Agenda

• Cloud & DevOps Benefits
• Harvard’s Cloud & DevOps Vision
• BC/DR Business Requirements
• Program Organization & Approach
• Migrating Applications
• New Risks and Mitigating Existing Risks
• Significant CSP Risks and CSP Risk Responses
• University Support Mechanisms
• The Ideal Approach
Cloud & DevOps Benefits

Benefits of the Cloud

Migrating key Harvard Community information technology solutions to the cloud doesn’t just improve efficiency and optimize cost — it also enables our systems to work more reliably in ever-shifting circumstances.

<table>
<thead>
<tr>
<th>Reliability</th>
<th>Agility with Quality</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Managed System Updates</td>
<td>• Application Team Self-Service</td>
<td>• Economies of Scale</td>
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<tr>
<td>• Automated Failover</td>
<td>• Deployment Automation</td>
<td>• Utility: Pay as You Go</td>
</tr>
<tr>
<td>• Disaster Recovery</td>
<td>• Focus on IT Solutions</td>
<td>• Elastic Capacity: Pay for Use</td>
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# Harvard’s Cloud & DevOps Vision

## The Vision for the Cloud & DevOps Program

To improve HUIT’s delivery of information technology solutions to the Harvard Community, we will employ **new methodologies, tools, and processes** that will enable us to simplify and deliver **higher-quality solutions** with **improved robustness and resiliency** in a **more timely manner**.

<table>
<thead>
<tr>
<th>Objectives</th>
<th>Guiding Principles</th>
<th>Key Performance Indicators</th>
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<tbody>
<tr>
<td>1. Develop training to transition staff from administrator roles to cloud and DevOps engineering roles</td>
<td>1. We are committed to staff growth and development as we pursue program goals</td>
<td>1. Percentage of HUIT employees who have successfully completed Cloud &amp; DevOps training</td>
</tr>
<tr>
<td>2. Lead staff transition process and create an empowered, service-focused culture</td>
<td>2. We will ensure close collaboration between the program and other HUIT teams to maintain high levels of existing services</td>
<td>2. Percentage of total apps migrated to cloud providers</td>
</tr>
<tr>
<td>3. Implement application design and deployment patterns to maximize consistency, quality, and reliability</td>
<td>3. Improving deployment methods and processes are as important as the technologies we use</td>
<td>3. Improved app availability from monitoring (uptime percentage)</td>
</tr>
<tr>
<td>4. Migrate existing app workloads with a goal of 75% of existing compute from on-premise data centers to the public cloud</td>
<td>4. Consistent architectural and design patterns are critical to achieving enterprise-level results</td>
<td>4. Successful DR testing processes in place — average time to recovery for migrated applications</td>
</tr>
<tr>
<td>5. Establish operational toolsets and processes to ensure operational effectiveness, awareness, and partnership with service teams</td>
<td>5. Communicating with all employees, partners, and customers is crucial to program awareness and understanding</td>
<td>5. Percent deployment rollbacks</td>
</tr>
<tr>
<td></td>
<td>6. Cost of deployment solutions compared with onsite measurement</td>
<td></td>
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</table>
Migrating Applications: The Process

Phase A: Planning

Step 0: Prepare for Application Migration

Step 1: Hold Initial Engagement Meeting

Step 2: Perform Architectural Discovery

Step 3: Create Migration Schedule

Step 4: Perform Cost Comparison

Step 5: Conduct Kick-off Meeting

Phase B: Execution (Iterative Process)

Step 1: Replatform/Remediate Application

Step 2: Integrate Application

Step 3: Migrate Environments

Step 4: Validate App & Complete Migration

Phase C: Operation & Optimization

Ongoing: Implement, Monitor, Optimize, Repeat

Ongoing: Decommission and Optimize Infrastructure
Cloud IaaS Magic Quadrant

Gartner’s Magic Quadrant shows AWS as a clear leader overall in cloud IaaS.
BC/DR Business Requirements

Goal: Solutions to withstand a range of incidents
Embed and build DR design into cloud architecture and migration
  • Build new systems to incorporate DR needs

Current: BC/DR for mission-critical services using SunGard Availability Services with some failover to 1 Summer St.

Future: BC/DR embedded as required into cloud designs and SaaS offerings.
**BC/DR Business Requirements**

For critical apps that may not migrate immediately, we are exploring a POC for replacing Sungard.

<table>
<thead>
<tr>
<th>Goal</th>
<th>Sub-Goal</th>
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<tbody>
<tr>
<td><strong>Replace Current BC/DR Solutions</strong></td>
<td>Continuous data replication to geographically dispersed off-site data centers; Lower RTO and enhance RPO</td>
</tr>
<tr>
<td></td>
<td>Support (and enhance) Harvard’s cloud migration strategy</td>
</tr>
<tr>
<td></td>
<td>Integrate with Harvard’s network, security, server, and storage infrastructure</td>
</tr>
<tr>
<td><strong>Provide Future BC/DR Solutions</strong></td>
<td>Provide on-prem to multi-cloud BC/DR capabilities (AWS, Azure, Google, etc.)</td>
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<td></td>
<td>Provide inter-cloud to cloud BC/DR capabilities (AWS regions)</td>
</tr>
<tr>
<td></td>
<td>Provide cloud-to-cloud BC/DR capabilities (AWS to Azure, etc.)</td>
</tr>
<tr>
<td><strong>BC/DR 1.0</strong></td>
<td>In FY15, provide BC/DR capabilities for PeopleSoft and Aleph (LTS)</td>
</tr>
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## IaaS Cloud at Harvard: New Risks

<table>
<thead>
<tr>
<th>Risk</th>
<th>Description</th>
<th>Mitigation Approach</th>
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</thead>
<tbody>
<tr>
<td>Cloud vendor lock-in</td>
<td>The leading vendor in IaaS by far is Amazon, who introduces proprietary architecture and coding dependencies for ongoing development</td>
<td>A cloud sourcing strategy is being developed, with Microsoft being reviewed as additional option; formalization of vendor SLA and contract terms required with AWS</td>
</tr>
<tr>
<td>Multitenancy</td>
<td>Multiple projects will work within similar data-center space in the cloud</td>
<td>Separation by org responsibilities, with security groups within the space additionally configured to segregate responsibility</td>
</tr>
<tr>
<td>Pay-per-use</td>
<td>A cost advantage — but this could introduce financial risk if creation is not managed</td>
<td>Embedded DevOps engineers will be centrally managed, sharing a common platform and using advanced monitoring toolsets</td>
</tr>
<tr>
<td>Data distributed outside Harvard</td>
<td>The cloud model requires Harvard to trust the infrastructure management of our vendor community</td>
<td>Cloud vendor contract language must be strong, allowing for Harvard to control ownership and access</td>
</tr>
<tr>
<td>Automated creation with limited organization controls</td>
<td>Infrastructure creation and account creation and management are distributed</td>
<td>Embedded DevOps engineers will be centrally managed; separation of duties is achieved by process, not people</td>
</tr>
</tbody>
</table>
# IaaS Cloud: Mitigating Existing Risk

<table>
<thead>
<tr>
<th>Existing Risk</th>
<th>Description</th>
<th>Cloud Improvements</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Limited disaster recovery capabilities</strong></td>
<td>The disaster recovery process is dependent upon SunGard and relies on restoring applications offsite from tape</td>
<td>Regional configuration and automatic recovery, if needed, with the appropriate application configuration</td>
</tr>
<tr>
<td><strong>QA inconsistencies</strong></td>
<td>No centrally coordinated QA approach for app deployment, resulting in inconsistent software quality</td>
<td>DevOps platform will allow automated QA testing, improving the consistency and speed associated with validating code</td>
</tr>
<tr>
<td><strong>Limited architecture patterns</strong></td>
<td>Today’s infrastructure is deployed as independent one-offs, resulting in learning curves for ongoing management</td>
<td>Deployment platforms specific to arch patterns, with automation and deployment benefits encouraging consistency</td>
</tr>
<tr>
<td><strong>Increasing data storage needs</strong></td>
<td>Increasing capacity for information collection results in overwhelmed storage, higher costs, and lower service quality</td>
<td>Cloud storage options offer alternatives to local storage with advanced management and monitoring capabilities</td>
</tr>
<tr>
<td><strong>Staffing</strong></td>
<td>Infrastructure staff hiring is becoming harder, and internal support demands are increasing; according to Gartner numbers, Harvard staff levels are too low</td>
<td>Automation and consistent processes will make creating supporting infrastructure more efficient; cloud vendors provide some functions performed locally today</td>
</tr>
</tbody>
</table>
Significant CSP Risks

Data breach results in $4.8 million HIPAA settlements
The U.S. Department of Health and Human Services (HHS) Office for Civil Rights (OCR) initiated its investigation of New York and Presbyterian Hospital (NYP) and Columbia University (CU) following their submission of a joint breach report, dated September 27, 2010, regarding the disclosure of the ePHI of 6,800 individuals, including patient status, vital signs, medications, and laboratory results. NYP has paid OCR a monetary settlement of $3,300,000 and CU $1,500,000, with both entities agreeing to a substantive corrective action plan, which includes undertaking a risk analysis, developing a risk management plan, revising policies and procedures, training staff, and providing progress reports.

HHR.gov  May 7, 2014

UNIVERSITY OF MARYLAND’S RESPONSE TO DATABASE BREACH MAY COST MILLIONS

Capital News Service  Feb 27, 2014
Significant CSP Risks

• Data security and integrity
• System availability
• Regulatory compliance
• Financial recourse for failures or breaches
CSP Risk Responses

- Data security and integrity
- System availability
- Regulatory compliance
- Financial recourse for failures or breaches
- Thorough vendor pre-selection vetting process
- Strong contract terms with recourse provisions
- Require vendor to have commercial insurance
- Audit and assess for compliance with terms
- Seek technical/expert assistance when in doubt
University Support Mechanisms

• **Expert resources:** HUIT, OGC, RMAS, Strategic Procurement, peer groups

• **Risk Research/Knowledge Center:**
  [http://rmas.fad.harvard.edu/cloud-service-providers](http://rmas.fad.harvard.edu/cloud-service-providers)

• **Financial:** University’s insurance is limited to damages caused to others; damages or expenses incurred by system owner should be considered entirely self-insured by School or Department

• **Internal funding:** Some limited loss recovery funds may be available through CADM
University Support Mechanisms

• Interest in a Vendor Risk Assessment Tool?
  • Survey-based
  • Scoring against in-place risk controls
  • First-pass vendor evaluation/grading tool
Cloud Service Providers

When weighing options for increasing enterprise computing capabilities or seeking ways to improve IT operational efficiency, the prevailing methods to integrate an external IT services vendor, commonly referred to as a cloud service provider or CSP, to supplement internal IT capacity or for completely outsourcing entire IT functions. While outsourcing has been shown as a valid approach for lowering the initial cost of deploying new IT-based services and shortening the time to which such investment yields tangible benefits, successfully mitigating or eliminating risks associated with this approach is proving to be more elusive. A proper risk assessment must be undertaken before concluding that outsourcing to a CSP will be advantageous over the long-term. This document is intended as an introduction to the basics of CSP risk for business managers considering or have already decided that utilizing cloud-based services, especially for departments with stringent privacy and security requirements, and offers guidance on recommended practices for integrating such vendors into the Harvard environment.

Needs and Gap Analysis. As a prelude to the formal risk assessment, prudent business and project management practice dictates that an organization first conduct a needs analysis to define business objectives, including:

1. Short and long-term operational goals,
Cyber Insurance as Risk Management Tool

When considering engaging a cloud services provider, we recommend that the liability for any breaches reside with the entity controlling the data, as those in control are in the best position to prevent or mitigate any losses. Furthermore, as data breaches can be extremely expensive and can include costs to notify those affected, to recreate lost data, and to make whole anyone who suffered a financial loss following leaked data, it is prudent to require vendors carry insurance to match the potential liability, as their assets alone may be insufficient to cover claims.

Our insurance recommendations for any vendor or firm collecting, storing, processing, transmitting or otherwise handling Harvard Level 3 or 4 information, including cloud services providers, can be found here.

More research on the current costs of data breaches, insurance as a risk management tool, and Harvard's cyber liability coverage are available below.

- [Ponemon Institute - 2014 Cost of Data Breach Study](#)
- [Deloitte Risk Compliance - Cyber Insurance as a Risk Management Tool](#)
- [Harvard Cyber Insurance Coverage Summary](#) (PIN Required)
The Ideal Approach

• Cloud service provider (CSP) risk management process starts BEFORE vendor selection step
• Driven by needs analysis, business objectives, and risk appetite
• Project sponsor/owner stays involved throughout vendor selection and vetting steps; don’t just delegate and dump onto IT
Summary

• Business leader and/or project sponsor must recognize they own, and are accountable for, cloud service provider risk management

• RMAS, HUIT, and others are available to assist with exploring and optimizing options

• Harvard must incorporate the cost of risk into the evaluation of migrating to a cloud provider
Questions?

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• Walter Pizzano  
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Don’t Miss It!

Ending Keynote Speaker: **Dr. Leonard Marcus**

*Founding Director of the Program for Health Care Negotiation and Conflict Resolution at the Harvard T.H. Chan School of Public Health and Co-Director of the National Preparedness Leadership Initiative*

Dr. Marcus will discuss how our individual risk tolerances affect our decision-making and how we can use the concept of “meta-leadership” to better act, collaborate, and direct others in high-stress, high-stakes situations.

He will also discuss “connectivity“, terrorism preparedness and emergency response as well as his research activities which include dilemmas facing emergency preparedness and response, from the 2005 Hurricanes Katrina and Rita to the frontlines of the Hezbollah-Israel war in 2006 to the 2013 Boston Marathon bombings.