2017 Trends and Technologies: Cloud
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## Citation


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Introduction

Since 2014, EDUCAUSE has examined higher education’s top strategic technology priorities. This year, in addition to reviewing the overall list of strategic technologies, EDUCAUSE will publish nine separate reports examining in detail the technology domains we asked about and reviewing each domain’s component technologies and the trends associated with those technologies. This report covers the 12 technologies and 8 trends included in the cloud domain.

A 2015 EDUCAUSE study found that 85% of colleges and universities had moved at least one service to the cloud.\(^1\) Two years later, that number is likely even higher. For institutions determining cloud strategy for their IT services, the question is not if they should consider cloud options, but how the cloud fits into their larger sourcing strategy. Some institutions are adopting a cloud-first strategy, while others are evaluating services on a case-by-case basis. In either model, cloud technologies are having an impact on the work of higher education IT, resulting in trends that reflect an attempt to both manage a quickly changing IT environment and take advantage of new opportunities to align with institutional mission.

Understanding the impact of cloud technologies is an important piece of managing and adapting to these changes. In addition to the potential for faster deployment, easier upgrades, and immediate scalability, the cloud is bringing new technologies that expand capacities for research computing, security, data storage, and data center management.\(^2\)

The focus of this report is the trends and strategic technologies associated with the cloud. Mature, commonly deployed technologies (such as financial information systems or networks) may be among the most mission-critical technologies, but they are generally more likely to receive operational rather than strategic attention.\(^3\) Strategic technologies, by contrast, are the relatively new technologies institutions will be spending the most time implementing, planning for, and tracking in 2017. None of the 12 cloud technologies analyzed in this research is currently in place in more than 30% of institutions.

Technologies are what IT organizations do. Trends, on the other hand, are widespread external factors that influence institutional and IT strategy and often spur the adoption of technologies. This report examines the trends that institutions are paying the most attention to and that are influencing emerging institutional IT strategy the most. This year’s trend list included eight items closely associated with cloud.
Covered in This Report

**Trends**

- Bimodal IT (managing two separate IT delivery modes, one focused on stability and the other on agility)
- Business process redesign
- Changing enterprise system architectures, integrations, and workflows
- Changing vendor-institution relationships (moving from a transactional to a strategic relationship)
- Cross-institutional partnerships and consortia
- DevOps movement to bring development and operations staff together to better manage an end-to-end view of an application or IT service
- Incorporating open standards into enterprise IT architecture
- Increasing complexity of technology, architecture, data

**Technologies**

- Blended data center*
- Blockchain
- Cloud access security broker (CASB)
- Cloud monitoring platform to track distributed infrastructure apps, tools, and services
- Cloud-based HPC
- Cloud-based identity services
- Cloud-based security services
- Data center capacity planning and management tools
- Institutional support for public-cloud storage
- Private-cloud computing
- Support for use of personal cloud services
- Uses of APIs*

*Part of the overall 2017 Top 10 Strategic Technologies
Findings and Recommendations

What do we know about the kind of progress higher education might make with cloud technologies? What trends might influence this progress? While our data can never be a substitute for an institution’s own cloud strategic plan or roadmap, this report can inform an institution’s overall IT strategy and cloud technology-deployment strategy.

The Trends

We characterized a trend as “influential” if it was already incorporated into IT strategy or exerting a major influence over emerging IT strategy. We used that characterization to classify the trends into four levels of influence, based on the prevalence of influence across institutions:

- **Most influential**: Trends that are influential in 61% or more of institutions
- **Taking hold**: Influential in 41–60% of institutions
- **Worth understanding**: Influential in 21–40% of institutions
- **Limited impact**: Influential in 20% or less of institutions

Understand how the most influential trends are affecting your institution.
None of the cloud trends is influential at 61% or more of colleges and universities.

Review the trends that are taking hold and address them at your institution.
Three trends (listed below from highest to lowest level of influence) are influential at 41–60% of institutions:

- **Increasing complexity of technology, architecture, data.** The pace of change in technology continues to increase. As institutions try to keep up, they are finding that the environments they manage are becoming more and more complex. New technologies need to be incorporated into the environment, older technologies need to be updated, and end users expect it all to work seamlessly. As the IT environment grows, and as cloud services are added to the environment, IT complexity increases.

- **Business process redesign.** Examining and redesigning work processes through business process management can uncover opportunities for greater efficiency, possibly allowing for cost savings or reallocation of resources. For example, business process improvement can decrease the need for customization of enterprise systems and increase alignment
between business processes and institutional mission. A move to the cloud can be a catalyst for examining business processes in this way. Because processes tend to span functional unit boundaries, strategies in this area are most successful when they include multiple units at an institution. Business process is more than simply workflow; it encompasses workflow design, systems capabilities, motivation, human resources, policies, rules, funding, and other resources. All should be considered in a business process redesign strategy.

- Changing enterprise system architectures, integrations, and workflows. The many facets of higher education require colleges and universities to run a large set of enterprise-wide computing systems. Options for these computing systems are expanding and becoming more specialized. In addition, the sourcing of those systems is evolving. Whereas IT once ran all enterprise systems on-premises, many now choose cloud options, with the result being a mix of different systems from different vendors, some on-premises and some in the cloud. These changes require IT to focus on system architecture, integrations, and workflows to ensure adequate interconnection between systems and data, enabling many different computer systems to effectively share information, automate data-sharing workflows, and efficiently support task workflows for students, faculty, and staff.

Understand these trends, and consider their possible role at your institution.

The influence of three trends (listed below from highest to lowest level of influence) is limited to 21–40% of institutions. Higher education is monitoring these trends with respect to emerging IT strategy and the deployment of cloud strategic technologies:

- Changing vendor-institution relationships (moving from a transactional to a strategic relationship). Next-generation enterprise IT is characterized by a shift in IT’s role from being a technology provider to a service broker and partner. This shift allows for a different level of conversation between institution and vendor, as IT can broker a strategic conversation between the two, bringing technology investments into closer alignment with institutional mission in the process. In the broker role, IT can ensure that cloud contracts meet institutional needs for data management, security, backup, and more.

- Cross-institutional partnerships and consortia. In an effort to be as efficient as possible with enterprise IT systems and services, many institutions look to cross-institutional partnerships and consortia as a way to possibly reduce costs or gain efficiency. Purchasing consortia are a good example.
In a purchasing consortia, a group of institutions develops a contractual relationship that allows for collective cost savings and the opportunity to work more closely with system and software vendors, including cloud vendors.

- **Incorporating open standards into enterprise IT architecture.** Getting the typical institution’s wide variety of complex enterprise systems to interconnect is difficult to begin with and arguably more complicated when some of those systems are in the cloud. Most enterprises adopt an existing framework or standard for how complex data architectures and communications between systems will work to produce a truly integrated computing environment. For example, The Open Group Architecture Forum framework for enterprise architecture is a widely adopted set of standards, methods, terminology, business workflow descriptions, and tools for standardizing systems-planning language and methods and for avoiding dependence on proprietary vendor solutions.

The remaining two trends were of limited impact in our research: DevOps movement to bring development and operations staff together to better manage an end-to-end view of an application or IT service, and bimodal IT (managing two separate IT delivery modes, one focused on stability and the other on agility).

**The Technologies**

The list of strategic technologies included in our survey was derived from the 2016 list and from several authoritative sources that annually identify emerging and maturing technologies in higher education. A total of 12 of the technologies in the survey pertain to cloud. For each of those technologies, respondents selected one of six response options to indicate the level of activity for that technology at their institution in 2017:

- **Institution-wide deployment:** Full production-quality technical capability is in place, including ongoing maintenance, funding, etc., with deployment potentially supporting institution-wide access.

- **Expanding deployment:** In 2017, we will move from initial or partial to broader or even institution-wide deployment.

- **Planning, piloting, initial deployment:** This technology is not yet available to users; however, meaningful planning for deployment is either in development or in place. Staff are investing significant time (multiple person-weeks of effort) and resources in executing the plan to pilot or deploy this technology within a defined time frame.

- **Tracking:** Multiple person-days of effort will be assigned but restricted to monitoring and understanding this technology (much more than just reading articles).
- **No deployment**: None of this technology is in place, and no work will be under way or resources committed for this technology in 2017.

- **Don’t know**: I don’t know what this technology is.

We assigned attention scores to the responses, and the scores were weighted to highlight responses indicative of higher levels of activity (expanding deployment; planning, piloting, initial deployment; and tracking) over responses that suggest little or no activity of that kind (institution-wide deployment, no deployment, and don’t know).

Understanding what peer institutions (both current and aspirational) are doing can help you gauge whether your institution’s current approach is on track or might warrant reconsideration. Some technologies are more relevant for some types of institutions than others. We looked at broad demographic categories, including Carnegie class, institutional size, and approach to technology adoption and found differences in attention score based on those factors. In figure 1, the U.S. mean is the average attention score for an item from all U.S. respondents. The minimums and maximums are the lowest and highest average attention scores among all groups within the categories of Carnegie class, institution size, and timing of technology adoption, with labels indicating which group or groups returned that score. In the event of a tie, all tied groups are represented.
Looking beyond attention scores, we sought to understand the kind of effort that the largest proportion of institutions is devoting to each technology. We created four attention categories by combining adjacent responses:

- Expanding deployment and institution-wide deployment, combined as **deploy and maintain**
- Planning, piloting, initial deployment and expanding deployment, combined as **pilot and deploy**
- Tracking and planning, piloting, initial deployment, combined as **decide and plan**
- No deployment and tracking, combined as **track and learn**
Although nearly every technology was represented to some degree in each attention category, we assigned each technology to the attention category with the greatest amount of institutional activity for that technology in 2017.

Complete initial deployment and maintain these technologies.
Our research shows that institutions are planning to deploy and maintain one cloud technology:

- **Institutional support for public-cloud storage.** Public-cloud storage options provide easy access, sharing, and backup of files and data. Institutions are moving to options such as Box to provide cloud storage and collaboration services that work with the university’s identity management system, integrate with other services, and provide contractual assurances of privacy, security, and uptime.⁶

Pilot and start deploying these technologies.
Our research shows that institutions are planning to pilot and deploy one cloud technology:

- **Uses of APIs.** An application programming interface (API) defines how a system interacts with other systems and how data can be shared and manipulated across programs. A good set of APIs is like building blocks that allow developers to more easily use data and technologies from various programs. APIs are used in many ways in higher education—for example, to pull data from the student information system into the learning management system, to integrate cloud-based with on-premises services, as an approach to security, and to access web-based resources.

Decide when these technologies fit your strategy, and start planning.
Institutions are watching one cloud strategic technology carefully, deciding and planning for potential future deployment:

- **Blended data center.** As institutions move services to the cloud, they usually move into a blended environment where they continue to maintain an on-premises data center while also managing a set of services that may run the gamut from software as a service to infrastructure as a service. While cloud-based solutions offer advantages related to agility, performance, and scalability, the blended environment requires a shift in strategy to one that encompasses both environments.
Learn about and track these technologies.
Institutions are tracking and learning about the following cloud strategic technologies (listed below from highest to lowest attention):

- **Private-cloud computing.** Private-cloud computing refers to cloud infrastructure operating for a single institution and closed to other use. Some institutions have used virtualization technologies to run parts of their environments on private-cloud virtualized platforms.

- **Cloud-based security services.** These services are usually used in conjunction with on-premises services and tools to enhance an institution’s information security posture.

- **Cloud-based identity services.** Cloud-based identity services manage identification and authentication processes to IT systems or data. Authentication services ensure that only authorized individuals (or other systems) are permitted to access IT systems and data.

- **Data center capacity planning and management tools.** Data center capacity planning is a strategy that allows IT to meet the institution’s evolving needs for data center resources such as storage, power load, and cooling capacity. Some vendors provide tools for capacity planning. IT service management frameworks such as ITIL describe subprocesses for capacity management that include business capacity management, service capacity management, and component capacity management.

- **Support for use of personal cloud services.** Faculty, staff, and students may use personal cloud services such as Apple’s iCloud or Google Drive instead of or in addition to institutionally supported cloud storage services. IT needs to be aware of this possibility and prepare guidelines, education, and policies to ensure adequate information security.

- **Cloud access security broker (CASB).** A CASB is a service that applies institutional security policies, such as authentication and authorization rules, to cloud-based resources. A CASB extends institutional information security policies and practices to the cloud-based services that the institution uses.

- **Cloud-based HPC.** “Traditional high-performance computing [HPC] workloads are characterized by tightly coupled scientific applications for which substantial processing capability, high-speed and low-latency interconnects, and performance parallel input/output are required. That is, they require high performance.” When these characteristics are provided by cloud vendors, as they now are, additional characteristics typical of cloud are inherited: ability to scale up and down quickly on demand in a pay-as-you-go environment.
Cloud monitoring platform to track distributed infrastructure, apps, tools, and services. The proliferation of cloud applications and services is challenging to support because it can result in a mix of distributed and centralized systems and tools, some under IT’s control and some not. Cloud monitoring platforms allow institutions to track the expanding set of cloud resources.

Blockchain. Blockchain is a public, distributed ledger of transactions maintained by a peer-to-peer network. Its most notable current use is to support value exchange with Bitcoin, but it has also been considered in the context of credentialing.8
Preparing for the Future

Understanding the technologies that are most relevant for your institution and how fast a certain strategic technology may be growing is critical to institutional IT strategy. We estimated the pace of growth based on the percentage of institutions we predict will implement each technology over the next five years (by 2022). Figure 2 positions each technology in one of 12 cells based on institutional intentions (the “recommendation for today”) and the expected pace of growth of that technology. Reflecting what was noted above, the figure shows that most of the technologies we tracked are still being explored—rather than deployed—by most institutions.

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<th>MODERATE</th>
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<td><strong>Pilot and deploy</strong></td>
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<td>Uses of APIs</td>
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<td><strong>Decide and plan</strong></td>
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<td><strong>Track and learn</strong></td>
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<td>Data center capacity planning and management tools</td>
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Figure 2. Plans for 2017 and pace of growth for cloud strategic technologies
Conclusion

The rapid development of options for cloud services and technologies is resulting in changes to higher education IT that extend beyond the cloud domain. The trends described in this report reflect the cloud’s broad impact. Adapting to an increasingly complex environment, managing new relationships with vendors, adjusting business processes, developing cross-institutional partnerships—these trends are having a direct impact on the development and management of IT strategy and are leading to a deepening connection between IT and the institutional mission. In addition, cloud adoption is a major player in a growing shift away from IT as a provider of technologies to IT as a partner and service broker. In that latter role, IT is better positioned to help the institution make technology decisions that directly support institutional mission and goals.

Even though institutions are aware of and starting to adapt to those trends, the adoption of most cloud-related strategic technologies remains modest. This year’s review of emerging cloud technologies shows that most colleges and universities are paying careful attention to new technologies by tracking and learning about them but largely have no plans in place for adopting them. Given that these are, by definition, new technologies, it is understandable that they have not yet reached wide adoption. However, the trends being driven by the cloud are likely to continue to exert a strong influence on institutional IT strategy, and institutions would do well to position themselves to be able to take advantage of new cloud technologies as part of that overall strategy.
Notes


2. For a more detailed description of the potential benefits of cloud technologies and services, see Asbed Bedrossian et al., *Cloud Strategy for Higher Education: Building a Common Solution*, November 2014.

3. EDUCAUSE tracks these types of established technologies in the Core Data Service because they are widespread enough to enable institution-level benchmarking.

4. Next-gen enterprise IT is Issue #9 on the list of 2017 Top 10 IT Issues. In Betsy Reinitz, “Enterprise IT Perspectives on the 2017 Top 10 IT Issues,” *EDUCAUSE Review*, January 17, 2017, the Enterprise IT Program Advisory Committee describes the opportunity provided by next-generation enterprise IT to align more closely with institutional strategy through the use of a variety of solutions and services to meet institutional goals.

5. Primary sources were The Horizon Report, Gartner’s Top 10 Strategic Technology Trends for 2014, and multiple 2014 Gartner Hype Cycles (education, big data, cloud computing, cloud security, enterprise architecture, enterprise information management, GRC, identity and access management, IT operations management, privacy, business intelligence and analytics, and emerging technologies). We augmented those with several additional technologies, most notably in analytics.


8. For more information about the use of blockchain in higher education, see [ELI 7 Things You Should Know About Blockchain](http://www.educause.edu/ir/library/index.php/IT-Perspectives/ELI-7-Things-You-Should-Know-About-Blockchain).

9. For a more thorough discussion of the shift in IT from managing technologies to managing services, see the ECAR study *IT Service Delivery in Higher Education*.