Contents

Introduction and Overview 3
Key Findings 5
The Top 10 Strategic Technologies for 2017 7
Descriptions 8
Institutional Differences 11
What We Don’t Yet Broadly Understand 15
Implications 17
Advice 23
Acknowledgments 25
Appendix: Methodology 26

Author

Susan Grajek, EDUCAUSE

Citation


©2017 EDUCAUSE. Creative Commons BY-NC-ND 4.0.
Introduction and Overview

Higher education has two primary technology priorities in 2017: re-architecting enterprise IT and supporting student success initiatives. Together, they encapsulate the 2017 top 10 strategic technologies.

IT organizations are incorporating cloud and mobile technologies into their enterprise IT, introducing additional layers of security, and preparing enterprise systems to support new institutional data needs. The most prominent of those data needs concerns student success. Student success technologies depend on data to drive analytics algorithms. Using technology to help students learn and attain credentials also draws on new and evolved specialized technologies to support classroom learning, educational planning, student advising, and ongoing feedback to students, faculty, and other academic stakeholders.

These two technology priorities parallel the 2017 top 10 IT issues. The primary focus of the year’s IT issues is “Foundations for Student Success,” comprising IT foundations, data foundations, effective leadership, and successful students. The top 10 IT issues are strategic and of interest to presidents, governing boards, provosts, CBOs, faculty, and students, as well as IT professionals. Technologies underlie almost all the 2017 issues. The 2017 top 10 strategic technologies complement the top 10 IT issues by identifying the emergent technologies institutions are implementing to build the foundations for student (and institutional) success.

This is a report of the technology investments institutions are making in 2017, not simply the technologies IT professionals are reading or talking about. It provides a snapshot of the new technological investments colleges and universities are actually planning and implementing in 2017, as well as technologies they are tracking or simply not addressing for the time being. Institutions can use it as a guide to consider which technologies they might focus on, where they might be lagging, and where they might be leading.

Our focus is on strategic technologies. We define a technology as “strategic” based on the time, active attention, and priority granted to it at a given time. Mature, more commonly deployed technologies (such as financial information systems or networks) may be among the most mission-critical technologies (and thus strategic in a different sense), but they are generally more likely to receive operational than strategic attention. EDUCAUSE tracks those established technologies in the Core Data Service because they are widespread enough to enable institution-level benchmarking. Strategic technologies, by contrast, are relatively new technologies institutions will be spending the most time tracking, planning for, and implementing in 2017. IT leaders and professionals are particularly interested in whether and when to invest in these still-maturing
technologies. None of the 85 technologies analyzed to identify the top 10 is currently in place at more than 30% of institutions. That may not be the case for long: 40–71% of institutions expect to begin planning for or implementing the top 10 strategic technologies in 2017.

The top 10 strategic technologies were selected from the analysis of a vetted set of 85 technologies presented to EDUCAUSE members in a survey in summer 2016, as described in this report’s Methodology section. This report does not aim to justify or assess these technologies; a number of excellent existing resources already do that. The value of the EDUCAUSE list is that it is based on data about members’ actual plans and thus sheds light not on what people are talking about but on what institutions are doing.

The top 10 strategic technologies in higher education complement the popular EDUCAUSE Top 10 IT Issues. A third report, Trend Watch 2017, summarizes the influence on institutional IT strategy of technology and higher education trends such as diversity and inclusivity, DevOps, data-driven decision making, adaptive learning, and the Internet of Things. Collectively, the three resources can provide more complete and nuanced context and insight to guide IT strategy.
Key Findings

- Student success technologies are poised to enter the mainstream set of technologies that colleges and universities use and support. The exceptions to this trend are bachelor's and small institutions, likely because they already provide high-touch support for students and because these technologies are additive investments and more affordable for larger institutions.

- Active learning classrooms (e.g., student-centered, technology-rich learning environments) was the top technology this year. As institutions transform the student advising and planning experience, they are focused on another component of student success: improving learning. The other academic technology on the list, incorporation of mobile devices in teaching and learning, topped last year’s list and acknowledges the need to provide access to learning at students’ points of need.

- Associate’s institutions—and, to a lesser extent, doctoral institutions—are at the forefront of the application of technology to student success and teaching and learning.

- Associate’s and doctoral institutions are also simply paying more attention than other institutions to their top 10 technologies. They are planning or expanding deployments for about half of the technologies on their respective top 10 lists. Bachelor’s institutions are spending less effort on their top 10 technologies and are only at the level of tracking technologies or planning deployments.

- The presence of three enterprise technologies on the list—uses of APIs, mobile apps for enterprise applications, and blended data centers (on-premises and cloud-based)—acknowledges higher education’s growing use of technologies and applications beyond the institution’s control and management, as well as the need to support mobile users.

- Security is the number one IT issue. The single security-related strategic technology is database encryption, which focuses on protecting sensitive data.

- It’s time to become familiar with the Internet of Things (IoT). Institutions are exploring multiple applications of the IoT, in areas such as teaching and learning, research, and campus management. Although only about 1% of institutions are making institution-wide use of the IoT today, almost one in five are actively planning or expanding use in each of these areas, and an additional one-third of institutions are tracking multiple IoT uses.
We predict that 7 of the top 10 technologies will achieve “mainstream” adoption (deployed in 61–80% of institutions) in the next five years: active learning classrooms (e.g., student-centered, technology-rich learning environments), uses of APIs, incorporation of mobile devices in teaching and learning, mobile apps for enterprise applications, blended data centers (on-premises and cloud-based), technologies for planning and mapping students’ educational plans, and technologies for triggering interventions based on student behavior or faculty input.
The Top 10 Strategic Technologies for 2017

(Numbers in parentheses are the 2016 rankings. Because of a tie for the 10th spot, this year’s list includes 11 technologies.)

1. Active learning classrooms (e.g., student-centered, technology-rich learning environments)*
2. Technologies for improving analysis of student data*
3. Incorporation of mobile devices in teaching and learning (1)
3. Uses of APIs*
5. Mobile apps for enterprise applications (6)
6. Blended data centers (on-premises and cloud-based)*
7. Technologies for planning and mapping students’ educational plans*
8. Database encryption (31)
9. Technologies for triggering interventions based on student behavior or faculty input*
10. Mobile device management (25)
10. Technologies for offering self-service resources that reduce advisor workloads*

* This technology was new in the 2017 survey.
Descriptions

1. **Active learning classrooms** (ALCs) “typically feature round or curved tables with moveable seating that allow students to face each other and thus support small-group work. The tables are often paired with their own whiteboards for brainstorming and diagramming. Many tables are linked to large LCD displays so students can project their computer screens to the group, and the instructor can choose a table’s work to share with the entire class. Wireless Internet plays an important role in retrieving resources and linking to content management systems, and depending upon the size of the room, table microphones can be critical so that every student’s voice can be broadcast across the room.”

   In practice, considerable variation in the levels and combinations of low and high technology persist due to costs, infrastructure, and goals. Regardless, the principles governing room layout/design, furniture, technology, and other features are that of active learning pedagogical approaches.

2. **Technologies for improving analysis of student data** enable immediate access to and rapid analysis of large, complex data sets, making it possible to discern trends in students’ engagement with college, in the types of difficulties students are encountering, and in their likely success in attaining credentials across the student body. These technologies allow advisors, student services staff, and administrators to examine broader patterns across departments, divisions, schools, demographics, financial aid status, or other categorizations of interest and adjust strategies accordingly.

3. **Incorporation of mobile devices in teaching and learning** means adopting these devices as tools to enhance the learning experience for students and the teaching experience for faculty. This could mean an extension of the classroom to the anytime, anywhere learning environment. It could also mean leveraging common mobile device features and applications to increase productivity, capture and archive course material, share information, and support the shift from students as consumers to students as creators. The unrealized value lies in using mobile technology to facilitate creativity, engagement, and interaction—all demonstrated to have a positive impact on student outcomes.

4. **Uses of APIs** (application programming interfaces). APIs define how a system interacts with other systems and how data can be shared and manipulated across programs. A good set of APIs acts 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.

5. **Mobile apps for enterprise applications** refers to web-based applications that run on mobile devices such as smartphones and are designed to integrate with all aspects of an organization’s businesses and processes. These apps make it possible to access enterprise-wide resources (such as course catalogs, student information systems, and human resource systems) and to conduct enterprise transactions from mobile devices.

6. **Blended data centers (on-premises and cloud-based)** are increasingly important because 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.

7. **Technologies for planning and mapping students’ educational plans** allow students and advisors to work together to build customized pathways through the curriculum that are appropriate for each individual’s interests and goals. In addition, these technologies offer a reliable way to chart and track progress toward a degree or credential completion. They also support institutions in the development of schedules that match demand.

8. **Database encryption** is the process of encrypting data within a database so that the data are rendered unreadable without the decryption key. Often recommended as a way to protect sensitive data, database encryption can be costly and requires more storage space than a regular unencrypted database.

9. **Technologies for triggering interventions based on student behavior or faculty input** gather data points from a variety of institutional and academic systems, sending communications to students, faculty, advisors, and administrators in support of early intervention. These technologies also provide a holistic view of a student’s progress, enabling targeted assistance in support of individual needs.
10. **Mobile device management** is the approach an institution takes for the policies, support, and procedures related to the variety of cell phones, tablets, and laptops on campus. Mobile device management involves a balance between security of institutional data and user convenience and productivity. Some institutions use third-party products and services to manage mobile devices. Considerations include data security issues, support for personally owned equipment, and application management.

10. **Technologies for offering self-service resources that reduce advisor workloads** include registration online, scheduling, and academic planning available directly to students, enabling those with professional responsibilities for guiding students to reserve in-person appointments for higher-level interactions and counseling on individual issues.
Institutional Differences

The top 10 strategic technologies were identified from a list of 85 technologies. Each technology was assigned an “attention” score that was a weighted combination of intentions to plan for, track, or implement a technology in 2017 (see the Methodology section for more details). We tested for statistically significant institutional differences in attention scores by:

- Carnegie Classification: associate’s, bachelor’s, public master’s, private master’s, public doctoral, and private doctoral.
- Institutional size: fewer than 2,000 FTEs (faculty, staff, and students), 2,000–3,999 FTEs, 4,000–7,999 FTEs, 8,000–14,999 FTEs, and 15,000+ FTEs.
- Institutional approach to technology adoption: early (before other institutions), mainstream (about the same time as peer institutions), and late (after peer institutions). Early adopters accounted for 30% of respondents, mainstream 45%, and late adopters 25%.

For five of the technologies, we found institutional differences in attention scores, or the amount of attention respondents reported their institution would be paying to technologies (figure 1). With respect to the three student-focused technologies, associate’s institutions are paying the most attention and bachelor’s institutions the least. Doctoral institutions are paying more attention to database encryption and active learning classrooms, and private doctorals pay more attention to mobile device management. The larger the institution, the more attention is being paid to three technologies: active learning classrooms, technologies for improving analysis of student data, and database encryption. Approach to technology adoption made a difference only for technologies for improving analysis of student data.
Institutional differences also clearly appear when we look at the strategic technologies for each of the institutional types we examined (figure 2). The figure lists the top 10 technologies by Carnegie class (some institutional types have more than 10 because of ties). The figure also depicts the magnitude of attention institutions are paying to each technology by placing technologies in one of three groups to show whether institutions on average are at best tracking the technology (least attention) or are piloting or deploying it (most attention).
<table>
<thead>
<tr>
<th>AA</th>
<th>BA</th>
<th>MA PUBLIC</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Active learning classrooms</td>
<td>1. Technologies for improving analysis of student data</td>
<td>1. Active learning classrooms</td>
</tr>
<tr>
<td>3. Incorporation of mobile devices in teaching and learning</td>
<td>4. Technologies for planning and mapping students’ educational plans</td>
<td>3. Incorporation of mobile devices in teaching and learning</td>
</tr>
<tr>
<td>4. Technologies for planning and mapping students’ educational plans</td>
<td>5. Technologies for offering self-service resources that reduce advisor workloads</td>
<td>4. Technologies for planning and mapping students’ educational plans</td>
</tr>
<tr>
<td>5. Technologies for offering self-service resources that reduce advisor workloads</td>
<td>6. Uses of APIs</td>
<td>6. Mobile device management</td>
</tr>
<tr>
<td>6. Technologies for triggering interventions based on student behavior or faculty input</td>
<td>7. Technologies for improving analysis of student data</td>
<td>7. iPASS (integrated planning and advising for student success) technologies</td>
</tr>
<tr>
<td>9. Open educational resources</td>
<td>9. CRM for alumni and/or institutional advancement</td>
<td>10. Institutional support for public-cloud storage</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MA PRIVATE</th>
<th>DR PUBLIC</th>
<th>DR PRIVATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Active learning classrooms</td>
<td>1. Technologies for improving analysis of student data</td>
<td>1. Active learning classrooms</td>
</tr>
<tr>
<td>2. Institutional repositories for research data</td>
<td>2. Technologies for improving analysis of student data</td>
<td>2. Technologies for improving analysis of student data</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>NONE–TRACKING</th>
<th>TRACKING–PLANNING</th>
<th>PLANNING–EXPANDING</th>
</tr>
</thead>
<tbody>
<tr>
<td>10. CRM for alumni and/or institutional advancement</td>
<td>10. Federated identity technologies</td>
<td>10. Next-generation Wi-Fi</td>
</tr>
<tr>
<td>10. Institutional support for public-cloud storage</td>
<td>10. Next-generation Wi-Fi</td>
<td>10. Open educational resources</td>
</tr>
</tbody>
</table>

Figure 2. Top 10 strategic technologies, by Carnegie class
The top 2 technologies overall appeared among the top 10 of every institutional type: active learning classrooms and technologies for improving analysis of student data. Both mobile technologies (incorporation of mobile devices in teaching and learning, and mobile apps for enterprise applications) made the top 10 for five of the six Carnegie groupings.

Associate’s and doctoral institutions are also paying more attention to their top 10 technologies. They are planning or expanding deployments for about half of the technologies on their lists. Bachelor’s institutions are spending less effort on their top 10 technologies and are only at the level of tracking technologies or planning deployments.
What We Don’t Yet Broadly Understand

Quite a few respondents indicated they were unfamiliar with particular technologies on the full list of 85 choices. Some technologies are hardly surprising to find on this list, like quantum computing and in-memory computing. Both are quite technical and obscure.

DNSSEC, enterprise GRC, and blockchain were perhaps the biggest surprises. Although nearly half of institutions are involved with DNSSEC (45% of respondents are tracking, planning, implementing, or already have in place these security extensions to the IP address Domain Name System), one-third of institutions remain unfamiliar with it. Almost two-fifths of respondents were unfamiliar with enterprise GRC systems, a surprise given the increasing focus on IT governance, risk, and compliance. Perhaps our failure to spell out GRC in the survey was a contributing factor. Unfamiliarity with blockchain was also surprising because it has received increasing attention within our community and in the media in the past year. Perhaps people may have heard of blockchain but simply don’t understand it.

1. **Enterprise GRC systems** (39% unfamiliar) are integrated IT applications that typically offer “modules” that help automate institutional governance, risk, and compliance processes and reporting by, for example, managing the policy development process; tracking legal requirements; monitoring and ensuring that compliance obligations are met; automating risk assessment exercises and tracking mitigation activities; and automating incident or issue tracking.

2. **Affective computing** (36%) refers to computing in relation to affemts, or emotions. It includes technologies that can recognize emotions, as well as technologies that can influence emotions.7

3. **DNSSEC** (31%) increases the security of the Domain Name System (DNS). DNS is a hierarchical distributed naming system that translates domain names (e.g., educase.edu) into numerical IP addresses. DNSSEC is a set of security extensions to DNS that can help authenticate DNS names and thus protect against forged or manipulated DNS data. It does not encrypt or otherwise protect data confidentiality.

4. **In-memory computing** (26%) can help “make big-data analytics possible by keeping data in a server’s RAM rather than removing it to databases on separate disk drives.”8 The data can be “retained in its original format,” and it can also be “searched, found, retrieved, and processed at much higher rates than data kept on disks.”

5. **Blockchain** (22%) 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.  

6. **Security information and event management (SIEM) (context-aware security)** (21%) tools are used to gather security log data across multiple IT systems and present the data via a single interface for action.

7. **Quantum computing** (20%) applies quantum mechanics to computation. It transcends the zero/one bit-based models of computation by using quantum bits, which can additionally work with “superpositions” of ones and zeros. This vastly increases the possible number of simultaneous calculations and enables tasks and computations that were previously out of reach. Currently, quantum computing’s primary relevance to higher education is in research.  

8. **Cloud-based HPC** (19%) describes high-performance computing in the cloud. “Traditional high-performance computing 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 the cloud are inherited: e.g., the ability to scale up and down quickly on demand in a pay-as-you-go environment.

9. **Text/content analytics** (18%) is a set of techniques and processes that analyze unstructured, text-based information to discern themes and patterns that can be used as data for analysis and decision making.

9. **ELNs (electronic lab notebooks)** (18%) are software-based tools to replace paper lab notebooks. Scientists and other researchers use laboratory notebooks to organize their data, and ELNs move the notebook into the digital world, which offers additional benefits, including easier search, organization, and linking to content and data. In addition, backing up and sharing data with other researchers (including in cases of collaborative work) are simplified with electronic notebooks.
**Implications**

What do these data tell us about the kind of progress higher education might make with the technologies measured in this study?

**Where Are We Heading and How Fast?**

We used institutions’ 2017 intentions for implementing and planning technologies to estimate deployment of all 85 technologies within roughly two years (2018–19) and five years (2020–22). We used the following categories to group estimates for when each technology is expected to be:

- Experimental (deployed institution-wide in 20% or fewer institutions)
- Emergent (deployed institution-wide in 21–40% of institutions)
- Growing (deployed institution-wide in 41–60% of institutions)
- Mainstream (deployed institution-wide in 61–80% of institutions)
- Universal (deployed institution-wide in 81–100% of institutions)

We predict that of the 11 technologies represented on this year’s top 10 list (due to a tie for 10th place), seven will achieve “mainstream” adoption (deployed in 61–80% of institutions) by 2022:

- Active learning classrooms (e.g., student-centered, technology-rich learning environments)
- Uses of APIs
- Mobile apps for enterprise applications
- Incorporation of mobile devices in teaching and learning
- Blended data centers (on-premises and cloud-based)
- Technologies for planning and mapping students’ educational plans
- Technologies for triggering interventions based on student behavior or faculty input

The other four technologies will achieve “growing” adoption (deployed in 41–60% of institutions) within five years (figure 3).
All but one (technologies for improving analysis of student data) of this year’s top 11 strategic technologies are among the 19 technologies experiencing the most rapid adoption (as defined by a predicted five-year increase in institution-wide deployment of 40 percentage points or more; figure 4).
<table>
<thead>
<tr>
<th>Technology</th>
<th>Today's Deployment Level</th>
<th>By 2022 Deployment Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active learning classrooms</td>
<td>Experimental</td>
<td>Mainstream</td>
</tr>
<tr>
<td>Incorporation of mobile devices in teaching and learning</td>
<td>Experimental</td>
<td>Mainstream</td>
</tr>
<tr>
<td>Uses of APIs</td>
<td>Experimental</td>
<td>Mainstream</td>
</tr>
<tr>
<td>Technologies for planning and mapping students' educational plans</td>
<td>Experimental</td>
<td>Mainstream</td>
</tr>
<tr>
<td>Mobile apps for enterprise applications</td>
<td>Experimental</td>
<td>Mainstream</td>
</tr>
<tr>
<td>Blended data centers</td>
<td>Experimental</td>
<td>Mainstream</td>
</tr>
<tr>
<td>Technologies for triggering interventions based on student behavior or faculty input</td>
<td>Experimental</td>
<td>Mainstream</td>
</tr>
<tr>
<td>Technologies for degree auditing (documenting and tracking students' educational plans)</td>
<td>Experimental</td>
<td>Mainstream</td>
</tr>
<tr>
<td>CRM for alumni and/or institutional advancement</td>
<td>Experimental</td>
<td>Mainstream</td>
</tr>
<tr>
<td>Technologies for planning and mapping students' educational plans</td>
<td>Experimental</td>
<td>Mainstream</td>
</tr>
<tr>
<td>Institutional support for public-cloud storage</td>
<td>Emergent</td>
<td>Mainstream</td>
</tr>
<tr>
<td>Technologies for offering self-service resources that reduce advisor workloads</td>
<td>Experimental</td>
<td>Growing</td>
</tr>
<tr>
<td>Mobile device management</td>
<td>Experimental</td>
<td>Growing</td>
</tr>
<tr>
<td>Mobile app development</td>
<td>Experimental</td>
<td>Growing</td>
</tr>
<tr>
<td>IT asset management tools</td>
<td>Experimental</td>
<td>Growing</td>
</tr>
<tr>
<td>Federated identity technologies</td>
<td>Experimental</td>
<td>Growing</td>
</tr>
<tr>
<td>Database encryption</td>
<td>Experimental</td>
<td>Growing</td>
</tr>
<tr>
<td>Predictive analytics for institutional performance</td>
<td>Experimental</td>
<td>Growing</td>
</tr>
<tr>
<td>Open educational resources</td>
<td>Experimental</td>
<td>Growing</td>
</tr>
</tbody>
</table>

**Figure 4. Technologies whose deployment is predicted to grow the fastest**
Pace of Adoption across Technology Domains

We organized the 85 technologies into 12 domain areas:

- Analytics
- Cloud
- Communications/networking
- Infrastructure and operations
- Integrated planning and advising for student success
- Internet of Things
- Mobile
- Research and scholarship
- Security, identity, privacy, and GRC
- Social/personal
- Teaching and learning
- User support

Many technologies were included in more than one domain. The appendix shows how technologies were grouped into the 12 domains. Separate reports will be published in 2017 that examine each domain and its component technologies in detail.

Figure 5 compares the pace of adoption across the 12 technology domains. The domain whose technologies we predict will make the most progress (as measured by increases in adoption) over the next five years is research and scholarship, followed by social/personal, mobile, and teaching and learning.
Higher Education's Top 10 Strategic Technologies for 2017

EDUCAUSE CENTER FOR ANALYSIS AND RESEARCH

Figure 5. Estimated pace of technology adoption across domains
Up and Coming

Knowing which technologies institutions are most commonly tracking can provide a preview into the future. We found a distinction between technology planning and implementation versus technology tracking: Only one of the technologies institutions are most commonly tracking—database encryption—made the overall top 10 list. Five of the possibly up-and-coming technologies listed below were also on last year’s list: Uses of the Internet of Things (this year split into three items), next-generation LMS, IT risk management automation, adaptive learning, and open educational resources. One of the technologies on last year’s up-and-coming list made this year’s top 10 list: mobile device management.

At least 30% of institutions are tracking these 12 technologies in 2017:

- Uses of the IoT for purposes other than teaching and learning, research, or campus management (38%)
- Next-generation LMS (37%)
- End-to-end e-mail encryption (36%)
- IT risk management automation (36%)
- Adaptive learning (35%)
- E-signature technologies (35%)
- Next-generation firewalls (33%)
- Database encryption (32%)
- Privacy-enhancing technologies (32%)
- Uses of the IoT for research (31%)
- Uses of the IoT for teaching and learning (31%)
- Open educational resources (30%)
Advice

The list of the top strategic technologies can inform—but should not substitute for—a strategic plan or roadmap. IT leaders and professionals should always ensure that institutional strategy drives IT strategy and that IT strategy and architecture drive technology decisions.

Use this report, the Top 10 IT Issues report, and the Trend Watch report to learn, benchmark, and lead.

Learn

- Become familiar with the top 10 strategic technologies, the up-and-coming technologies (see the sidebar on page 22), and the technologies in each domain that are receiving the most attention in 2017.
- Understand how each technology does or does not fit your institution.
- It’s time to become familiar with the Internet of Things. Institutions are exploring multiple applications of the IoT, in areas such as teaching and learning, research, and campus management.
- Take a deeper dive into the 85 technologies we assessed by reviewing relevant domain-area reports as EDUCAUSE releases them throughout 2017.

Benchmark

- Compare your technology strategy and progress with that of others. Determine whether your institution is moving quickly enough to keep pace with technology advances and opportunities.
- Find role models among peer institutions and communities of practice to help you understand how best to introduce and deploy the technologies most relevant to your institution.
- Identify the technologies whose adoption you may need to accelerate, and determine why.
- Don’t forget that technologies alone cannot advance digital initiatives. Initiatives must also have sufficient and sustainable funding and staffing models, active support from institutional leadership and faculty, engagement of and adequate training for the entire institutional community, alignment with institutional strategy, dedicated leadership, and supporting policies that are appropriate and clear. Use the EDUCAUSE Benchmarking Service to assess and compare your institution’s digital capabilities in eight areas, including student success, e-learning, and information security.
Lead

- Use this report, the Top 10 IT Issues report, and the Trend Watch report to brief leadership at your institution.

- Your technology improvements and initiatives are more than just a set of projects: They reflect and support the institution’s digital strategy. The 2017 top 10 strategic technologies can be linked to improving student success, teaching and learning, and institutional security and—via the enterprise technologies—to containing costs, developing analytics capabilities, and reducing risk through infrastructure modernization. Tie the value of technology projects to institutional strategy, and communicate that value to institutional leadership.

- Take a risk management approach: Will your institution’s current technology and plans reduce or increase institutional risk in the coming years?

- Convene and collaborate with key institutional partners (e.g., finance, procurement, HR, distributed IT, student success) to shape a collective understanding of the institution’s technology needs and investments that align with various stakeholders’ needs. Ensure that purchases are secure, are not redundant, and work with enterprise infrastructure or architecture.
Acknowledgments

Many thanks are due to the EDUCAUSE staff who made this report possible. Ben Shulman led the statistical analysis, and Kate Roesch developed the graphics that help bring this information to life. Ana Burray, Malcolm Brown, Eden Dahlstrom, Joanna Grama, Leah Lang, Nancy Millichap, Betsy Tippens Reinitz, and Karen Wetzel advised on the choices, definitions, and categorization of technologies. Gregory Dobbin provided his usual expert editorial review.

EDUCAUSE members are amazing. The time members spend to support the association is critical and deeply appreciated. The ECAR Working Group Strategies Committee, the Higher Education Information Security Council (HEISC) Leadership Team, and the HEISC Technologies, Operations, and Practices Working Group in particular gave invaluable feedback on the technologies we should include.
Appendix: Methodology

The list of 85 technologies was derived from the 2016 list and from several authoritative sources that annually identify emerging and maturing technologies in higher education. The ECAR Working Group Strategies Committee and EDUCAUSE staff who lead program areas (ELI, ECAR working groups, ECAR research, cybersecurity, and enterprise IT) reviewed the list and augmented and edited it. Several technologies on the 2016 list were removed. Some were eliminated because they were obscure, becoming irrelevant as technologies and practices continue to evolve, or still too nascent in higher education to warrant inclusion (e.g., virtual assistants, autonomic computing). Some technologies were redundant with CDS content or were widespread enough based on the 2016 research to exceed our threshold of existing institutional deployment at no more than 30% of institutions. We refactored other technologies to better describe them and their relevance to evolving practices. Even so, the list could be improved. We reexamine it annually.

The survey was distributed to 10,256 EDUCAUSE members as part of the Top 10 IT Issues survey, with two reminders sent.

Respondents indicated the attention their institution was planning to devote to each technology in 2017. Respondents selected one of six response options:

- **Don’t know**: I don’t know what this technology is.
- **No deployment**: None of this technology is in place, and no work will be under way or resources committed for this technology in 2017.
- **Tracking**: Multiple person-days of effort will be assigned but restricted to monitoring and understanding this technology (much more than just reading articles).
- **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.
- **Expanding deployment**: In 2017, we will move from initial or partial to broader or even institution-wide deployment.
- **Institution-wide deployment**: Full production-quality technical capability is in place, including ongoing maintenance, funding, etc., with deployment potentially supporting institution-wide access.

Because the list was so long (and to minimize “don’t know” responses), respondents were given the option of identifying the technology domains for which they are responsible and responding only to items within those domains.
Further, if several members from a single institution completed the survey, only one rating was included (we used the CIO as the primary rater). As a result, the number of respondents rating individual technologies ranged from 181 to 236.

The final list of strategic technologies—which included 11 items because of a tie for 10th—is a weighted average of institutions’ plans, with the heaviest weight (5) given to expanding deployment, followed by planning/piloting/initial deployment (3), and then tracking (2). Other response options (no deployment, institution-wide deployment, and don’t know) were given a weight of zero in our scoring schema.

**Complete List of Technologies, Organized by Domain**

*Note: The domains are not mutually exclusive. About two-thirds of the technologies (58) were assigned to two or three domains, and three technologies were assigned to four.*

**Analytics**

- Flexible interactive platforms for descriptive and predictive analytics of institutional data
- Massively scalable database architectures and software
- Mobile apps for institutional BI/analytics
- Predictive analytics for institutional performance
- Predictive analytics for learning
- Predictive learning analytics (course level)
- Talent/workforce analytics
- Technologies for degree auditing (documenting and tracking students’ educational plans)
- Technologies for improving analysis of student data
- Technologies for integrating student records data across case management systems
- Technologies for offering self-service resources that reduce advisor workloads
- Technologies for planning and mapping students’ educational plans
- Technologies for triggering interventions based on student behavior or faculty input
Higher Education’s Top 10 Strategic Technologies for 2017

**Cloud**

- Blended data centers
- Blockchain
- Cloud access security brokers (CASB)
- Cloud-based HPC
- Cloud-based identity services
- Cloud-based security services
- Cloud monitoring platform to track distributed infrastructure apps, tools, and 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

**Communications/Networking**

- DDoS prevention products and services
- DNSSEC
- End-to-end e-mail encryption
- Ethernet fabrics
- IPv6
- Next-generation firewalls
- Next-generation Wi-Fi
- Science DMZ
- Software-defined networks
- Tools to support cross-institutional and international collaborations
- Tools to support cross-institutional and international research data-sharing
Higher Education’s Top 10 Strategic Technologies for 2017

**Infrastructure and Operations**

- Application performance monitoring
- Blended data centers
- Cloud monitoring platform to track distributed infrastructure apps, tools, and services
- Data center capacity planning and management tools
- Ethernet fabrics
- IPv6
- IT asset management tools
- Life-cycle contract management
- Massively scalable database architectures and software
- Mobile apps for enterprise applications
- Next-generation firewalls
- Next-generation LMS
- Next-generation Wi-Fi
- Service-level reporting tools
- Software-defined networks
- Uses of APIs
- Uses of the IoT for campus management

**Integrated Planning and Advising for Student Success**

- Flexible interactive platforms for descriptive and predictive analytics of institutional data
- iPASS (integrated planning and advising for student success) technologies
- Mobile app development
- Mobile apps for institutional BI/analytics
- Predictive analytics for learning
- Predictive learning analytics (course level)
- Technologies for degree auditing (documenting and tracking students’ educational plans)
- Technologies for improving analysis of student data
- Technologies for integrating student records data across case management systems
- Technologies for offering self-service resources that reduce advisor workloads
- Technologies for planning and mapping students’ educational plans
- Technologies for triggering interventions based on student behavior or faculty input
- Uses of APIs

**Internet of Things**

- Affective computing
- Augmented reality
- Drones
- IPv6
- Next-generation Wi-Fi
- Uses of in-memory computing
- Uses of the IoT for campus management
- Uses of the IoT for purposes other than teaching and learning, research, or campus management
- Uses of the IoT for research
- Uses of the IoT for teaching and learning

**Mobile**

- Development tools to support multiple key platforms
- High-precision location-sensing technologies
- Incorporation of mobile devices in teaching and learning
- Location-based computing
- Mobile app development
- Mobile apps for enterprise applications
- Mobile apps for institutional BI/analytics
- Mobile device management
Higher Education’s Top 10 Strategic Technologies for 2017

EDUCAUSE CENTER FOR ANALYSIS AND RESEARCH

Research and Scholarship

- Affective computing
- Blended data centers
- Cloud-based HPC
- Data center capacity planning and management tools
- Disciplinary repositories
- ELNs (electronic lab notebooks)
- Flexible interactive platforms for descriptive and predictive analytics of institutional data
- High-precision location-sensing technologies
- Institutional repositories for research data
- IPv6
- Massively scalable database architectures and software
- Private-cloud computing
- Quantum computing
- Science DMZ
- Text/content analytics
- Tools to support cross-institutional and international collaborations
- Tools to support cross-institutional and international research data-sharing
- Uses of in-memory computing
- Uses of the IoT for research
- Virtual reality

Security, Identity, Privacy, and GRC

- Applications of analytics to security
- Cloud access security brokers (CASB)
- Cloud-based identity services
- Cloud-based security services
- Content-aware DLP
- Cryptocurrencies
- Database encryption
Higher Education’s Top 10 Strategic Technologies for 2017

EDUCAUSE CENTER FOR ANALYSIS AND RESEARCH

- DDoS prevention products and services
- DNSSEC
- E-signature technologies
- End-to-end e-mail encryption
- Enterprise GRC systems
- Federated identity technologies
- IT risk management automation
- Life-cycle contract management
- Mobile device management
- Next-generation firewalls
- Privacy-enhancing technologies
- Private-cloud computing
- SIEM (context-aware security)

Social/Personal

- Affective computing
- Augmented reality
- Blockchain
- CRM for alumni and/or institutional advancement
- Cryptocurrencies
- Institutional support for speech recognition
- Integration/uses of machine speech recognition
- Integration/uses of voice-user interfaces
- Location-based computing
- Privacy-enhancing technologies
- Support for use of personal cloud services

Teaching and Learning

- Active learning classrooms
- Adaptive learning
- Affective computing
- Augmented reality
- Blockchain
- Courseware
- Digital microcredentials
- Games and gamification
- Incorporation of mobile devices in teaching and learning
- Institutional support for speech recognition
- Integration/uses of machine speech recognition
- iPASS (integrated planning and advising for student success) technologies
- IT accessibility assessment tools
- Mobile app development
- Next-generation LMS
- Open educational resources
- Predictive analytics for learning
- Predictive learning analytics (course level)
- Remote proctoring services
- Technologies for degree auditing (documenting and tracking students’ educational plans)
- Technologies for improving analysis of student data
- Technologies for integrating student records data across case management systems
- Technologies for offering self-service resources that reduce advisor workloads
- Technologies for planning and mapping students’ educational plans
- Technologies for triggering interventions based on student behavior or faculty input
- Text/content analytics
- Uses of APIs
- Uses of the IoT for teaching and learning
- Virtual reality
**User Support**

- Institutional support for public-cloud storage
- Institutional support for speech recognition
- IT accessibility assessment tools
- IT asset management tools
- Mobile apps for enterprise applications
- Mobile device management
- Service-level reporting tools
- Support for use of personal cloud services
- Tools to support cross-institutional and international collaborations
- Tools to support cross-institutional and international research data-sharing
Notes

1. EDUCAUSE Core Data Service.

2. EDUCAUSE program staff and member leaders helped select and word the 85 technologies. Participants included leaders of the EDUCAUSE Learning Initiative (ELI), the Higher Education Information Security Council (HEISC), the Enterprise IT Program, and Core Data Service, as well as members of the ECAR Working Group Strategies Committee. This group identified technologies to add, technologies to retire because they were no longer relevant, and technologies to move into CDS because they are deployed in more than 30% of institutions. The group also helped categorize technologies.


6. Respondents were asked to indicate their institution’s preferred overall approach to adopting technology; they were given five response options:
   - We are usually among the very first to adopt new technologies.
   - We strive to be early adopters of new technologies where we see exceptional benefits.
   - We tend to adopt new technologies at the pace of our peers.
   - We tend to adopt new technologies after our peers do so.
   - We are one of the last to adopt new technologies.

7. See Affective Computing.


9. ELI 7 Things You Should Know about Blockchain, September 1, 2016.


13. 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.