Preparing the IT Organization for the Cloud
Building a Migration Plan

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This paper is the fourth in a series on Preparing the IT Organization for the Cloud from the ECAR Cloud Working Group. For institutions that have decided to adopt cloud services, transitioning to the cloud presents both opportunities and challenges. This series provides guidance to help institutions effectively prepare to address these challenges. More information can be found at the ECAR working groups website.

Introduction

Higher education institutions increasingly rely on cloud services to support their administrative, academic, and research activities. Colleges and universities have two primary options regarding how this transition to cloud services will occur: They can allow it to evolve organically over time, or they can develop a deliberate migration plan. The EDUCAUSE Center for Analysis and Research (ECAR) Cloud Working Group believes that the development of an institutional cloud migration plan is the prudent course of action for many organizations. Such a plan will allow the institution to better manage organizational change, mitigate risk, and maximize the financial and service benefits of moving to the cloud.

This paper is intended to help IT leadership develop such a migration plan.¹ It describes several concrete approaches to incorporating the cloud into technical and organizational processes, and it includes examples of the paths followed by several institutions that have adopted one of three IT organizational cloud strategies: Experimental Cloud, Opportunistic Cloud, and Cloud First. This paper also shares the challenges and opportunities associated with each operational strategy.

Even if you have already adopted a few cloud services, it is not too late to develop a cloud migration plan to guide your future efforts. Every institution will likely end up with a unique migration plan that aligns with its IT strategy and cloud computing aspirations, but most effective organizational migration plans address, in some way or another, the following questions:

- How can the institution set reasonable goals with regards to migrating to the cloud?
- Who are the key institutional stakeholders regarding cloud adoption, and how can IT leadership effectively build support among them?
- What key factors should be considered when selecting cloud pilot projects?

Complete Series List

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• How are IT services identified, staged, and moved to ensure that these steps are performed in an orderly fashion?
• How should data and system integration be considered within the context of a migration plan?
• What financial model would make most sense to support the institution’s cloud migration?

Lessons learned from early adopters can and should inform all institutional migration plans. For this purpose, the ECAR Cloud Working Group has included brief case studies that relate the experience of several institutions as a major part of this paper. These examples help illustrate how plans for cloud computing can emerge and how they can influence the direction of the institution.

**Developing the Migration Plan**

As with any significant technology migration, developing a cloud migration plan requires that the organization examine and understand its goals, requirements, and challenges and that careful attention be paid to the selection of pilot projects; the development of stakeholder support; and the technical, security, and compliance details.

However, adopting cloud solutions adds some wrinkles. From a technology perspective, integration with on-premises data and authentication sources can present hurdles. Will the service require a business-to-business VPN, federated identity and authentication services, or access to university data? When planning the migration, it is essential to bring together representatives from the technical areas such as the networking, storage, database, and authentication teams. Ideally, the organization would have an enterprise-architect function that would be able to plan for these integrations.

Institutions will face some common challenges, such as:

• The need for appropriate administrative processes (budget, purchasing, accounts payable, etc.) to support the purchase and use of cloud services
• The difficulty of migrating applications out of an institutional data center and into the cloud
• Vendor selection—your first pilot may set the stage for future migrations, so it is an important decision
• Lack of industry-provided migration paths
• Differing architectures, which require different staff skill sets regarding design, implementation, and operations
• User expectations and how to manage them

In addition, the development of a migration plan will be impacted by an institution’s cloud strategy. Institutions that are just beginning to experiment with cloud services will need identify what’s required to take advantage of cloud services at a foundational level (e.g., networking requirements, security policies). For those that have adopted an opportunistic, or best-fit, approach, there may be more difficult questions of integration with on-premises solutions. And for the institutions that are adopting a cloud-first strategy, migration planning requires a comprehensive understanding of the institution’s data, resources, and needs.
Experimental Cloud

Most IT professionals are familiar with the term “proof of concept”—a demonstration or experiment conceived to identify and/or verify that certain concepts, practices, or technology implementations have the potential for full-blown, sustainable application. A proof of concept is a prototype designed to determine feasibility. In this sense, the experimental cloud stage is similar to a proof of concept.

The focus of experimental cloud is not specific deliverables but a clearer understanding of what works and what does not within the characteristics and limitations of the institution’s infrastructure.

So where to begin?

- Identify 3–5 quick wins that deliver immediate technical and business value.
- Start with services that require minimal integration with other services.
- Keep the technical requirements simple.
- Focus on trying a few services, understanding how they work, how the institution will be billed for the services, how they fit in the institution’s current IT environment, and how they can benefit the institution.
- Look for available funds in current IT budgets to use as seed funding for experimentation with cloud services.

This stage provides the institution with a good opportunity to explore important factors such as the characteristics of cost; service performance expectations; service level agreements (SLAs) and how they differ from traditional hosting service provider agreements; what potential hurdles should be expected; what the cloud is doing for stakeholders and the institution; and how the cloud can be quantified and measured as part of the experimentation.

As in the case of proofs of concept, some homework is involved; you will need to consider some key issues in advance, such as:

- **Data Integration**: How will data integration work (e.g., point-to-point integrations, message brokers, etc.)? This will be particularly important for SaaS.
- **Identity Management**: How will users authenticate to services, and is federated identity management an option?
- **Security Boundaries and Trust Relationships**: How will the institution’s environment and data be segregated from other clients’?
- **Business Infrastructure**: What type of business infrastructure will be needed (e.g., to support billing)?
- **Networking**: How will it change the institution’s networking (e.g., VPN with cloud vendor)?

Other issues should be considered as well. Even low-risk tools bring risks, and these often concern the execution of service contracts and the accompanying SLAs. Most contract issues with cloud-based services surround the institution’s ability to recover its data created by the cloud service or tool once the

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**Experimental Cloud**: The IT organization begins to learn about the various cloud services available to them in the forms of SaaS, PaaS, and IaaS. The organization may begin deploying some common SaaS solutions (such as e-mail and collaboration tools), which sometimes grows into testing IaaS deployments (e.g., building experimental servers for learning purposes).

For more about SaaS, PaaS, and IaaS, see *Preparing the IT Organization for the Cloud: An Introduction*. 

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relationship with the service’s company comes to an end. Tools with low data-recovery requirements are often the best for experimental cloud implementations.

The biggest challenge during the experimental cloud stage is managing the expectations and biases (or misconceptions) of stakeholders. It is not uncommon at this stage to have varying levels of understanding about what cloud computing entails, the benefits that it may provide to the institution, the ease with which the benefits can be attained, or the risks that the institution may incur by moving to the cloud. For example, a prevalent perception that the cloud is insecure may make it difficult to recruit willing business partners for pilot projects. Conversely, an overly optimistic assessment of benefits may stifle progress if the expected level of savings does not materialize early in the project.

The experimental cloud stage should better enable IT units to answer the question, What are we trying to accomplish and why are we going down this road? Once the answer to this question has become clear, the institution will be in a better position to look for real-world opportunities to leverage and ask another question: How are we going to get there? What is most important at this stage is to manage project scope creep (i.e., keep it simple, quick, and minimal) and curb the temptation to turn pilot projects and proofs of concept into real-world production implementations.

Case Study: Career Services Tools at Denison University

The proliferation of SaaS cloud tools and the speed at which these tools are available in the marketplace are unprecedented. As with the adoption of any new tool or service, most institutions are understandably cautious about embracing SaaS tools, especially when the companies behind them can sometimes be less than a year old. Traditionally, and with the implementation of any on-premises system, embracing a new tool, software, or service also required the institution to look at the impacts of the software on a horizon of three to five years, based on considerations of hardware life. With rapid deployment of cloud-based SaaS tools, institutions can now look at those services that have the potential for immediate impact, despite being unproven or new, without having to contemplate the lifespan of hardware.

In the spring of 2015, Denison University, a small liberal arts college in central Ohio, hired a new dean of career preparation. Eager to try some new engagements with various emerging career services tools within the Center for Career Exploration, the dean adopted a philosophy of “Let’s throw some tools out there and see if any stick!” With this seemingly low-risk, potentially high-reward approach, the center engaged with two new cloud-based services: Handshake and Switchboard.

The end-user perspective from the center’s staff toward these tools was fairly simple—with access and a little self-service training, they could be operational. Additionally, the center’s staff could take the branding from a previous on-premises tool and simply tell the students that the new tool (Handshake) was a replacement for the old tool. (URLs could simply be redirected, and from the Denison student portal, links to the old tool would be updated to links for the new tool.) From an IT perspective, the only integration work was helping the center with a small batch feed (a simple .CSV file) that would populate the new system with student information from the college’s SIS system. The other system, Switchboard, was a self-discovery tool and had no integrations points at all. The go-live for these services took days, as opposed to weeks or months for similar on-premises solutions. The speed at which these tools can become production-ready was, of course, a primary impetus for implementing cloud tools.
Other Examples: CloudLab and Chameleon

As institutions look for opportunities to embrace experimental cloud deployments, they should not overlook their research community, most notably computer-science researchers who might be looking to conduct large-scale cloud research projects. Two emerging open cloud research platforms will enable computer scientists and researchers to experiment with building transformative cloud futures. NSF has funded the creation of two cloud computing test-beds: CloudLab and Chameleon. These testbeds are broadly available to U.S. researchers, instructors, and students free of charge and allow for the exploration of new advancements in cloud networking, storage, and security.

The primary goal of these platforms is to support a broad range of cloud computing research initiatives. Academic researchers can use them to run experiments that seek to improve the fundamental architectures of cloud computing—from optimizing virtualization technologies to improving the performance and resiliency of storage systems, to securing data in the cloud, to experimenting with new networking technologies, and more. The facilities are also available to instructors who want their students to “build their own clouds.”

Both the CloudLab and Chameleon projects comprise several anchor institutions: the University of Utah, Clemson University, the University of Wisconsin–Madison, the University of Massachusetts at Amherst, the University of Chicago, Northwestern University, the University of Texas at Austin, the University of Texas at San Antonio, and the Ohio State University.

Opportunistic Cloud

As noted in previous installments of this series, opportunistic cloud is driven mostly from within an institution by departments and business units turning to the marketplace in search of functionality and capabilities to meet specific business needs.

So when does cloud make sense? What is the low-hanging fruit? Good candidates for a cloud alternative include new applications or services with customization, flexibility, and convenience requirements that on-premises services cannot provide at a competitive cost. Other likely candidates include applications that do not cross over multiple business units or processes, do not consume or store regulated or financial data, can tolerate some down time, have limited financial and/or political risk, work in isolation, or have very low dependency on other applications.

Institutional web presence and web applications that do not consume or store sensitive data are good examples of opportunistic cloud deployment. With appropriate policy guidance, e-mail, collaboration tools, storage, web presence/web apps, and content management can be considered.

Depending on the institution’s needs and capabilities, more complex IaaS or PaaS solutions might be good candidates for integration into the organization’s cloud portfolio. In these cases, the institution might not move its entire infrastructure to the cloud but instead develop hybrid cloud solutions or use public cloud services to meet well-defined needs. For example, an organization might find that it needs to be able to provision web services and associated storage more rapidly and dynamically than its on-premises...
solutions can. The organization could either turn to a public cloud solution for this use case or develop a hybrid solution, using a combination of on-premises and cloud resources.

Some good practices include:

- Develop organizational enthusiasm and obtain commitment from executive management and other key stakeholders.
- Develop a strategy or plan that identifies project sponsors.
- Focus on applications and services that align with core cloud characteristics.
- Leverage implementations to shape governance structures, nurture user communities, and draft necessary policies.
- Determine whether parameters need to be established for what data can be stored and/or processed in the cloud, including potentially developing or leveraging a data-classification methodology.\(^5\)
- Develop standard procedures for assessing the total cost of ownership for both on-premises and cloud solutions.\(^6\)
- Understand that applications that use common development environments (e.g., Java) may be an easier move to PaaS.
- Consider implementing cloud collaboration tools, which many institutions have done successfully. Content management systems or web services may be good candidates for cloud migration.
- Consider nontransactional applications and systems with low-integration requirements as potential opportunities to leverage. Examples include data warehousing and institutional websites.
- Leverage cloud-computing capabilities for backing up data, creating failover servers and serving as a secondary data center to supplement existing institutional disaster recovery strategies.

**Case Study: Google Apps at NC State**

North Carolina State University began its investigation of cloud-based e-mail solutions as a response to complaints that the on-premises solution for faculty and students was dated and did not provide adequate storage allocations. Further, administrative staff used an expensive groupware system separate from the student e-mail and calendar solutions, creating headaches. The university determined that it should investigate upgrades to the on-premises solutions and compare them to cloud-hosted e-mail and calendar services in order to provide a unified solution that was more feature rich and cost-effective.

The vice chancellor for information technology charged a team to investigate potential solutions. This core team worked with the university’s IT governance committee and created a task force that was responsible for assessing the options and making a recommendation. The task force evaluated three cloud solutions and compared them to the on-premises solution. Considerations in the evaluation included costs (e.g., support, migration tools, staff effort to migrate and maintain the service), features, market share of solutions, integration with campus infrastructure and authentication systems, security and privacy, legal issues, and contract terms. The task force recommended Google Apps for Education to replace its on-premises solutions.

When planning the migration, NC State addressed technical, business, and support needs. A third-party solutions developer was engaged to create a custom migration tool from the groupware product to Google Apps because there was no industry-provided migration path. Internal staff developed the
technical migration process for faculty/student e-mail. Technical planning determined that at that time, the on-premises e-mail relays would need to remain to support e-mail archiving.

Scheduling the migration around university processes and business needs was one of the most challenging aspects. The ultimate success of the migration resulted from a concerted effort to train staff to provide support on the day of the transition. On “Google Day,” teams of help desk staff, power users, and other technical staff wearing Google Day t-shirts were physically present across the campus to help users with the transition.

Cloud services continue to proliferate at NC State, with central IT, academic, business units, and faculty subscribing to a variety of services. NC State has made a deliberate decision to approach cloud services on a case-by-case basis to ensure that chosen solutions are optimized for the institution’s business needs.

Case Study: AWS at Binghamton University

In 2014, Binghamton University launched a request for proposals to acquire a replacement portal product, seeking a provider for a role-based portal that allowed both quick access to content and high usability. The existing portal was largely unused by the university community, and a more dynamic tool was needed. Technical requirements for the new portal included integration with institutional authentication and authorization tools and with key campus systems such as Ellucian, DegreeWorks, and Blackboard Learn. The RFP offered respondents the option of cloud or locally hosted applications.

The Innovations Team of Information Technology Services at Binghamton University responded to the RFP and ultimately won the bid, citing reduced costs, local control, change management, and data governance as positive differentiators from commercial solutions. Functionality built into the new portal included the ability to deliver individualized content to the person who is logged in. Students, for instance, can view content including grades, courses, and the status of the washers and dryers in the residential community in which they live. Faculty might see course rosters and payroll information.

Over the course of project development, which was initially envisioned as a locally hosted application, the Innovations Team turned to cloud providers to host the internally developed tool. Speed of portal development and deployment was essential, and existing, internal IT processes for the creation of servers and virtual servers was too unwieldy and slow. In addition, because the portal environment needed to be robust and accessible, speed of recovery in the event of a failure or other incident was deemed critical. Amazon Web Services (AWS), the selected cloud provider, was able to provide deployment and recovery services swiftly. With the cloud service provider, many tools were available to the portal developers that are challenging to acquire on campus, including an easy-to-use management interface, scalability, and test-to-operations capacity.

The university continues to investigate cloud services as an alternative to locally hosted providers to provision services, with central IT and business units working collaboratively to determine viable options on a case-by-case basis.
Cloud First

Institutions choosing to adopt an all-in or “cloud first” strategy must approach migration in a different manner from institutions using a more opportunistic approach. Instead of viewing the cloud migration as a series of one-off projects that build relatively isolated services in a cloud environment, cloud-first institutions are essentially building a new data center within the confines of an IaaS environment. This requires careful planning and architectural design. Beginning that design process before moving a large number of services to the cloud results in a more organized approach and reduces rework in later stages of the migration.

Building a Data Center in the Cloud

When institutions move to a cloud-first strategy, they leave behind quite a bit of legacy technology baggage. One of the great appeals of cloud infrastructure is that it frees an institution’s IT team from the burden of worrying about power, cooling, capacity, and other parameters of an on-premises data center. However, IT leaders should not view a cloud migration as a free pass that leaves all of the infrastructure work to vendors. Institutional IT architects must still concern themselves with the design of a data center in the cloud that meets the institution’s business requirements, security needs, and performance goals.

Architects should work closely with networking professionals, security analysts, and representatives of other IT disciplines to lay out a logical design that incorporates many of the same issues considered by the designers of on-premises data centers. Some of the questions that should be addressed during this process include:

- How will systems of varying security levels be isolated from each other? What zones of security will exist?
- What IP addressing scheme will be used? How does this align with the physical campus IP addressing scheme?
- How will systems physically located on campus connect securely to the cloud environment? Is a direct fiber connection to the cloud provider required, or will a VPN tunnel suffice?

The questions asked during this phase of the process must also extend beyond data center design issues and address the computing standards used throughout the environment. In many cases, it will be both possible and desirable to simply adapt an institution’s existing on-premises processes to a cloud environment. In other cases, addressing computing standards will require significant modifications or the creation of new standards. Topics to address include:

- Commissioning and decommissioning of server instances
- Financial management
- Change and configuration management
- Encryption of sensitive information
Addressing these issues before migrating a large number of services to the cloud allows the institution to move services into a reasonably mature environment. Postponing these discussions until after a cloud move may introduce many different requirements for rework as the institution adopts new practices.

**Migrating Legacy Services**

Once an institution builds its data center in the cloud, it often immediately begins placing new IT services into that environment as they are built. This eventually results in a bifurcated computing environment where legacy services exist in the on-premises data center while newer services exist in the cloud. Eventually, institutions will want to begin migrating those legacy services to the cloud, as they set their sights on the retirement of redundant physical infrastructure to realize cost and space savings on campus.

As an institution begins planning the migration, the first step is the development of a comprehensive catalog of legacy IT services. This can be straightforward if the institution maintains an existing and accurate service catalog. In other cases, the migration team may find itself developing a catalog as it conducts its migration planning. In either case, the catalog should include some key information to assist with the prioritization:

- Server listings
- Storage requirements
- Database requirements
- Dependencies on other services
- Customers
- Upgrade cycle/timing
- Peak usage periods
- Criticality to the institution

Each institution may then develop its own scoring methodology to help stage a migration plan that fits within its technical strategy and risk tolerance. The main objective is to develop a rating of both technical and business risk. For example, an institution might choose to use a technical risk score derived from the number of server instances and dependencies on other services and then develop a business risk score based on the criticality to the institution.

This scoring information can then be used to develop a rough timeline for migrating legacy services, beginning with services with low risk scores and working toward riskier services as time goes on and the institution develops experience with the new environment. The timeline should then be refined based on operational considerations to develop a detailed project plan. For example, if a service is slated for replacement or a major upgrade in six months, it would be wise to defer the migration until that time, reducing the potential downtime and the number of times that administrators work on a service.

Migration plans can be quite complex because institutions may need to move hundreds of services over a period of several years. Glitches will arise, and it’s important to view the plan as a work in progress, shifting timelines and priorities as other issues arise.
Case Study: University of Notre Dame

The University of Notre Dame adopted a cloud-first strategy in 2014, with the goal of moving 80% of IT services to the cloud over three years. As of fall 2015, approximately one-third of IT services were operating on either SaaS platforms or in Notre Dame’s AWS data center. University IT professionals developed a comprehensive migration plan that stages service migrations based on a combination of business risk, technical risk, and operational timing considerations.

The Cloud-First Team at Notre Dame benefits from technical staff sharing a common office space. System engineers, database administrators, security professionals, network engineers, architects, and project managers all spend approximately 50% of their time working together to build the institution’s new data center environment and migrate services from the on-premises data center to the cloud. Notre Dame hopes to complete enough of the migration to close down one of two on-premises data centers by the end of 2016.

Case Study: University of Washington

The University of Washington began the move to cloud computing with the adoption of cloud-based e-mail to replace an aging, on-premises e-mail system. Today, all new services look to the cloud first when determining what IT resources will be used to deliver value to the university community. Partnerships with Amazon and Microsoft have led to PaaS offerings like Azure and AWS in an effort to replace on-premises server hosting. New products have been adopted, including a new cloud-based IT service management system, ServiceNow, replacing a locally hosted solution.

The most dramatic move to the cloud is happening with the university’s adoption of Workday, a SaaS HR/payroll solution. Workday will replace several legacy systems, most of which were developed by the university, which also maintains and hosts them. This is a major campus-wide effort, with stakeholders not just in IT but also in human resources, payroll, and many academic departments. Workday replaces 33-year-old software with a solution that is cost-effective, constantly updated, and agile enough to cope with frequent changes to laws and regulations. Workday also frees up resources spent on server hosting, software development, and many other infrastructure-related tasks, giving staff more time to support the function of the software instead of the software itself.

Conclusion

Cloud migration may already be occurring at your institution, and the pace of adoption by business units may be faster than the pace at which institutions can plan a migration. Institutions of higher education have two primary options: either allow the transition to the cloud to evolve organically, or develop a deliberate migration plan. Developing an institutional cloud migration plan is a concerted effort involving IT, business units, information security, and compliance and requires a clear understanding of and careful attention to institutional goals and requirements, potential opportunities and challenges, and the risks to the institution’s information security posture. A coordinated approach is the best way to get critical stakeholder buy-in, address institutional concerns, and provide needed support to the academic community.
In developing a migration plan, look for interesting pilots that will provide insight to potential integration problems with institutional infrastructure and in-house applications, vendor selection and definition of service levels, and staffing and skill sets necessary to sustain a migration. Managing expectations and not having the right administrative processes (budget, purchasing, accounts payable, etc.) in place to support purchase and use of cloud are common but not insurmountable challenges.

It is important to keep in mind that moving to the cloud is not risk-free. As stewards of institutional data, colleges and universities are accountable to understand the risks associated with cloud computing and hold cloud computing providers to the standards required to keep institutional data secure and in compliance with regulations. In the next installment of this series, we will provide more detail and pointers to additional information about risks in the cloud before we then move to operationalizing the migration plan.

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Notes

1. Note that this paper focuses on planning the migration; a future paper on operationalizing the cloud will look at the execution of this planning.

2. Current IT funding models can at times present difficulties to how cloud is budgeted. As was noted in Teri Abbo et al., *TCO for Cloud Services: A Framework*, ECAR working group paper, April 24, 2015, “On-premises solutions and cloud-based solutions typically have different expense cycles and significant differences in capital versus operational expenses.” In addition, “Funding models for sponsored research add complexity in comparing costs between purchasing computing equipment and using cloud options for sponsored research.” More on this can be found in Jerrold M. Grochow, “Federal Indirect Costs Affect Total Cost of Ownership,” *EDUCAUSE Review*, April 13, 2015. In addition, a recent ECAR working group paper, *Aligning IT Funding Models to the Pace of Technology Change: Enabling Financial Flexibility for Core, Flexible, and Transformative Services*, focuses on this issue as well, noting: “The complications with purchased IT services in today’s world make labeling expenditures as operating expenditures (OPEX) or capital expenditures (CAPEX) a challenge. Notably, the growing adoption of cloud services has blurred the line between CAPEX and OPEX.”

3. See CloudLab.

4. See Chameleon Cloud.

5. For more on the importance of developing data guidelines, see Douglas Blair et al., *The Compelling Case for Data Governance*, ECAR working group paper, March 19, 2015, and the ECAR working group paper *Establishing Data Stewardship Models*. To learn more about data classification, visit the 2014 Information Security Guide Data Classification Toolkit.

6. See Abbo et al., *TCO for Cloud Services*, to effectively understand and analyze all costs associated with running a system or service on-premises versus moving it to the cloud.