service on demand</td>
<td>• Non-core applications (e.g., HR, CRM, and document collaboration)</td>
<td>salesforce.com, ORACLE, Google, IBM, Rackspace</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Email</td>
<td></td>
</tr>
<tr>
<td><strong>Platform-as-a-Service (PaaS)</strong></td>
<td>Building, delivering applications &amp; services from Web; Computing platform and solution stack as a service</td>
<td>• Large-volume storage, batch processing, large-volume computations</td>
<td>Windows Azure, VMWare, force.com, Google, Amazon, Terremark, HP, IBM, Rackspace</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• VoIP, Virtualized Desktops, Cloud Storage</td>
<td></td>
</tr>
<tr>
<td><strong>Infrastructure-as-a-Service (IaaS)</strong></td>
<td>Computer infrastructure (typically a platform virtualization environment) as a service</td>
<td>• Dev and Test Environments</td>
<td>Amazon Web Services, Terremark, HP, IBM, Rackspace</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• High compute calculations (e.g., Monte-Carlo scenario analysis)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Web servers</td>
<td></td>
</tr>
</tbody>
</table>

### Cloud Delivery Models

<table>
<thead>
<tr>
<th>Delivery Model</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Public Cloud</strong></td>
<td>• External to a client's premises</td>
</tr>
<tr>
<td></td>
<td>• Infrastructure third-party owned and managed</td>
</tr>
<tr>
<td></td>
<td>• Multi-tenant</td>
</tr>
<tr>
<td><strong>Virtual Private Cloud</strong></td>
<td>• External to a client's premise</td>
</tr>
<tr>
<td></td>
<td>• Third-party owned and managed</td>
</tr>
<tr>
<td></td>
<td>• Multi-tenant (but virtually private)</td>
</tr>
<tr>
<td><strong>Private Cloud</strong></td>
<td>• Usually internal and delivered on client premises (although can be hosted by third-party provider)</td>
</tr>
<tr>
<td></td>
<td>• Only used by internal customers</td>
</tr>
<tr>
<td><strong>Community Cloud</strong></td>
<td>• As per private cloud but shared infrastructure resources with “communities” or groups with similar requirements (e.g., industry peers)</td>
</tr>
<tr>
<td><strong>Hybrid Cloud</strong></td>
<td>• Mix of private and public cloud environments (e.g., data stored in private premises but other infrastructure shared in public cloud)</td>
</tr>
</tbody>
</table>
### Where does cloud fit? *(Source: David Linthicum c 2010)*

<table>
<thead>
<tr>
<th>A Fit When:</th>
<th>Not A Fit When:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Processes, applications, and data are largely independent</td>
<td>Processes, applications, and data are largely coupled</td>
</tr>
<tr>
<td>Points of integration are well defined</td>
<td>Points of integration are not well defined</td>
</tr>
<tr>
<td>Lower level of security is fine</td>
<td>Higher level of security is required</td>
</tr>
<tr>
<td>Core internal enterprise architecture is healthy</td>
<td>Core internal enterprise architecture needs work</td>
</tr>
<tr>
<td>Web is the desired platform</td>
<td>The application requires a native interface</td>
</tr>
<tr>
<td>Cost is an issue</td>
<td>Cost is an issue</td>
</tr>
<tr>
<td>Applications are new</td>
<td>Application is legacy</td>
</tr>
</tbody>
</table>
Where to Begin
Where to Begin? Technology Strategy

1. Begin with a review of the business strategy, realized through a business operating model

2. Define the business drivers, scope and key stakeholders, data, services and processes

3. Assess the current state, define the future state, and create a transition plan “roadmap”

4. Leverage an enterprise architecture methodology, such as TOGAF and/or DODAF, to build integrated artifacts

5. Extend the business and technology analysis to define parameters and metrics to apply to all technology alternatives, including cloud

6. Incorporate all findings to prioritize a technology migration plan
Cascading Effect

Strategy Relationships

Business Mission and Vision

Business Strategy

IT Strategy

IT Roadmap
Understanding the Relationships (Source: David Linthicum c 2010)
## Simplified View of Enterprise Architecture

### Current State
- Stakeholders
- Capabilities
- Services
- Processes
- Logical Data

### Future State
- Stakeholders
- Capabilities
- Services
- Processes
- Logical Data

### Transition Plan
- Mission & Vision
- Standards and Reference Models
- Business
- Technology

### System Actors
- Existing Systems
- Manual Systems

### System Functions
- Physical Data

### Technology Options
1. 
2. 
3. ...
Leverage the Business Operating Model Classification
Cited from “Enterprise Architecture as Strategy” c 2006 HBS Press

- Coordination
  - Organic: stream of product innovations easily made available to existing customers using existing integrated channels
  - Acquisition: can acquire new customers for existing products but must integrate data

- Diversification
  - Organic: small business units may feed core business; company grows through business unit growth
  - Acquisition: unlimited opportunities; must ensure shareholder value

- Unification
  - Organic: leverage economies of scale by introducing existing products/services in new markets; grow product line incrementally
  - Acquisition: can acquire competitors to leverage existing foundation; must rip and replace infrastructure

- Replication
  - Organic: replicates best practices in new markets; innovations extended globally
  - Acquisition: can acquire competitors to expand market reach; must rip and replace

Business Process Integration

Low → High

Low → High

Business Process Standardization
There are four dimensions in which scope may be defined and limited:

- Enterprise scope or focus
- Architecture domains
- Vertical scope (level of detail)
- Time periods (project schedule)
The Open Group Architecture Framework (c The Open Group)
Phase C: Information System Architecture (c The Open Group)

- Defines the applications and data considerations that support the enterprise's Business Architecture

- Primary outputs of the ISA are Target Architectures covering data and/or application system domains

- Consider:
  - Data → Service → Process → Platform
  - Define the information models
  - Define the service models
  - Cloud obscures platform details
Why Information System Architecture Matters to the Business, for Cloud

- **Data Architecture** – defines the major types and sources of data necessary to support the business in a way that is understandable by stakeholders, complete and consistent, and stable
  - Not database design, it’s about defining data elements and data relationship rules relevant to the enterprise.

- **Application Architecture** – defines the major kinds of application systems necessary to process data and support the business.
  - Not application systems design, it’s what applications are relevant to the enterprise.
Artifacts List - Data Architecture

- Data Entity/Data Component catalog
- Data Entity/Business Function matrix
- System/Data matrix
- Class Diagram or Relational Data Model
- Data Dissemination diagram
- Data Security diagram
- Class Hierarchy diagram
- Data Migration diagram
- Data Lifecycle diagram
Artifacts List – Application Architecture

- Interface catalog
- System/Organization matrix
- Role/System matrix
- System/Function matrix
- Application Interaction matrix
- Application Communication diagram
- Application and User Location diagram
- System Use-Case diagram
- Enterprise Manageability diagram
- Process/System Realization diagram
- Software Engineering diagram
- Application Migration diagram
- Software Distribution diagram
The DoD Architecture Framework (DoDAF) Viewpoints

- **Capability Viewpoint**: Articulate the capability requirement, delivery timing, and deployed capability.
- **Operational Viewpoint**: Articulate operational scenarios, processes, activities & requirements.
- **Services Viewpoint**: Articulate the performers, activities, services, and their exchanges providing for, or supporting, DoD functions.
- **Systems Viewpoint**: Articulate the legacy systems or independent systems, their composition, interconnectivity, and context providing for, or supporting, DoD functions.
Operational Viewpoint (OV)

- Organizations and Performers (actors/stakeholders)
- Tasks, or activities performed (processes)
- Information that must be exchanged between tasks/activities for mission accomplishment (data)
- Types of information exchanged
- Frequency of exchange
- Which tasks and activities are supported by the information exchanges, and
- Nature of information exchanges.
## Operational View Models

<table>
<thead>
<tr>
<th>OV-1: High Level Operational Concept Graphic</th>
<th>The high-level graphical/textual description of the operational concept.</th>
</tr>
</thead>
<tbody>
<tr>
<td>OV-2: Operational Resource Flow Description</td>
<td>A description of the resource flows exchanged between operational activities.</td>
</tr>
<tr>
<td>OV-3: Operational Resource Flow Matrix</td>
<td>A description of the resources exchanged and the relevant attributes of the exchanges.</td>
</tr>
<tr>
<td>OV-4: Organizational Relationships Chart</td>
<td>The organizational context, role or other relationships among organizations.</td>
</tr>
<tr>
<td>OV-5a: Operational Activity Decomposition Tree</td>
<td>The capabilities and activities (operational activities) organized in an hierarchal structure.</td>
</tr>
<tr>
<td>OV-5b: Operational Activity Model</td>
<td>The context of capabilities and activities (operational activities) and their relationships among activities, inputs, and outputs; Additional data can show cost, performers or other pertinent information.</td>
</tr>
<tr>
<td>OV-6a: Operational Rules Model</td>
<td>One of three models used to describe activity (operational activity). It identifies business rules that constrain operations.</td>
</tr>
<tr>
<td>OV-6b: State Transition Description</td>
<td>One of three models used to describe operational activity (activity). It identifies business process (activity) responses to events (usually, very short activities).</td>
</tr>
<tr>
<td>OV-6c: Event-Trace Description</td>
<td>One of three models used to describe operational activity (activity). It traces actions in a scenario or sequence of events.</td>
</tr>
</tbody>
</table>
Services Viewpoint (SvcV)

- System Functionality
- Service Functionality
- Interconnection between Services
- Service support for Operational Activity
## Services Viewpoint Models

<table>
<thead>
<tr>
<th>Services Viewpoint Models</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SvcV-1 Services Context</strong></td>
<td>The identification of services, service items, and their interconnections.</td>
</tr>
<tr>
<td><strong>SvcV-2 Services Resource Flow</strong></td>
<td>A description of resource flows exchanged between services.</td>
</tr>
<tr>
<td><strong>SvcV-3a Systems-Services Matrix</strong></td>
<td>The relationships among or between systems and services in a given Architectural Description.</td>
</tr>
<tr>
<td><strong>SvcV-3b Services-Services Matrix</strong></td>
<td>The relationships among services in a given Architectural Description. It can be designed to show relationships of interest, (e.g., service-type interfaces, planned vs. existing interfaces).</td>
</tr>
<tr>
<td><strong>SvcV-4 Services Functionality</strong></td>
<td>The functions performed by services and the service data flows among service functions (activities).</td>
</tr>
<tr>
<td><strong>SvcV-5 Operational Activity to Services Traceability Matrix</strong></td>
<td>A mapping of services (activities) back to operational activities (activities).</td>
</tr>
<tr>
<td><strong>SvcV-6 Services Resource Flow Matrix</strong></td>
<td>It provides details of service resource flow elements being exchanged between services and the attributes of that exchange.</td>
</tr>
<tr>
<td><strong>SvcV-7 Services Measures Matrix</strong></td>
<td>The measures (metrics) of Services Model elements for the appropriate time frame(s).</td>
</tr>
<tr>
<td><strong>SvcV-8 Services Evolution</strong></td>
<td>The planned incremental steps toward migrating a suite of services to a more efficient suite or toward evolving current services to a future implementation.</td>
</tr>
</tbody>
</table>
Services Viewpoint Models (continued)

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SvcV-9 Services Technology &amp; Skills Forecast</td>
<td>The emerging technologies, software/hardware products, and skills that are expected to be available in a given set of timeframes and that will affect future service development.</td>
</tr>
<tr>
<td>SvcV-10a Services Rules Model</td>
<td>One of three models used to describe service functionality. It identifies constraints that are imposed on systems functionality due to some aspect of system design or implementation.</td>
</tr>
<tr>
<td>SvcV-10b Services State Transition Description</td>
<td>One of three models used to describe service functionality. It identifies responses of services to events.</td>
</tr>
<tr>
<td>SvcV-10c Services Event-Trace Description</td>
<td>One of three models used to describe service functionality. It identifies service-specific refinements of critical sequences of events described in the Operational Viewpoint.</td>
</tr>
</tbody>
</table>
Integrating Artifacts

• Data and Applications artifacts should have the same scope to support the analysis and documentation

• Cross-referencing the artifact components in a matrix can identify where and how specific data objects support specific application functions

• Repository-based EA tools can store data objects for use in associating with processes when building process models

• Associations between logical data and logical business processes are frequently stable over time
Leverage Artifacts to Populate the Enterprise Architecture

1. Artifacts range from catalogs, to matrices to diagrams to models

2. Sample business artifacts include stakeholder interaction diagrams, process models and data models

3. Sample technology artifacts include system catalogs, physical data models

4. Sample transition artifacts include consolidated gaps, solutions and dependencies assessment matrix, architecture definition increments table, business/benefit value assessment matrix

5. Define services at the macro and micro business and technology levels, and define parameters (as if to outsource)
Integration and optimization of business processes and systems functions requires understanding the data elements supporting the activities.

Data Models are the most stable products in architectures. Data entities, attributes, and their relationships reflect, analyze and enforce business rules in the most logically consistent way.

Conceptual, Logical and Physical Data Models are leveraged across multiple layers of the architecture framework.

Including data sets in system artifacts adds valuable detail and strengthens links across business, solution and systems architectures.

In the diagrams to the right:

- The data model excerpt identifies data entities, attributes and relationships, and
- The Business Object CRUD Matrix maps primary functions with data entities, detailing where a function “Creates”, “Reads”, “Updates” and/or “Deletes” instances of the data. This is a critical cross reference between data and functions.
IaaS cloud suitable applications should be evaluated based on the degree of technical and business fit against key cloud characteristics.

### Technical Requirements

- Low application criticality
- Low number of internal users with low latency needs
- Low to moderate service level requirements
- No confidential data or data is easily masked
- Minimal interdependencies to other apps/data
- Currently virtualized or is a strong virtualization candidate; uses cloud vendor supported OS
- Uses commodity hardware (e.g. x86 servers)
- Low bandwidth and low/moderate infrastructure requirements
- Stands alone environments and software stack
- Does not depend on specialized appliances

### Business Requirements

- Low or moderate application criticality
- Internal users with low latency needs
- Moderate service level requirements
- Confidential data can be masked
- Some interdependencies on other apps/data
- Good virtualized candidate; uses cloud vendor supported OS
- Uses commodity hardware (e.g. x86 servers)
- Moderate bandwidth and infrastructure requirements
- Shares environments or software stacks
- Does not depend on specialized appliances

### Cannot Do

- Mission critical application
- Large number of external users with high latency requirements
- High service level requirements, contains confidential data not easily masked
- Complex interdependencies to other apps/data
- Not suited for virtualization; uses unsupported OS by cloud vendors
- Uses custom hardware (e.g. vendor hardware or highly customized grid)
- High bandwidth and infrastructure requirements
- Shared environments and software stack
- Depends on specialized appliance

### Should Not Do

- Mission critical application
- Large number of external users with low latency expectations
- High service level requirements, contains confidential data not easily masked
- Complex interdependencies to other apps/data
- Currently virtualized or is a strong virtualization candidate; uses cloud vendor supported OS
- Uses commodity hardware (e.g. x86 servers)
- Low bandwidth and low/moderate infrastructure requirements
- Shared environments and software stack
- Depends on specialized appliance

### Technical Requirements

- IaaS cloud suitable applications should be evaluated based on the degree of technical and business fit against key cloud characteristics.
- Some interdependencies on other apps/data
- Good virtualized candidate; uses cloud vendor supported OS
- Uses commodity hardware (e.g. x86 servers)
- Moderate bandwidth and infrastructure requirements
- Shares environments or software stacks
- Does not depend on specialized appliances

### Business Requirements

- Low application criticality
- Low number of internal users with low latency needs
- Low to moderate service level requirements
- No confidential data or data is easily masked
- Minimal interdependencies to other apps/data
- Currently virtualized or is a strong virtualization candidate; uses cloud vendor supported OS
- Uses commodity hardware (e.g. x86 servers)
- Low bandwidth and low/moderate infrastructure requirements
- Stands alone environments and software stack
- Does not depend on specialized appliances
Common initial cloud candidates include Analytics, ECM, and BPM tools.

<table>
<thead>
<tr>
<th>Business Requirements</th>
<th>Technical Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meets Business Requirements</td>
<td>Can Do (Later)</td>
</tr>
<tr>
<td>Customer Information Systems</td>
<td></td>
</tr>
<tr>
<td>Processing Engines</td>
<td></td>
</tr>
<tr>
<td>Call Centre Technology and Telephony</td>
<td></td>
</tr>
<tr>
<td>Cannot Do</td>
<td></td>
</tr>
<tr>
<td>Highly Customized Applications Using Non-Commodity Hardware</td>
<td></td>
</tr>
<tr>
<td>Security Tools</td>
<td></td>
</tr>
<tr>
<td>Meets Cloud Technical Requirements</td>
<td>Should Not Do</td>
</tr>
<tr>
<td>Core Deposits Systems</td>
<td></td>
</tr>
<tr>
<td>Core Lending Systems</td>
<td></td>
</tr>
<tr>
<td>ATM / POS Technology</td>
<td></td>
</tr>
<tr>
<td>Does Not Meet Business Requirements</td>
<td>Can Do</td>
</tr>
<tr>
<td>Enterprise Content Management</td>
<td></td>
</tr>
<tr>
<td>Business Analytics</td>
<td></td>
</tr>
<tr>
<td>Business Process Management</td>
<td></td>
</tr>
<tr>
<td>Online Banking</td>
<td></td>
</tr>
<tr>
<td>Customer Relationship Management</td>
<td></td>
</tr>
</tbody>
</table>

ILLUSTRATIVE
Current State Analysis
Simplified View of Enterprise Architecture

Current State

- Stakeholders
- Capabilities
- Services
- Processes
- Logical Data

Future State

- Stakeholders
- Capabilities
- Services
- Processes
- Logical Data

Mission & Vision

Business

Technology

- System Actors
  - Existing Systems
  - Manual Systems
- System Functions
- Physical Data

- Technology Options
  1. 
  2. 
  3. 
  ...

Environmental Changes
Future State Analysis
Simplified View of Enterprise Architecture

Current State
- Stakeholders
- Capabilities
- Services
- Processes
- Logical Data

Future State
- Stakeholders
- Capabilities
- Services
- Processes
- Logical Data

Business
- Mission & Vision
- Standards and Reference Models

Technology
- System Actors
  - Existing Systems
  - Manual Systems
- System Functions
- Physical Data

Technology Options
1. 
2. 
3. ...
# Analysis of Future State

| Business and IT Strategy Alignment | How do cloud computing technologies and services align with business and IT strategic goals?  
|                                 | What business benefits can be derived by utilizing cloud computing technologies, and to what degree? |
| Opportunities                   | How can you determine which, if any, cloud computing technologies and services are suitable for the company?  
|                                 | How does cloud technology differ with existing service types, in terms of functions and characteristics?  
|                                 | How can cloud technology support current and new service or application deployments?  
|                                 | Which cloud computing services provide the highest potential business value?  
|                                 | How much flexibility in Capital / Operating Expenditures can be gained? |
| Technologies and Services       | Which cloud computing technology fit your current or planned IT infrastructure and architecture?  
|                                 | Which cloud computing vendors fit your IT and business needs? |
| Delivery Models                 | To what degree can the existing delivery methods be leveraged?  
|                                 | Who are the leading cloud computing providers for each service type and technology?  
|                                 | How will procuring cloud services affect relationships with existing vendors?  
|                                 | Are the standard Service Level Agreements acceptable to you? |
| IT Readiness                    | What business and IT processes are affected when transitioning to cloud-based capability?  
|                                 | To what degree can existing IT infrastructure, technologies, and services be leveraged?  
|                                 | Does the organization have the capabilities to make adequate use of cloud computing technology?  
|                                 | Are the appropriate security and privacy controls in place to support cloud computing technology? |
| Roadmap                         | What are the immediate next steps?  
|                                 | What cloud computing initiatives can be planned to take place in the next 2-3 years? |
Additional Considerations for Future State Technology

Define metrics for critical business performance areas, and ensure these are inherited by system alternatives

Include cloud computing options as part of the future state technology alternatives for comparison

Ensure systems principles of technology architecture, dependability, and performance metrics are maintained through all alternatives, which often will require levels of diversification and redundancy to achieve

Ensure service definition and metrics are derived from the business operating model

Ensure the technology alternatives support and map to the business drivers, scope, stakeholders and operating model
Not all applications are suitable for cloud, enterprises should consider several dimensions when evaluating which future applications are built to be cloud-ready.

### Considerations For Building a Cloud Ready Application

<table>
<thead>
<tr>
<th>Technology</th>
<th>Business</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Do the workloads exhibit characteristics that can <strong>derive real benefits from scalability and elasticity</strong>?</td>
<td>- What are the anticipated usage patterns for the application and will it be cost effective to move to the cloud?</td>
</tr>
<tr>
<td>- Will the application be built to run on a cloud supported platform (e.g., commodity hardware, supported OS)</td>
<td>- What is business sponsor's <strong>preference for CapEx vs OpEx</strong>?</td>
</tr>
<tr>
<td>- Can the <strong>application components</strong> be architecturally designed to be suitable for deployment to a <strong>cloud</strong> based solution?</td>
<td>- How will designing for cloud readiness <strong>impact my implementation cost and timelines</strong>? Can I achieve overall <strong>lower TCO</strong>?</td>
</tr>
<tr>
<td>- <strong>What design trade-offs will be needed</strong> to make this application cloud-ready?</td>
<td>- <strong>Will moving to cloud help me capture new sources of value</strong> for the business?</td>
</tr>
<tr>
<td>- Are internal IT architecture and organization structures “ready”?</td>
<td>- <strong>Are cloud offerings mature enough</strong> for these workloads?</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Operational</th>
<th>Regulatory and Compliance</th>
</tr>
</thead>
<tbody>
<tr>
<td>- <strong>What are the availability requirements</strong> for this application and can those be met by cloud?</td>
<td>- Are there any <strong>risk management or compliance requirements for this application</strong>? Will cloud be able to satisfy those requirements? (e.g., Audits)</td>
</tr>
<tr>
<td>- <strong>How will support model for this application change</strong> if it is moved to the cloud? Are the potential changes acceptable?</td>
<td>- Does the application hold confidential or customer data? Can this data be <strong>easily masked in the future</strong>?</td>
</tr>
<tr>
<td>- <strong>How will cloud impact my chargeback model</strong> for this application? <strong>Can I support the new model</strong>? Will business accept the changes?</td>
<td>- Does the application data need to reside within organization? Will we be <strong>prohibited from moving data outside of the country</strong>?</td>
</tr>
<tr>
<td>- Can cloud meet my business continuity and disaster recovery requirements for the application?</td>
<td>- <strong>Who owns the data? How is it be used? Are controls in place?</strong></td>
</tr>
<tr>
<td>- Is the vendor limiting interoperability or access to your data?</td>
<td>- <strong>How is security achieved? What is the level of privacy protection?</strong></td>
</tr>
</tbody>
</table>

- Deloitte.
Applications most suited to cloud computing have dynamic and unpredictable usage patterns, compared to more static hosting environments.

### Comparing Managed Hosting to Cloud Computing

<table>
<thead>
<tr>
<th>Managed Hosting Applications</th>
<th>Cloud Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Email &amp; Messaging&lt;br&gt;Voice Systems&lt;br&gt;Corporate Web Sites&lt;br&gt;Back-Office Systems</td>
<td>Software as a Service&lt;br&gt;Dynamic Applications&lt;br&gt;High-Compute Processing</td>
</tr>
</tbody>
</table>

### Mainstream Adoption of Workloads by Service Type

- **SaaS**
  - New Core Apps
  - Engineering Apps
  - Core Apps - ERP
  - SMB Apps
  - Desktop Virtualization
  - Collaboration
  - Dev & Test
  - Websites, Intranet

- **IaaS**
  - High Performance Computing / Clusters
  - High-End Servers
  - Storage & Back-Up
  - Low-End Servers

- **PaaS**
  - Productivity Apps
  - Rapid App Dev
  - Test and Development
  - DR, Backup and Storage

*Service type solution maturity over the next 4 years and expected timeframe for mainstream adoption of workload types.*
A structured approach should be taken when reviewing IaaS cloud suitability factors for applications and workloads.

**Level 1: Workload Analysis**
- Workload attributes
- Application characteristics
- Suitability framework

**Level 2: Determine Suitability for Cloud (IaaS Cloud Candidates)**
- Technical reviews with application owners and infrastructure teams
- Input from application business owners and SLAs

**Level 3: Business Case and Operational Analysis**
- TCO Data and Analysis
- Stakeholder Inputs

**Execution**
- Business Case Analysis
- Technical Analysis

**In-Depth Analysis & Planning**
- Applications / Workloads Targeted for Migration

**Workload Attributes**
- Workload Analysis
- Potential Cloud Candidates
- Feasible Cloud Candidates
- Proposed Cloud Candidates

**Preliminary Assessment**
- Application Criticality (business criticality of app)
- Application Complexity
- Poor Virtualization Candidate
- Utilizes Commodity Infrastructure

**Technical Feasibility**
- High Network Bandwidth Needs
- Infrastructure Requirements
- Shares Environments
- Shares Software Stack
- Utilizes Specialized Infrastructure

**Business Feasibility**
- Internal / External Facing Application
- High User Impact
- Service Level Requirements
- Confidential / Customer Data

**Not Technically Feasible**
- Evaluate Suitability for SaaS and PaaS

**Not Business Suitable**
- Not Business Suitable

**Detailed Analysis**
- Business Case Analysis
- Detailed Technical Analysis
- Operational Analysis
- Management Considerations

**Migration Not Feasible**
- Migration Planning
- Testing
- Change Management
- Cutover

**Illustrative**
- Candidate list for cloud evaluation
- List of cloud applications / workloads with high migration potential
Organizations face a wide range of new risk and control considerations when transitioning to the cloud

- Amongst the many operational impacts cloud brings, it introduces new inherent risks and increases the complexity of managing existing risks that may be well controlled in the internal environment; primarily around data security.
- For instance, a non-US company may face the challenge of a vendor only providing data centres in the US which would make data subject to the Patriot Act.

**Risk and Control Considerations**

- **Data Controls and Ownership**
  - Who will own the data? How might it be used?

- **Data Location and Access**
  - Where will your data reside? Who can access your data?

- **Legal / Regulatory Compliance**

- **Backup, Retention, Disposal**
  - Do the cloud vendor’s retention/destruction timelines and practices meet your requirements?

- **Availability and Reliability**
  - How is reliability, access, and availability assured by cloud vendors?

- **Disaster Recovery**

**Risk and Control Issues**

**Can cloud vendors comply with your regulatory / compliance requirements?**
Transition Planning
Transition Planning: Leveraging TOGAF Phases E, F, G &H:

- **Opportunities and Solutions:**
  - Identifies changes and projects to be undertaken to move from current to target state.

- **Migration Planning:**
  - Focuses on prioritization of projects. Generates detailed implementation roadmap, timeline as well as the impact analysis.

- **Implementation Governance:**
  - Defines implementation contract which guides and governs the projects.

- **Architecture Change Management:**
  - Helps to manage changes in a cohesive way.
Transition Planning

The most critical aspect of transition planning: the evolution of the business operating model

Leverage the gap analysis between current state business and future state business, between current state business and current state technology, and between current state environmental factors and future state projected environmental conditions

Ensure performance metrics are defined and baselined for realistic comparison of alternatives and for prioritization of migration options
Transition Planning Includes Data Security

Example of Systems Security Concerns, cited from the US Federal Cloud Computing Strategy

(Detailed cloud security guidance is available through a series of NIST publications. NIST has also classified cloud service models and cloud deployment models.)

1. Statutory compliance to laws, regulations, and agency requirements
2. Data characteristics to assess which fundamental protections an application’s data set requires
3. Privacy and confidentiality to protect against accidental and nefarious access to information
4. Integrity to ensure data is authorized, complete, and accurate
5. Data controls and access policies to determine where data can be stored and who can access physical locations
6. Governance to ensure that cloud computing service providers are sufficiently transparent, have adequate security and management controls, and provide the information necessary for the agency to appropriately and independently assess and monitor the efficacy of those controls
Conclusion

1. Cloud Computing is a great way to avoid the cost of implementing and managing infrastructure; what you run on that infrastructure and how successful the results will be depends on the skill and effort your team put into the work.

2. However: Cloud computing requires architecture, management and implementation. Start with architecture.

3. Most critical aspect of architecture analysis: the business operating model.

4. Establish current state, future state and transition plans

5. Define metrics for critical business performance areas, and ensure these are inherited by systems (SLAs)

6. Include cloud computing options as part of the future state technology alternatives for comparison

7. Ensure systems principles of technology architecture, dependability, and performance metrics are maintained through all alternatives, which often will require levels of diversification and redundancy to achieve
Given the significant benefits that cloud offers, mainstream adoption likely as vendor solutions mature and operating model challenges are overcome

**Finding Value Beyond The Hype**

- The hype cycle for cloud is at all-time high and for good reason – the **benefits companies stand to gain from cloud are significant**: IT agility, decreased costs and improved IT service delivery capabilities to name but a few.

- The **big question is how – not if**. Take-up statistics show that a large proportion of enterprises are beginning to leverage cloud to some extent or the other. **Wider scale adoption is primarily being held back due to organizations trying to understand how to overcome challenges** such as adopting new operating models, shaping appropriate data governance policies, addressing new security and risk controls, and understanding how to adjust tax strategies to the cross-border intricacies that cloud can bring.

**Long Term Outlook**

- **The consensus on cloud growth remains polarized**: One positions cloud at the apex of the hype curve, but still two to five years away from mainstream adoption. The other suggests that cloud is about to “explode” over the next year.

- In reality, **in the immediate term we are likely to see growth in segments** where offering dynamically scalable and virtualized resources makes good business sense (e.g., non-critical file storage or customer-facing applications that see large spikes in demand).

- **The strong benefits that cloud offers and the improved solution maturity and diversity** from vendors indicate that it is here to stay.

- Moreover, many of the **operational and security challenges can be addressed through vendor management and enterprise architecture standardization**.

- Within the five year time horizon, it is expected that **core cloud solutions will become mainstream services adopted widely by enterprise customers**.

- **Bottom line**: Enterprises should **take the steps now to ensure they are well positioned to leverage cloud benefits in the future**; this includes ensuring that there is a **cloud strategy** in place, that **architecture** is being built “cloud-ready”, and that consideration has been given to **future operating model implications**.

Questions and Answers