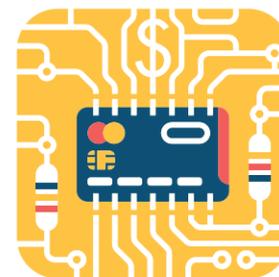# TOP 10 IT ISSUES 2016

Divest, Reinvest, and Differentiate

Susan Grajek and the 2015–2016 EDUCAUSE IT Issues Panel

The difficult I'll do right now. The impossible will take a little while.
—Billie Holliday

Information technology in higher education has never been easy to manage, but these days doing so seems like a choice between the merely difficult and the impossible. That is partly because so much is changing so quickly—technology and higher education, opportunities and expectations, requirements and funding—and partly because we are trying to apply existing methods to new problems. Imagine driving a car in the first years of automobiles. There were roads, certainly. But they were narrow and rough and had been built for different, previous kinds of vehicles and traffic. The necessary fuel sources were hard to find, and the rules of the road that worked for wagons and carriages frustrated car drivers. Early drivers were inexperienced, of course. The existing infrastructure thus limited the potential of the new automobiles. In many ways, colleges and universities are similarly expecting the existing ecosystem—their people, processes, and culture—to be able to support, without change, today's new and very different technologies.

How can we align our timelines and change our ecosystem? The 2016 EDUCAUSE Top 10 IT Issues[1] offer a clear response: *divest, reinvest,* and *differentiate.* As will be explained below, the ten issues divide into these three categories. Higher education IT organizations are *divesting* themselves of technologies that can be sourced elsewhere and of practices that have become inefficient and are *reinvesting* to develop the necessary capabilities and resources to use information technology to achieve competitive institutional *differentiation* in student success, affordability, and teaching and research excellence.
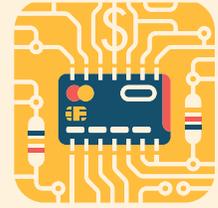
er.educause.edu

Top 10 IT Issues, 2016

1. **Information Security:** Developing a holistic, agile approach to information security to create a secure network, develop security policies, and reduce institutional exposure to information security threats

2. **Optimizing Educational Technology:** Collaborating with faculty and academic leadership to understand and support innovations and changes in education and to optimize the use of technology in teaching and learning, including understanding the appropriate level of technology to use

3. **Student Success Technologies:** Improving student outcomes through an institutional approach that strategically leverages technology

4. **IT Workforce Hiring and Retention:** Ensuring adequate staffing capacity and staff retention as budgets shrink or remain flat and as external competition grows

5. **Institutional Data Management:** Improving the management of institutional data through data standards, integration, protection, and governance

6. **IT Funding Models:** Developing IT funding models that sustain core services, support innovation, and facilitate growth

7. **BI and Analytics:** Developing effective methods for business intelligence, reporting, and analytics to ensure they are relevant to institutional priorities and decision making and can be easily accessed and used by administrators, faculty, and students

8. **Enterprise Application Integrations:** Integrating enterprise applications and services to deliver systems, services, processes, and analytics that are scalable and constituent centered

9. **IT Organizational Development:** Creating IT organizational structures, staff roles, and staff development strategies that are flexible enough to support innovation and accommodate ongoing changes in higher education, IT service delivery, technology, and analytics
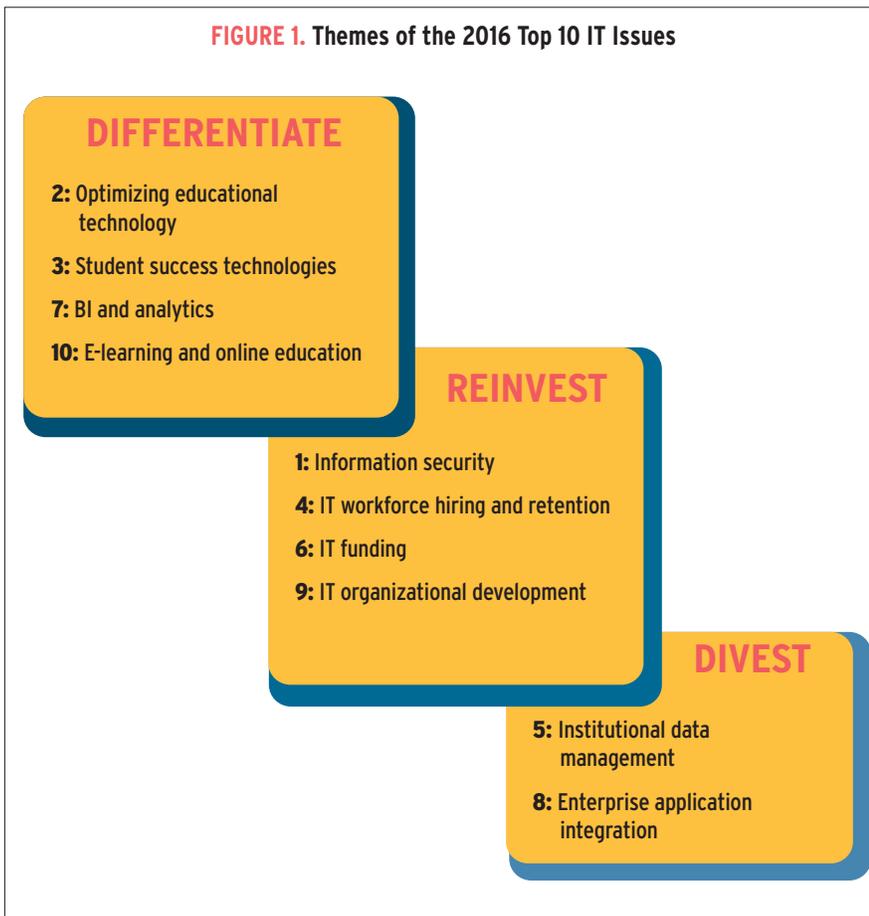
10. **E-Learning and Online Education:** Providing scalable and well-resourced e-learning services, facilities, and staff to support increased access to and expansion of online education

FIGURE 1. Themes of the 2016 Top 10 IT Issues

DIFFERENTIATE

2: Optimizing educational technology

3: Student success technologies

7: BI and analytics

10: E-learning and online education

REINVEST

1: Information security

4: IT workforce hiring and retention

6: IT funding

9: IT organizational development

DIVEST

5: Institutional data management

8: Enterprise application integration

Divest

The only way to move higher education's people, processes, and culture into the developing future is by moving away from methods whose effectiveness is waning and by adopting practices that better fit that new world. Reform is insufficient, because it optimizes today's practices in lieu of developing tomorrow's. To make room for a new set of practices—a new infrastructure—we need to divest ourselves of today's practices. Higher education institutions are doing just that, with 58 percent of them reporting that business process redesign (not optimization) is a major influence on their IT strategy.[1]

Divestment also extends to technologies and services. Many colleges and universities have moved or are moving beyond the question of whether to run their own infrastructure and applica-

tions in the presence of reliable, effective, and up-to-date external solutions; IT organizations are reengineering and resourcing their systems and services. Moving from historical services onto emerging platforms is a major part of IT strategy at six in ten (61%) colleges and universities, and shared services is a major part of IT strategy for over half (54%).[3] Two of this year's Top 10 IT Issues focus on this divestment challenge:

Issue #5. Institutional Data Management
Issue #8. Enterprise Application Integrations

IT as a Service
How can institutions divest effectively to address both of these issues? IT as a Service is a model for running the IT organization more like a business—one

that has to compete with alternative providers—and less like a cost center. The model focuses the IT organization on efficiency and transparency to contain and clarify costs and on service and agility to best meet the changing needs of the institutional community. IT as a Service includes methods to help IT organizations achieve a balance of efficiency and excellence.

Standardization and simplification are core principles of IT as a Service. Complexity kills efficiency. Copious, distributed, and disjointed, today's higher education's enterprise applications exemplify unintentional complexity. That complexity resulted from optimizing departmental authority and decision making. Now higher education needs applications and systems that can cost-effectively share data and processes to support services and analytics. Well-engineered systems integrations can meet current and future needs efficiently.

Systems integrations include data integrations, which require data governance and management and can address multiple objectives: developing effective analytics while reducing costs and risk. Data needs to be standardized and integrated to lay the groundwork for cost-effective, scalable, and valid analytics. Standards and integration are almost impossible to achieve without an institutional commitment to data governance. Using data in broader and more consequential ways increases its exposure and the potential impact of data breaches, making data protection more important than ever.

Reinvest

Divestment alone addresses only part of today's challenge. IT organizations need to lay the groundwork for using information technology to deliver meaningful value to higher education. They need to develop funding models that focus on information technology as an investment instead of a cost, and

they need to reinvest in their people (the organization's most important asset) and information security approaches. Reinvestment is a theme of four of the 2016 Top 10 IT Issues:
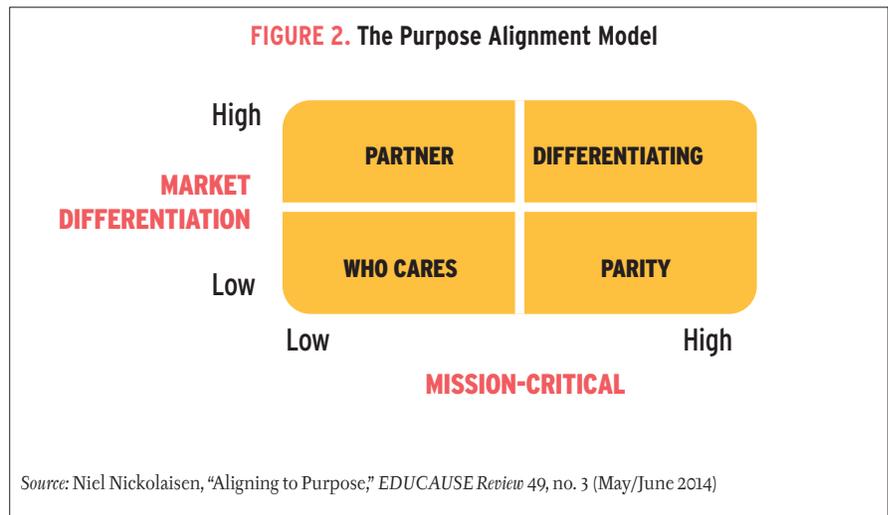
Issue #1. Information Security
Issue #4. IT Workforce Hiring and Retention
Issue #6. IT Funding Models
Issue #9. IT Organizational Development

Feeling Insecure

Information security is the top issue for 2016, by a significant margin.[4] Our understanding of information security has deepened as the security ecosystem has advanced. Addressing the challenge of information security encompasses technical controls, policies, outreach and education, and risk management. The EDUCAUSE IT Issues Panel was clear that institutions need to constantly respond to changing circumstances and need to consider information security holistically rather than responding separately to each new threat, security layer, or component.

People

The changes under way are most disruptive to those in the IT workforce—those who must also design and implement the changes. IT organizations are shifting as surely as IT services and infrastructure. Many current roles are becoming obsolete, to be replaced by new roles.[5] Adapting both the workforce and the organization will require special skills of CIOs and IT managers and will place more emphasis on the partnership between the human resources (HR) and IT organizations. Yet organizational change is not the only workforce challenge for CIOs: many institutions are reducing budgets and benefits or flat-lining compensation at a time when new IT hires are essential to fulfilling institutional objectives, and an improved job market for IT professionals may make it hard to keep existing and prospective staff.

FIGURE 2. The Purpose Alignment Model

Source: Niel Nickolaisen, "Aligning to Purpose," *EDUCAUSE Review* 49, no. 3 (May/June 2014)

Follow the Money

Funding continues its unbroken streak of achieving a place in the EDUCAUSE Top 10 IT Issues list every year. The funding challenge remains unchanged from the previous two years: how to fund ongoing operations, growth in demand, and institutional innovation.

Panel members emphasized that to contain the IT budget, institutions need to introduce an ongoing discipline of continual divestment, replacing outdated foundations (services, processes, and technologies), and of continual reinvestment, ensuring that the IT workforce is agile and adaptable and that risks like information security are well-managed.[6]

Differentiate

The term *special snowflakes* has been used to describe institutions or departments that can't standardize or collaborate because they do things their own way.[7] To achieve value, IT organizations must distinguish between *difference* and *differentiation*. Niel Nickolaisen's Purpose Alignment Model (see figure 2) provides a framework for understanding when variability is meaningless and when variability adds value.[8] On the bottom half of the model, services with low market differentiation are good candidates for the most efficient yet effective solutions (for mission-critical needs like payroll or e-mail), the very lowest cost solutions, or even divestment (for needs that may no longer be relevant). Needs that are not mission-critical but are differentiating are uncommon (the model's top-left quadrant); when they exist, they provide opportunities to partner or share services to contain costs.

A few mission-critical services can also create market differentiation (the top-right quadrant). They provide opportunities to use information technology for a competitive advantage. In Nickolaisen's words, "These *differentiating activities* are the few things—somewhere between one and three in number—that we *must* do better than anyone else. They deserve our innovation and creativity because these are the things that create our competitive advantage, our unique value proposition." It is these genuinely special activities that the IT organization and the institution should invest in, not simply pay for. Differentiating activities will vary from institution to institution, however. Even when many institutions have the same differentiating activity, they will mold their solutions to reflect meaningful differences in mission, values, and constituents. E-learning, student success technologies, and analytics are priorities for many institutions,[9] and they can and should be designed to strengthen and extend each institution's unique value to the higher education marketplace.[10]

2015–2016
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The EDUCAUSE IT Issues Panel comprises individuals from EDUCAUSE member institutions to provide feedback to EDUCAUSE on current issues, problems, and proposals across higher education information technology. Panel members are recruited from a randomly drawn and statistically valid sample to represent the EDUCAUSE membership.

Four of this year's Top 10 IT Issues reflect higher education's efforts to use information technology to differentiate:

Issue #2. **Optimizing Educational Technology**
Issue #3. **Student Success Technologies**
Issue #7. **BI and Analytics**
Issue #10. **E-Learning and Online Education**

Where to Differentiate
James Hilton, University Librarian and Dean of Libraries and Vice Provost for Digital Education and Innovation at the University of Michigan, has predicted: "The multivariant pressure on higher education going forward—over the next five years and beyond—is going to be to get better at telling a story that embraces differentiation."[11] Information technology can help. Information technology has begun to deliver services that can be directly mapped to higher education's most strategic priorities, including student success, affordability, excellence in research and teaching, and analytics. Integrated student planning and advising systems contribute measurably to student success. Institutions are starting to accrue cost savings from standardization and outsourcing. Research not only benefits from technology; it depends on it. We seem finally to have entered an era in which technology-supported education is fulfilling its aspirations to improve pedagogy and learning and to expand access to all types of underserved populations. And the use of analytics is enabling institutions to make more timely intelligent decisions to benefit themselves and individual members of their communities. These are examples of potentially differentiating activities that institutions identify as priorities that they "*must* do better than anyone else."

How to Differentiate

These differentiating activities are innovations that require new investments. Innovation is an inherently inefficient process: close to 90 percent of innovations fail.[12] A financially beleaguered institution under intense scrutiny from a governing board and perhaps also a state legislature may have little appetite for spending money and for making bets with long odds.

Divestment and reinvestment are foundations upon which differentiation depends. Divestment paves the way for differentiation by developing the IT organization's ability to operate efficiently; the organization can institute needed simplifications, integrations, and new processes, and by achieving savings in one area, it can deploy those savings in another area to support differentiation. Reinvestment strengthens the organizational and technical foundations on which successful innovation depends.

Collectively, the Top 10 IT Issues represent enormous change, challenge, and promise. Though each deserves separate consideration, they are inseparable.

Issue #1: Information Security

Developing a holistic, agile approach to information security to create a secure network, develop security policies, and reduce institutional exposure to information security threats

Top 10 Strategic Technologies

The EDUCAUSE IT Issues research is complemented by *Higher Education's Top 10 Strategic Technologies for 2016* (http://www.educause.edu/top10tech2016) from the EDUCAUSE Center for Analysis and Research (ECAR). The strategic technology reports provide a snapshot of the relatively new technological investments on which colleges and universities will be spending the most time implementing, planning, and tracking, as well as the trends that influence IT directions in higher education. Together, the trends and forecasts reported in the Top 10 IT Issues and Strategic Technologies research help IT professionals enhance decision making by understanding what's important and where to focus.

Across the entire spectrum of higher education missions—from teaching and learning to business operations to community outreach to innovation and discovery—we rely on technology that is constantly under threat. Protecting the institution from the myriad of security threats is a fundamental challenge for IT leadership. Information security has evolved from a largely technical field to one that encompasses not only technology but also risk-management practices, user training and education, and business acumen. With information security now acknowledged as a field in which "perfection

isn't nearly good enough," one security incident can ruin an IT leader's day(s), expose confidential data of users or the institution, lead to significant out-of-pocket costs connected with responding to the incident, and diminish an institution's reputation and consumer confidence. *A bad day indeed.*

Against this backdrop of constant threats is a higher education technology environment where the expectations and needs of the user community are wide-ranging and fast-changing. IT leaders anticipate that the time currently spent managing infrastructure and technical resources will shift to time spent managing services, vendors, and contracts.[13] Agility in the delivery of technology-based solutions and services is key—especially with the fast-paced adoption of cloud-based services (see figure 3). Services and solutions need to be architected so that they can be introduced, modified, and even retired in rapid fashion.

Without appropriate security measures, however, any open and agile solution lessens in value. Higher education is challenged to quickly design and build systems that include proper safeguards for reliability and security. This challenge is further exacerbated by the changing nature of IT service delivery and the move toward the cloud. Even though the number of institutional security and privacy professionals is increasing because of the changed nature of service delivery,[14] the central IT organization is still perceived as being slow to review and approve the implementation of cloud and other outsourced services. If the central IT organization cannot be agile enough in its review and implementation of cloud services, the path of least resistance for users may be to go it alone, without institutional IT involvement. In those instances, it is also entirely likely that the path of least resistance may not include effective security safeguards and that users may unwittingly put institutional and/or individual data at risk.[15]

The truth is that institutional information security is everyone's job. Recent news reports of high-profile data breaches have highlighted that organizational approaches to information security must be holistic, agile, and comprehensive. No longer content to merely "secure the perimeter," institutional approaches must encompass technical safeguards (i.e., those approaches implemented in technology solutions) and administrative safeguards (i.e., those approaches implemented in institutional policies), in order to be effective. Due to its unique mission and cultural need for transparency and openness, higher education has long adopted multifaceted information security approaches:

- 96 percent of institutions have an institutional IT acceptable use policy.[16]
- 92 percent of institutions have deployed malware protection technologies.
- 90 percent of institutions have deployed secure remote-access technologies.
- 78 percent of U.S. institutions have conducted some sort of IT security risk assessment.
- 71 percent of U.S. institutions have mandatory faculty/staff training on information security.[17]

Even with these numbers, institutions still have much work to do to secure networks, systems, and applications; develop security policies (only 27% of U.S. institutions have an information security policy that is fully approved by leadership[18]); educate campus IT users; and reduce institutional exposure to information security threats. Recent news reports of data breaches provide IT leaders with a springboard to launch discussions with institutional leaders about improving campus information security.

Information security can be a daunting topic for IT departments with limited resources: managing security effectively is not free. So there must be buy-in from

"The expectations and needs of the user community at an institution of higher education are wide-ranging and fast-changing—agility in our delivery of technology-based solutions and services is key. But, without appropriate security measures, any open and agile solution lessens in value."
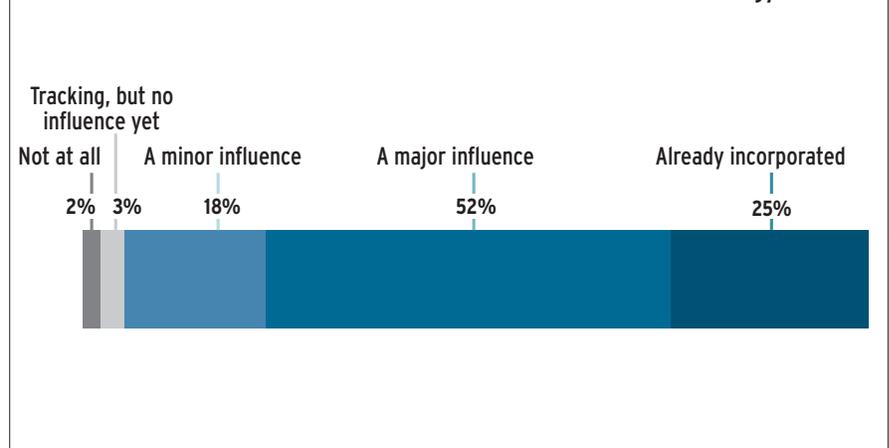
—**Michael Bourque**, Vice President, **Information Technology Services**, **Boston College**

the executive level to secure funding and create enforceable policies. All institutional departments and all users of IT resources (students, faculty, and staff) must understand and promote good information security practices to protect institutional data. Making modest institutional improvements in information security posture can give institutions and their IT departments the confidence to tackle the more challenging information security tasks that will inevitably arise as service-delivery approaches evolve.

Advice
- Create comprehensible and enforceable information security policies. Make sure that these policies are understandable and actionable by all community members, and post them conspicuously.
- Develop a comprehensive approach that addresses the information security concerns of mobile, cloud, and digital resources. The changing nature of service delivery is inevitable, and institutional leaders must develop strategies for handling an environment in which institutional data and services are located on third-party resources and are accessed by computing devices not owned or controlled by the institution.
- Develop a training framework for information security awareness to educate all members of the campus

FIGURE 3. The Influence of Cloud-Based Services on IT Strategy

Tracking, but no influence yet

Not at all | A minor influence | A major influence | Already incorporated

2% | 3% | 18% | 52% | 25%

The 2016 Top 3 Strategic Information Security Issues

Joanna Lyn Grama and Valerie Vogel

nformation security is a perennial favorite on the EDUCAUSE annual Top 10 IT Issues lists, appearing 13 times since 2000. In 2016, information security returns to the top ranking (a spot it previously occupied in 2008). To help us better understand the nuance of information security issues in higher education, members of the Higher Education Information Security Council (HEISC)[1]—including Chief Information Officers (CIOs), Chief Information Security Officers (CISOs), IT directors and managers, and IT staff members—drilled down into the topic of information security and identified their top 3 strategic information security issues: (1) Ensuring that members of the institutional community (students, faculty, staff) receive information security education and training; (2): Developing an effective information security strategy that responds to institutional organization and culture and that elevates information security concerns to institutional leadership; and (3): Planning for and implementing next-generation security technologies to respond to evolving threats.

#1: Ensuring that members of the institutional community (students, faculty, staff) receive information security education and training

This issue was #2 on the 2015 list. There was great agreement this year that education and training is the most critical information security issue facing higher education. It was the top issue identified by all respondent roles—CIOs, CISOs, and IT directors, managers, and staff (see figure 1)—and was also the top issue at Associates, Masters, and Doctoral institutions (see figure 2).

Institutions continue to make headway providing information security awareness and training opportunities for students, faculty, and staff. In 2014, information security training was mandatory for faculty or staff at 71 percent of institutions and for students at 29 percent of institutions.[2] Since its inception in 2004, many institutions have also promoted National Cyber Security Awareness Month each October with campus activities, events, and targeted campaigns. To help institutions do an even better job with security awareness in 2016, the HEISC Awareness and Training working group has prepared ready-made content that security professionals and IT communicators can integrate into campus information security education communications (http://www.educause.edu/securityawareness).

#2: Developing an effective information security strategy that responds to institutional organization and culture and that elevates information security concerns to institutional leadership

This issue was #1 on the 2015 list. This year it features prominently in the top 3 issues for all institutional Carnegie classifications (see figure 2). Information security strategies outline the high-level priorities and goals of an information security program. These strategies demonstrate how information security relates to an

FIGURE 1. Top 10 Strategic Information Security Issues, by Responder Role

RANK	ALL RESPONSES (n=93)		CIOs (n=12)		CISOs (n=48)		IT DIRECTOR, MANAGER, STAFF (n=27)
1	Ensuring that members of the institutional community (students, faculty, staff) receive information security education and training. (50.5%)		Ensuring that members of the institutional community (students, faculty, staff) receive information security education and training. (50.00%)		Ensuring that members of the institutional community (students, faculty, staff) receive information security education and training. (50.00%)		Ensuring that members of the institutional community (students, faculty, staff) receive information security education and training. (51.9%)
			Developing an effective information security strategy that responds to institutional organization and culture, and that elevates information security concerns to institutional leadership. (50.00%)				
2	Developing an effective information security strategy that responds to institutional organization and culture, and that elevates information security concerns to institutional leadership. (44.1%)		(two issues tied for second place omitted from graphic)		Planning for and implementing next generation security technologies to respond to evolving threats. (45.82%)		(second place issue omitted from graphic)
3	Planning for and implementing next generation security technologies to respond to evolving threats. (38.7%)		Planning for and implementing next generation security technologies to respond to evolving threats. (33.33%)		Developing an effective information security strategy that responds to institutional organization and culture, and that elevates information security concerns to institutional leadership. (43.75%)		Developing an effective information security strategy that responds to institutional organization and culture, and that elevates information security concerns to institutional leadership. (44.4%)
			(three additional issues tied for third place omitted from graphic)		(one additional issue tied for third place omitted from graphic)		(one additional issue tied for third place omitted from graphic)
							Planning for and implementing next generation security technologies to respond to evolving threats. (29.63%) (Fourth Place)

FIGURE 2. Top 10 Strategic Information Security Issues, by Institutional Carnegie Class

RANK	AA (n=9)	BA (n=10)	MA (n=19)	DR (n=52)
1	Ensuring that members of the institutional community (students, faculty, staff) receive information security education and training. (66.7%)	Developing an effective information security strategy that responds to institutional organization and culture, and that elevates information security concerns to institutional leadership. (70.0%)	Ensuring that members of the institutional community (students, faculty, staff) receive information security education and training. (57.9%)	Ensuring that members of the institutional community (students, faculty, staff) receive information security education and training. (42.3%)
	Developing an effective information security strategy that responds to institutional organization and culture, and that elevates information security concerns to institutional leadership. (66.7%)	(one additional issue tied for first place omitted from graphic)		Planning for and implementing next generation security technologies to respond to evolving threats. (42.3%)
2	(second place issue omitted from graphic)	Ensuring that members of the institutional community (students, faculty, staff) receive information security education and training. (60.0%)	(second place issue omitted from graphic)	(second place issue omitted from graphic)
3	Planning for and implementing next generation security technologies to respond to evolving threats. (33.3%)	(third place issue omitted from graphic)	Developing an effective information security strategy that responds to institutional organization and culture, and that elevates information security concerns to institutional leadership. (42.1%)	Developing an effective information security strategy that responds to institutional organization and culture, and that elevates information security concerns to institutional leadership. (34.6%)
	(five additional issues tied for third place omitted from graphic)		(two additional issues tied for third place omitted from graphic)	(four additional issues tied for third place omitted from graphic)
		Planning for and implementing next generation security technologies to respond to evolving threats. (30%) (Fourth Place, tied with three other issues)	Planning for and implementing next generation security technologies to respond to evolving threats. (31.58%) (Fourth Place, tied with three other issues)	

institution's overall mission and how information security helps support the institutional mission and core values. "An information security strategy provides focus and direction for the institution," said Melissa Woo, CIO and Vice Provost for Information Services at the University of Oregon and HEISC co-chair. "It provides the campus a means for prioritizing resources and investments in information security."

#3: Planning for and implementing next-generation security technologies to respond to evolving threats

Although this issue did not appear in the top 3 issues in 2015, it seems fitting that a technology-focused issue would round out the list this year. With increasing concerns about cloud security, the Internet of Things, and other emerging, more sophisticated threats—as well as the ongoing challenge of limited campus resources (both financial and human)—finding new tools and technologies to help identify and mitigate threats more efficiently will continue to be of utmost importance to security and IT professionals. "Planning for next-generation security technologies must be done in concert with other technology enhancements and replacements," said Cathy Bates, Associate Vice Chancellor and CIO at Appalachian State University and HEISC co-chair. "This planning ensures that security technologies are an integrated component of IT architecture and infrastructure roadmaps and are represented in the overall budget needs for a secure and stable infrastructure."

■ ■ ■

Information security is of paramount importance to all colleges and universities, and with our connected world, this won't change anytime soon. We encourage institutions to continue the tradition of openly collaborating and sharing ideas to help move our community forward in the information security space.

Notes
1. HEISC supports higher education institutions as they improve information security governance, compliance, data protection, and privacy programs. The HEISC *Information Security Guide*, created *by* practitioners *for* practitioners, features toolkits, case studies, effective practices, and recommendations to help jumpstart campus information security initiatives. For more information, see the EDUCAUSE Cybersecurity Initiative: http://www.educause.edu/security.
2. *EDUCAUSE Core Data Service Almanac*, February 2015, https://net.educause.edu/ir/library/pdf/CDA1401.pdf.

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community about threats and how to take action to protect institutional data. The training framework should include initial training and ongoing educational opportunities.

■ Continue to engage in proactive information security activities that adopt a defense-in-depth approach. Use scanning tools to identify and respond to system vulnerabilities; actively and aggressively identify and block malicious activity; implement reliable identity-management technologies; perform penetration testing and act on the results; collect logs and monitor for suspicious or concerning events; and back up critical institutional data and make sure data can be restored from those backups. Do not rely on a single control.

■ Participate in organizations that work together to improve higher education information security. Organizations such as EDUCAUSE, Internet2, and the Research and Education Networking Information Sharing and Analysis Center (REN-ISAC) provide opportunities to improve understanding about information security practices in higher education, develop higher education information security professionals, and collectively respond to information security threats.

■ Provide the institution's governing board with an annual IT security risk update, which can greatly help board members as they assess and govern the institution's overall enterprise risk assessment.

■ Use the EDUCAUSE Information Security Maturity Index and the HEISC (Higher Education Information Security Council) Information Security Program Assessment Tool (http://www.educause.edu/library/resources/information-security-program-assessment-tool) evaluate the institution's current state of information security.

Issue #2: Optimizing Educational Technology

Collaborating with faculty and academic leadership to understand and support innovations and changes in education and to optimize the use of technology in teaching and learning, including understanding the appropriate level of technology to use

Today's collegiate classroom and pedagogy look very different from those of ten years ago.[19] Almost every institution is supporting a set of core educational technologies (e.g., LMS, technology-enhanced spaces, hybrid/blended courses), and most faculty are adopting them.[20]
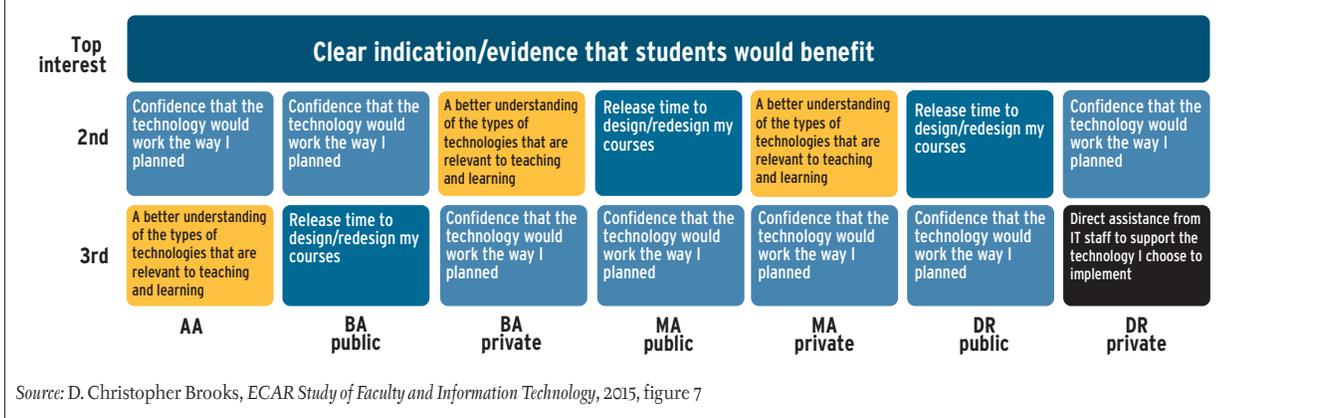
Innovation comes in response to concrete problems. To find the most useful educational technology innovations, we should give thought to the issues and challenges that technology could help us address. For example, technology provides real opportunities to enhance both faculty-student and student-student interactions and to virtualize and extend the campus environment:

■ *Faculty-student interactions.* Most current interactions outside the physical or digital classroom are asynchronous, via LMS or e-mail. However, students appreciate having their questions answered by instructors in real time. Holding virtual online office hours can create a number of benefits: meetings can take place at convenient times, and relevant discussions can be archived and shared with the entire class.

■ *Student-student interactions.* Students who have the opportunity to communicate and work with each other become more effective and successful learners. According to the Pew Research Center, 92 percent of teens report going online daily, including 24 percent who say they go online "almost constantly."[21] Providing tools, training, and guidelines to reinforce formal and informal student-to-student interaction is a vital part of virtualizing the campus experience.

■ *Student–campus environment interactions.* Today's students live in a digital environment that needs to be embraced to effectively engage students and prepare them for the future. Technologies such as gaming, simulations, open educational resources (OERs), and courseware are transforming the way faculty teach, the way students learn, and how the two groups interact with each other. New technologies such as alerts and pathways are also transforming other administrative and academic areas like advising and planning. Not all technologies translate well from personal to academic use: for example, students use social media extensively in their personal lives, but a growing majority prefer to keep their academic and social lives separate.[22]

The impact of these and other teaching and learning technologies needs to be assessed and shared to ensure that educational technology is truly effective and continues to flourish and evolve. Optimizing educational technology isn't actually about the technology. It's about understanding and working within the complex system in which postsecondary learning and teaching take place. It's about

FIGURE 4. Factors Motivating Faculty to Integrate Technology into Teaching or Curriculum

	AA	BA public	BA private	MA public	MA private	DR public	DR private
Top interest	Clear indication/evidence that students would benefit						
2nd	Confidence that the technology would work the way I planned	Confidence that the technology would work the way I planned	A better understanding of the types of technologies that are relevant to teaching and learning	Release time to design/redesign my courses	A better understanding of the types of technologies that are relevant to teaching and learning	Release time to design/redesign my courses	Confidence that the technology would work the way I planned
3rd	A better understanding of the types of technologies that are relevant to teaching and learning	Release time to design/redesign my courses	Confidence that the technology would work the way I planned	Confidence that the technology would work the way I planned	Confidence that the technology would work the way I planned	Confidence that the technology would work the way I planned	Direct assistance from IT staff to support the technology I choose to implement

Source: D. Christopher Brooks, *ECAR Study of Faculty and Information Technology*, 2015, figure 7

understanding learning objectives from the macro (institutional, disciplinary) to the micro (course, module, class period) level. It's about understanding what facilitates learning: strengthening and leveraging relationships (among faculty, students, and advisors), delivering relevant and engaging content, supporting active student learning, and helping students understand and focus on priorities.

Optimizing educational technology is also about understanding how faculty on a particular campus are, or aren't, rewarded for delivering excellent teaching and services, partnerships, and support—and also how they are motivated to do so. The most important motivator for faculty is clear indication or evidence that students benefit from technology. Faculty also want help with incorporating technology into their courses (see figure 4).[23]

Technology has many faculty at hello but loses them soon after. Trying a new technology in the learning environment is easy. It is much less easy for faculty to accurately and easily recognize how effectively the tool is working, whether learning is being enhanced, and whether and how to modify the use of the tools to make them more effective. Without evidence of impact, the majority of faculty will not be motivated to incorporate new technologies into their teaching. Without support, many will struggle to do so, even if they are motivated. Instructional design support can be an important component of optimizing the appropriate level of technology to use.

> **The evaluation of technology-based instructional innovations is**
>
> - a major part of IT strategy at 44% of institutions,
> - a minor influence on IT strategy at 34% of institutions, and
> - not considered at all at 19% of institutions.
>
> —Susan Grajek, *Trend Watch 2016* (ECAR, forthcoming)

Finally, increasing use of technology is not always the best way to improve teaching and learning. Students have made it clear that technology-enhanced learning is appealing. However, technology-dominated learning in the form of fully online courses is not: 61 percent of students say they learn best in courses with some online components, 18 percent prefer mostly online courses, and only 9 percent learn best in fully online courses.[24] Different levels and applications of technology are appropriate for different institutional missions, individual faculty, and individual learners. Ideally, learners will find the faculty and institutions that best fit them, and institutions and faculty will help students make those choices. IT leaders' roles are to help raise awareness of the possibilities and to execute with excellence. Academic leaders and instructors, not IT professionals, should determine the pedagogical and mission-driven pri-

orities. Most effective is when all stakeholders—IT leaders, academics, advisors, and students—collaborate on solutions.

Advice

- Implement practices (don't start with technologies) that strengthen relationships: faculty to student, student to student, faculty to faculty. Secure collective acknowledgment that (a) strengthening relationships leads to learning, (b) certain practices strengthen relationships, and (c) certain technology tools can facilitate those practices.
- Consider how faculty curate and create relevant content (and partner with libraries for this). Then, make it easier

> "As the availability of technology grows on our campuses, virtualizing and extending the campus environment and the faculty-student interaction becomes central."
>
> —Karin Moyano Camihort, Dean of Online Programs and Academic Initiatives, Holyoke Community College

for them to curate, create, and provide access to that content through the use of OERs, videos, simulations, and other resources. Secure collective acknowledgment that (a) relevant content leads to and supports learning, (b) certain processes are involved with curating and creating that content, and (c) certain technology tools, services, and support can facilitate those processes.

- Promote active involvement by students in and out of the classroom. Understand how the brain works (e.g., using 10-minute chunks in lectures) and how to encourage student reflection. Secure collective acknowledgment that (a) active involvement of students promotes learning, (b) certain practices strengthen active involvement, and (c) certain technology tools can facilitate those practices.
- Keep students on-task/invested/engaged/persisting. Secure collective acknowledgment that (a) engaged, persistent students are more likely to be students who learn (and complete), (b) certain practices strengthen engagement and persistence, and (c) certain technology tools can facilitate those practices.
- Partner with other service units, faculty affairs, and administration to
  - *define* (learning objectives) or *inventory* (practices for strengthening learning relationships/community, curating and creating relevant content, promoting active learning, promoting student engagement and persistence);
  - *probe* for ideas for new practices;
  - *link* existing practices to current and desired tools, services, support; and
  - *pilot and evaluate* new tools and services, which might be different by discipline. Be careful not to overpilot (i.e., introduce too many different solutions) so that you can drive for a (hopefully flexible) standard offering.
- Tap into existing expertise in the faculty ranks, using effective practitioners as role models and facilitators.
- Provide appropriate and effective instructional design support and resources to maximize opportunithat ties for effective use of technologies.
- Develop ways in which faculty and students can share their experiences with one another and showcase innovative uses to campus stakeholders and leadership.

Teaching and Learning and IT Issues: Exploring the Intersections

Veronica Diaz and Malcolm Brown

Since 2011, the EDUCAUSE Learning Initiative (ELI) has been surveying the EDUCAUSE community in order to identify and track the key issues (formerly called content anchors) in higher education teaching and learning for the coming year (http://www.educause.edu/eli/initiatives/key-issues-in-teaching-and-learning).

One might ask: Why does EDUCAUSE conduct two separate surveys on significant issues for its community? The annual Top 10 IT Issues list, discussed in this issue of *EDUCAUSE Review*, provides a view of higher education seen primarily through the lens of the IT organization. It covers the full range of postsecondary "business," from administrative to academic pursuits. By contrast, the ELI Key Issues survey is more narrowly focused on teaching and learning. At the same time, however, it canvasses community members from a variety of campus areas, including IT organizations but also centers for teaching and learning, libraries, and the dean and provost offices. The additional perspective afforded by the ELI Key Issues is important in light of higher education's shift in emphasis away from technology per se and toward learning and instructional practices. Digital technology remains, of course, the key and strategic enabler, but it is no longer the centerpiece. Using faculty development as an example, today it is no longer a matter of getting faculty to "teach with technology." Instead, the issue is supporting faculty to adopt learner-centered instructional designs as a way to foster student success. Technology enables those designs, but it does not dictate them.

Taken together, these two EDUCAUSE surveys provide a rich and informative view on the top issues facing higher education today. Since they are complementary in nature, it is useful to closely examine the points at which they converge.

Optimizing Educational Technology, #2 on the EDUCAUSE Top 10 IT Issues list, closely aligns with several of the ELI Key Issues. *Faculty development* (ELI Key Issue #1) is about improving practice and enabling faculty members to support learning with the effective use of technology. *Academic transformation* (ELI Key Issue #2) is about using information technology creatively to support new teaching and learning models. *Learning analytics* (ELI Key Issue #5) refers to studying data about learners and their contexts in order to understand and optimize learning and the environments where it occurs. Finally, *working with emerging technology* (ELI Key Issue #3) is about having an ongoing awareness of innovations, developing an effective process by which to discover them, utilizing pilots, and considering full-scale implementation. Many, if not all, innovations from the past five years began with discovering the best ways to address an institutional challenge—such as first-year retention, developmental education, persistence or graduation—with the creative use of technology situated in new organizational models or approaches.

We've known for some time that in order to make progress on these particularly challenging issues, we must establish cross-organizational collaborations, involving key stakeholders who support learners not just in the classroom but all along their experience. Interestingly, the most significant teaching and learning innovations of the past five years have also required cross-organizational collaborations, cohort-based leadership, and institutional community building. Thus, *Optimizing Educational Technology* has the potential

to transform our institutions, from our classrooms to our very cultures. This issue is especially conspicuous if we think about the work being done in the area of integrated student advising systems. To further the work already under way in this area, the Next Generation Learning Challenges (NGLC) has recently awarded nearly 20 grants to support continued development for these tools (http://www.educause.edu/focus-areas-and-initiatives/teaching-and-learning/ipass-grant-recipients). These new grants will enable schools to further integrate data and its analysis, providing a more complete picture of a student's status, most often in real time, and offering the basis for more effective intervention. Here again, the interests of the IT organization and of the teaching and learning community converge, since these advances in advising systems will require the integration of an ever-wider range of data types and the creation of IT resources to perform the analyses.

Learning management system (LMS) services (ELI Key Issue #15) is another area of converging interests. According to EDUCAUSE Center for Analysis and Research (ECAR) data, 99 percent of institutions run at least one LMS, 85 percent of faculty use an LMS, and almost 75 percent feel the LMS is a useful tool. For an environment as diverse as teaching and learning, this is an extraordinary adoption rate. However, 15 percent of institutions anticipate changing their LMS application within the next three years.[1] This suggests that the teaching and learning community is looking past the current LMS, envisioning instead a broader, more comprehensive digital learning environment. Strategic core functions, such as customization and

> **We've known for some time that in order to make progress on these particularly challenging issues, we must establish cross-organizational collaborations, involving key stakeholders who support learners not just in the classroom but all along their experience.**

personalization, learning analytics, and collaboration, as well as accessibility and universal design, are emerging as key features for this new landscape. This means that the IT organization staff and teaching and learning staff will have a host of new collaboration opportunities in the coming years: the new landscape will require a blend of IT and pedagogical expertise to design and craft this next generation of digital learning environments for both instructors and students.[2]

Lastly, *online and blended learning* (ELI Key Issue #4) has been among the top five teaching and learning key issues since 2012. Since so many emerging innovations (i.e., learning analytics, adaptive learning, personalized learning) involve this context in one way or another, it remains highly relevant. According to *The State of E-Learning in Higher Education*, e-learning is ubiquitous, with more than 80 percent of institutions offering at least several courses online and more than 50 percent offering a "significant" number of courses online in 2013.[3] In addition, mature institutions that offer online and blended learning options to their students are beginning to evolve these models to discover the one that best fits their students. Personalized learning is an example of a model that provides a unique, focused learning path for each student. Technology systems and tools, along with rich data sets and analytics programs, can support a customized learning experience regardless of the student or institutional type by leading learners through learning experiences and offering the support they need, at the time they need those resources, and in a form well suited to them. Personalized learning is one of many new ways tools and processes are being integrated to reimagine ineffective, outdated models for

the purpose of delivering an improved learning experience.

These points of contact between the key teaching and learning issues and the top IT issues can provide the basis of strategic and tactical discussions between the IT organization and the cohort of campus organizations supporting teaching and learning. Each roster of significant issues serves to illuminate the other, providing a better sense of direction as we move forward in support of the key mission of teaching and learning.

Notes
1. Eden Dahlstrom, D. Christopher Brooks, and Jacqueline Bichsel, *The Current Ecosystem of Learning Management Systems in Higher Education: Student, Faculty, and IT Perspectives*, research report (Louisville, CO: ECAR, September 2014), 4, 3, http://www.educause.edu/library/resources/current-ecosystem-learning-management-systems-higher-education-student-faculty-and-it-perspectives.
2. For a fuller description of this new digital learning environment, see Malcolm Brown, Joanne Dehoney, and Nancy Millichap, "The Next-Generation Digital Learning Environment," an ELI paper, April 2015, http://net.educause.edu/ir/library/pdf/eli3035.pdf.
3. Jacqueline Bichsel, *The State of E-Learning in Higher Education: An Eye toward Growth and Increased Access*, research report (Louisville, CO: ECAR, June 2013), 19, http://www.educause.edu/library/resources/state-e-learning-higher-education-eye-toward-growth-and-increased-access.

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Issue #3: Student Success Technologies

Improving student outcomes through an institutional approach that strategically leverages technology

Student success technologies involve the use of data collection and analysis tools at all levels to predict student success or risk, alert those who can intervene, and assess the effectiveness of those interventions. Student success technologies can be broken into three categories: (1) tools that support advising and other student services, (2) tools that support teaching and learning, and (3) tools that inform curricular design and institutional priorities.

In the first area—advising and student support services,—there has been interest over the past few years in the redesign of the advising process and the inclusion of early-alert technologies that provide opportunities for faculty and advisors to send manual alerts or to trigger automated alerts providing students with reasons for the alert, recommendations, and next steps. Student academic planning tools are also available at many institutions. Some institutions require each student to have an educational
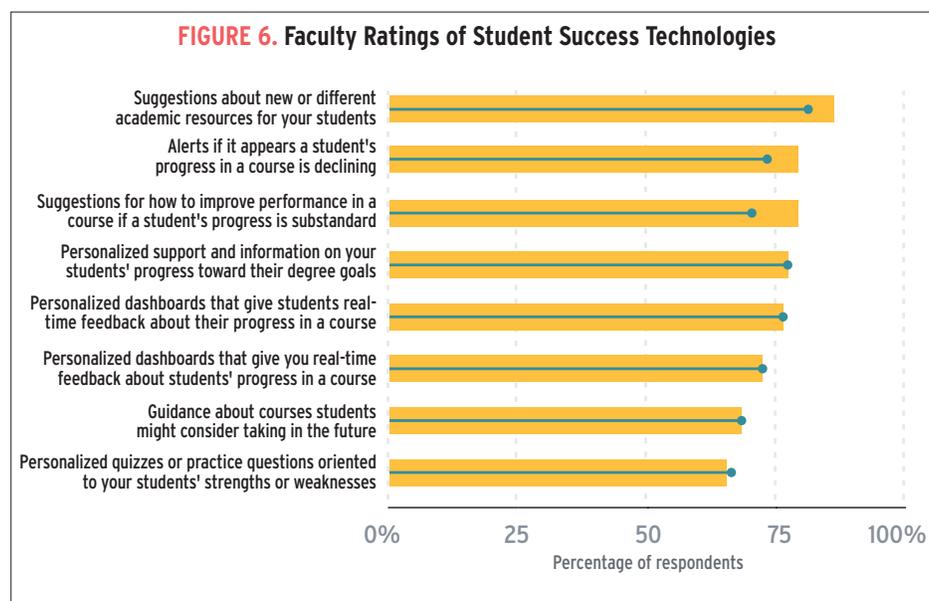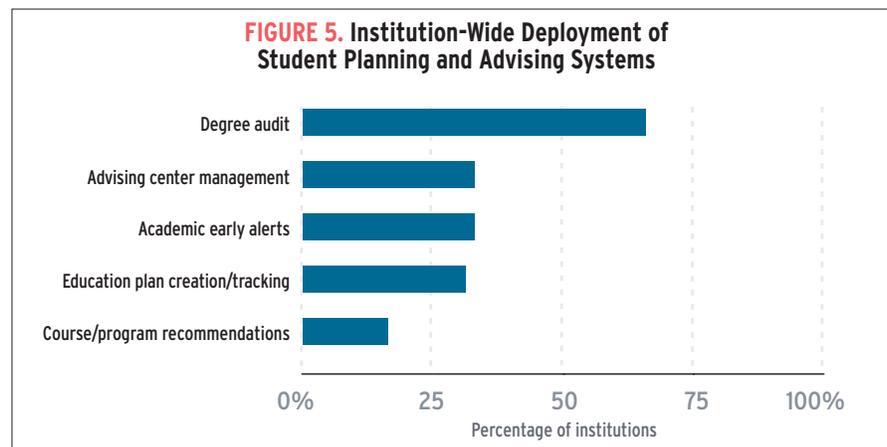
plan, which facilitates a more in-depth conversation with advisors and provides the institution with data to develop an academic course schedule that aligns with students' plans (see figure 5).

In the second area—teaching and learning—technologies that support student engagement and that provide students and faculty with learning analytics are being used to improve student outcomes. While technologies are being developed and enhanced to support student success, the institutional processes and usage of the tools contribute more to improvement than do the technologies themselves.

Finally, analytics also plays a major role in the third area: curricular design and institutional priority-setting. Metadata

about student swirl—in and out of majors, in and out of courses, and in and out of institutions—can and should inform curricular design, academic programming, and even faculty assignment or development. It can also identify different pathways for students through a degree program. In addition, many student success technologies support interactions between the students and the institution.

Students are conceptually interested in having their instructors receive feedback about their performance: 59 percent are extremely or very interested, and only 13 percent are not interested. They are equally interested when instructors actually have access to this kind of feedback: 58 percent find these technologies extremely
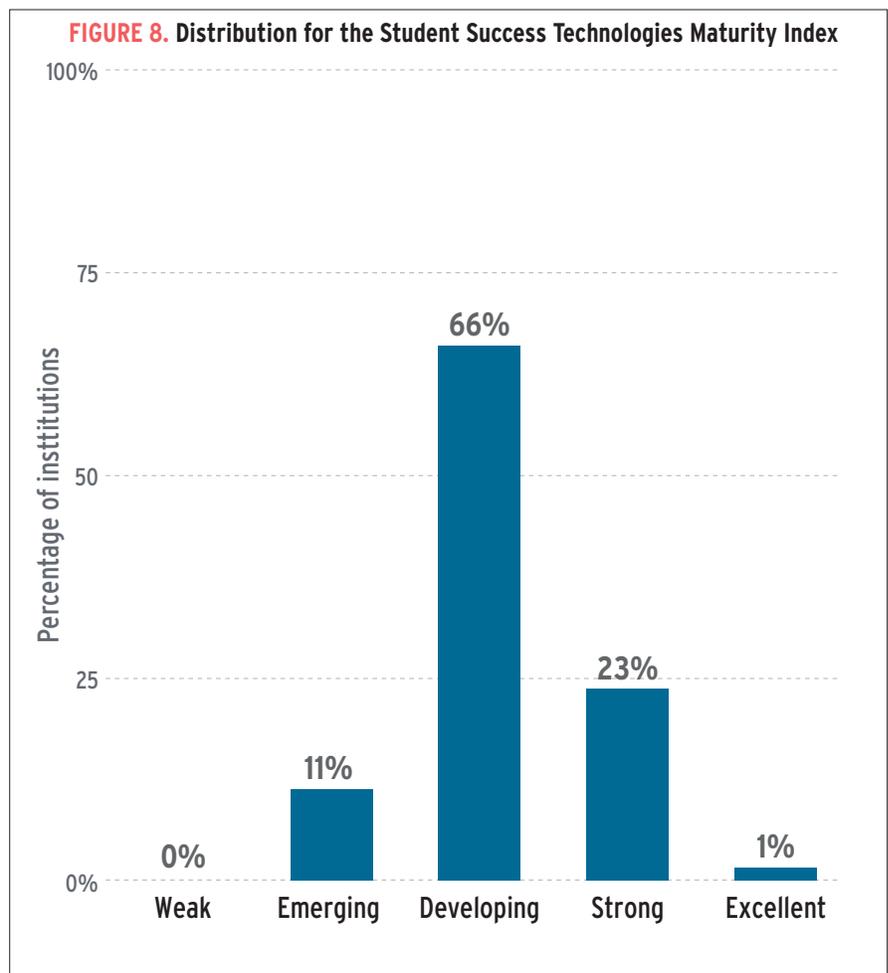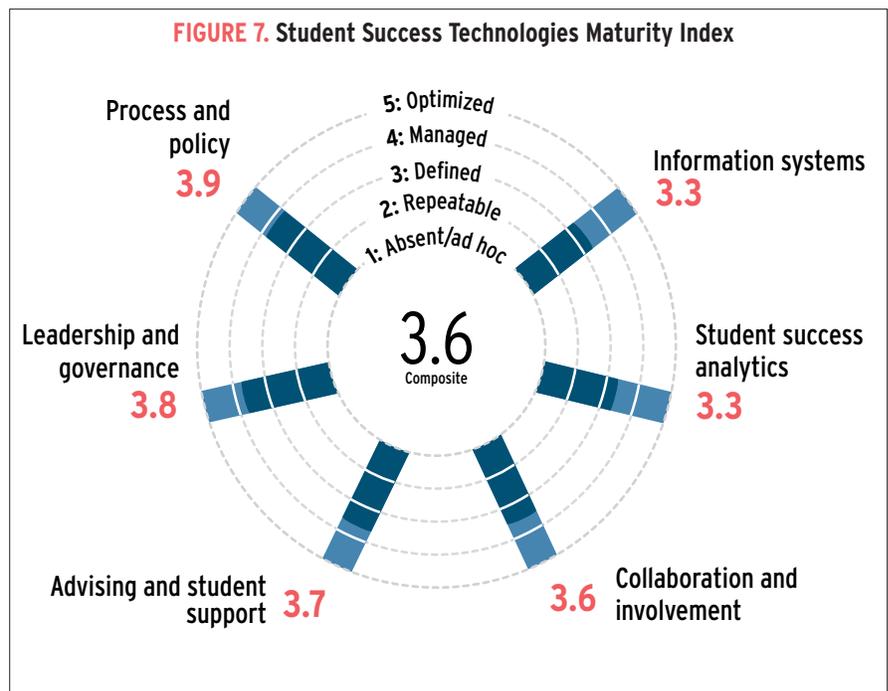
FIGURE 5. Institution-Wide Deployment of Student Planning and Advising Systems

FIGURE 6. Faculty Ratings of Student Success Technologies

or very useful when their institutions provide them, and only 11 percent find them not very or not at all useful.[25]

The real challenge in the application of student success technologies to student outcomes is the institution's ability and willingness to embrace change. Faculty are unlikely to resist in large numbers. When asked about an array of technologies that use analytics to improve student success, faculty found them both highly interesting and useful (see figure 6).

New technologies are only one component of the design that supports improved student outcomes. Effective student success initiatives often entail institutional policy updates, redesigned processes, organizational and role changes, new governance structures, and implementation of tools that require training of and adoption by faculty and staff. Combining expert opinion and research, EDUCAUSE has identified six overall success factors that compose maturity in student success initiatives (see figure 7):

1. *Process and policy.* Policies and requirements for degree attainment, security, and access are clear and adaptable.
2. *Leadership and governance.* Initiatives have leadership support and oversight and adequate funding.
3. *Advising and student support.* Faculty, advisors, and others who work directly with students support the student success goals and use student success technologies.
4. *Collaboration and involvement.* IT, faculty, institutional research, students, staff, student affairs, and other key stakeholders collaborate and participate in decision making.
5. *Student success analytics.* Analytics initiatives and tools are used and useful.
6. *Information systems.* Needed student success technologies are deployed, their data is integrated, and end-users have sufficient training.
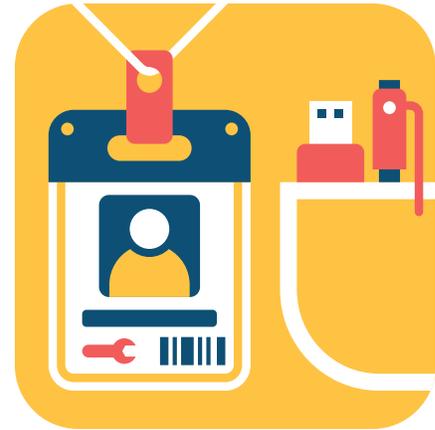
Almost one in four institutions have reasonably strong student success initiatives; the rest are still launching their efforts (see figure 8). Of course, student

FIGURE 7. Student Success Technologies Maturity Index

Process and policy **3.9**
Information systems **3.3**

5: Optimized
4: Managed
3: Defined
2: Repeatable
1: Absent/ad hoc

3.6 Composite

Leadership and governance **3.8**
Student success analytics **3.3**

Advising and student support **3.7**
3.6 Collaboration and involvement

FIGURE 8. Distribution for the Student Success Technologies Maturity Index

Percentage of institutions

Weak	Emerging	Developing	Strong	Excellent
0%	11%	66%	23%	1%

success efforts are not a "one and done." New technologies will provide new opportunities. The institutions that are leading the way will constantly raise the bar for all. The most successful institutions will be those that adopt continuous improvement practices, so that the cycle of plan-do-check-act is incorporated into ongoing institutional management.

Advice

- Before technology selection, contact other institutions that have deployed similar tools to understand best practices in implementation and outcomes achieved.
- Before launching new student success initiatives, set goals and determine how to measure success.
- Include all stakeholders (e.g., faculty, students, advisors, academic leaders, IT managers) in the selection, implementation, and testing to ensure that the solution will be feasible, affordable, and useful.
- Don't stint on communication and training, which are key components of successful projects.
- Adopt continuous-improvement practices: assess success systematically, use the results to modify, and reassess, always with a goal of improving student outcomes.
- Prepare to play the long game: major change initiatives may take months or even years to bear fruit. Estimate a realistic ROI timeline to help make the decision of whether to stay the course or move on.
- Ensure the institution owns and can modify the algorithms that generate alerts. More important, design the business and support processes that will apply the alerts: determine which interventions will take place across which student service or academic units and how those will be communicated to those units and judged for effectiveness.
- Understand how to integrate data sources and manage private data across a spectrum of student services and academic units, ensure staff and faculty are trained accordingly, and develop a communication strategy so that uses of data are not perceived as intrusive or controlling.
- Complete the EDUCAUSE Student Success Maturity Index to benchmark institutional maturity.

> "Institutions must be able to generate the appropriate alerts for their students, and if institutions can't participate in tweaking algorithms that might be proprietary to a vendor, that's a red flag for me. More important, institutions benefit from having a full understanding of which interventions will take place across any number of student service or academic units, how those will be communicated across those units, and how they will be judged for effectiveness."
>
> —**Deborah Keyek-Franssen, AVP, Digital Education and Engagement, University of Colorado System**

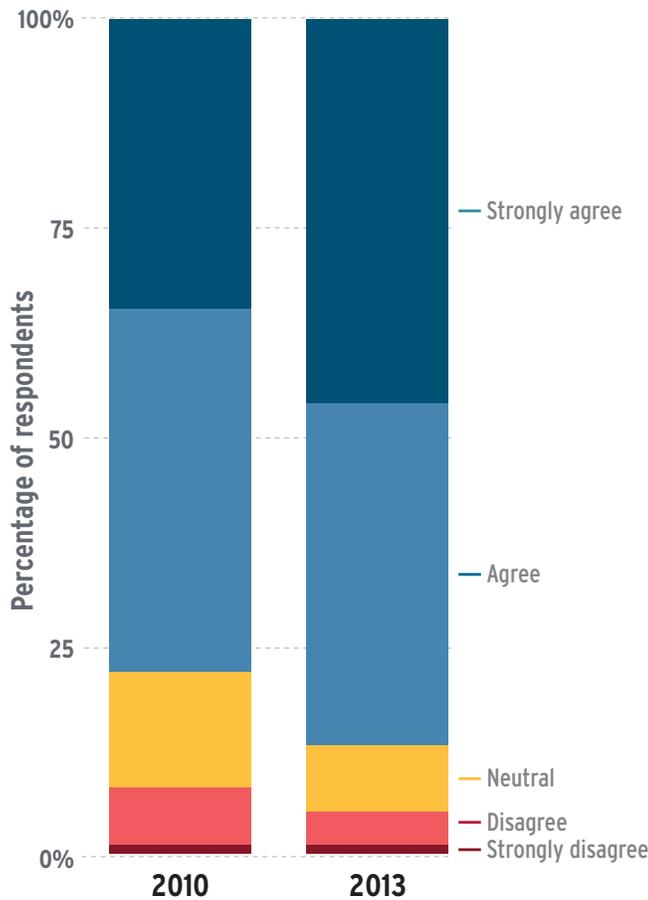## Issue #4: IT Workforce Hiring and Retention

Ensuring adequate staffing capacity and staff retention as budgets shrink or remain flat and as external competition grows

Higher education is now using many of the same technologies as are corporations and private industries around the world, looking for the same technical and management skillsets, and thus competing for the same IT talent. In past years, academic institutions offered staff an appealing set of tangible and intrinsic benefits: more time off, more opportunities to apply technology creatively, the appeal of working in a campus setting with faculty and students, and a highly collaborative professional network—all of which more than offset the generally lower compensation. With the economic situation over the past several years, however, numerous IT organizations have experienced budget reductions, minimal salary increases, declining benefits, and relocations that have separated IT staff from the academic community. Many IT professionals would argue that the one increase they

FIGURE 9. IT Workforce Perceptions of Workload Increases

Legend:
- Strongly agree
- Agree
- Neutral
- Disagree
- Strongly disagree

Y-axis: Percentage of respondents (0%, 25, 50, 75, 100%)

X-axis: 2010, 2013

Source: Jacqueline Bichsel, *Today's Higher Education IT Workforce*, research report (Louisville, CO: ECAR, January 2014), unreported data

FIGURE 10. Top Reasons CIOs, Managers, and Staff Stay in Their Jobs

	CIOS	Managers	Staff
Top reason	My staff	Benefits	
2nd	Quality of life		
3rd	Opportunity to build my leadership skills		Work hours
4th	My colleagues	My staff	My colleagues
5th	My boss/ leadership	My colleagues	Geographic location

Source: Jacqueline Bichsel, *Today's Higher Education IT Workforce*, research report (Louisville, CO: ECAR, January 2014), table 4

have seen is in workload and expectations, an untenable trend (see figure 9). Today, with cautious rebounds in the economy, particularly in technology jobs, IT talent is a hot commodity. As a result, higher education IT organizations are experiencing increased staff turnover, more aggressive staff recruitment, increasing market salaries they cannot match, and more failed searches. This is not an abstract concern: an estimated 1 in 8 CIOs, 1 in 6 managers, and 1 in 5 IT professionals are likely to leave their current institution.[26]

Retaining staff becomes a critical priority. In many technology areas, and particularly at small institutions, IT organizations are "one deep" in knowledgeable staff expertise; as a result, those departures could severely disrupt campus services. Many colleges and universities have difficulty offering salaries that are competitive with private industry, but a creative and proactive management team and HR department can improve the odds. Options such as completion bonuses after a long project or even a temporary stipend during a period of critical need can make a difference.

However, compensation is not what primarily attracts or retains most professionals.[27] The hard-driving, live-to-work Baby Boomers are giving way to Gen Xers and Millennials who want a better work-family balance. They expect more opportunities for flexible schedules, telecommuting, and updated family and parental leave. Boomers too are hoping to continue past traditional retirement ages in different roles or capacities that flexible organizations can provide. Professional development opportunities and new assignments or projects can also motivate staff to stay. But it is primarily people and quality of life (including the quality supported by good benefits) that retain staff, no matter their age or position (see figure 10). Managers who can develop and foster a collaborative and congenial workplace are the superpower of a stable, high-performing organization. They should

"Speaking on behalf of smaller institutions, I know there is little margin for error if a staff member does not fit within an IT group. It is thus very important for management to do whatever they can to retain good employees. Explore creative compensation ideas with your HR department. Don't be satisfied with the 'we have never done that before here' reasoning."

—**William R. Senter, Chief Technology Officer, Texas Lutheran University**

be identified, developed, and nurtured.

Workforce diversity is increasingly understood to be both essential and beneficial. Higher education's cultural and organizational structures have evolved within the context of a majority population, a fact that may introduce unconscious and unintentional biases against non-majority students and staff. For IT organizations to be agents of change, IT staff and leaders need to better understand how organizational structures and culture continue to reflect the contexts of a majority population and must then improve those structures and culture to benefit all. And all will benefit. Diverse teams outperform homogenous teams, improving innovation, problem-solving, and productivity.[28] Conceptions of diversity should be broad and various: gender, race, age, religion, and sexual orientation are just the beginning.

Advice

- Ensure that staff witness and learn about the benefits of working at the IT organization and the institution. Ensure also that the best employees know their interests are being kept in mind over time.
- Set annual organizational and individual goals, and measure achievement so that staff feel valued and understand the contributions they make. Celebrate successes; have senior executives talk with staff about the role and value of the IT organization; link IT initiatives and services to student experiences, faculty accomplishments, new instructional approaches, and new business processes.
- Proactively manage the organization, roles, and careers. Regularly review staff and positions in the department to prepare for opportunities (e.g., new positions, vacancies) that arise. When vacancies develop, consider how work and roles could be restructured to provide growth opportunities for existing staff. Inform institutional leadership of organizational and staffing changes that are under consideration, so that they will have time to reflect, prepare, and support in advance.
- Develop backup and succession plans, starting with the roles that are most difficult to fill or are most mission-critical. Establish useful and measurable cross-training experiences. Find opportunities to share skills and resources within a state university system or other collaborative.
- Ensure that managers are highly effective, and develop management skills on an ongoing basis. Managing technical people is a very special skill, and few are good at it.
- Investigate options for flexible work arrangements and telecommuting.
- Don't settle. Before hiring, be sure you have (1) the right fit, (2) someone who has a passion for the mission of higher education, and (3) someone who shares the organization's values.
- Build and retain a diverse workforce through effective recruitment, retention, and advancement. Understand and try to prevent the effects of unconscious bias in recruitment, retention, and advancement.
- Include risks related to the IT workforce as part of the institution's enterprise risk analysis. Discuss with the chancellor, president, provost, CFO, and institutional board the human resource challenges the IT organization is experiencing. Leadership will likely be more receptive if the discussion is linked to the achievement of, or the risks of not achieving, institutional goals and strategic objectives.
- IT staff crave professional development and expect it to be an organizational priority. Establish a specific budget and a transparent process for requesting training. However, with tight funding, ensure that all development has a particular end in mind. Include staff professional development as part of each person's goals and each manager's and director's performance review.

Issue #5: Institutional Data Management

Improving the management of institutional data through data standards, integration, protection, and governance

Data is the engine that feeds the higher education mission. It is entrusted to us by faculty, students, alumni, parents, donors, staff, and others to support decisions related to admissions, financial aid, curriculum, research, employees, infrastructure, investments, purchases, and health care. As information technology systems and uses have proliferated over the years, managing the underlying data has become increasingly important.

Much data still exists in silos within our institutions today. This situation is a natural result of the decentralized nature of most colleges and universities and the organic growth of departmental services, often in response to the lack of centralized services and the limitations in the central IT organization's ability to support departmental needs and priorities. It also reflects a failure of most institutions, until very recently, to recognize the value of a strategy in which data is viewed as a strategic enterprise asset, to be leveraged to benefit institutional strategic objectives

as well as departmental or operational objectives. Current efforts to identify risk factors to student and researcher success depend on data from disparate sources, internal as well as external to the institution, as do efforts to deliver increasingly personalized services to constituents. With many institutions still grappling with multiple answers to even the most basic data-informed questions—for example, how many students and faculty do we have?—higher education has its work cut out for itself.

Institutions must understand not only what data they possess, but how to care for the data through thoughtful governance and administration. *Data governance* is a structure empowered by institutional leadership to establish effective standards and practices for data handling and sharing and to arbitrate disputes over access to categories or elements of data. Many institutions begin by clarifying data ownership and by classifying data according to varying levels of confidentiality, compliance requirements, and desired uses. *Data administration* is a structure (or group) that operationalizes standards for institutional data handling and sharing (including integration) and is responsible for maintaining data integrity; data definitions; authorization, retention, and disposition practices and procedures; and technical architectures. Data management requires ongoing assessment and improvement to maintain compliance with new and evolving regulatory requirements and to retain agility and flexibility.

Though often viewed as an "IT issue," data governance is really a larger business issue. Multiple roles and responsibilities are associated with data management. Since all institutional constituents need to understand their roles and responsibilities, education, outreach, and training are critical components of effective data management.

Each institution will organize the work of data management differently, depending on existing organizational assignments and strengths. The 2015 ECAR study of analytics showed that depending on the institution, the CIO, institutional research (IR) director, chief academic officer, president, student success leader, and dedicated chief data or analytics officer are all likely leaders of analytics programs.[29] There is no one best practice, other than to designate *someone* to lead.

> "Institutions should begin with identifying a framework for data management decisions: a data governance model. Ensure the model provides for accountability as well as agility. Data must be managed, but in a way that still allows for rapid development of new applications of the data."
>
> —**Brad Judy, Director of Information Security, University of Colorado System**

Enterprise IT Perspectives on the 2016 Top 10 IT Issues

Betsy Tippens Reinitz

Members of the EDUCAUSE Enterprise IT Program Advisory Committee considered four of the 2016 Top 10 IT issues that are particularly relevant to enterprise information technology. Below they describe how these issues are addressed at their institutions and what opportunities the issues present for the future, and they provide advice for enterprise IT leaders who are tackling these issues. The following committee members shared their thoughts:

- **Mark I. Berman**, Chief Information Officer, Siena College
- **Geoffrey Corb**, Deputy Chief Information Officer, The Johns Hopkins University
- **Kyle Johnson**, Dean for Information Technology and Services, Chaminade University of Honolulu
- **James M. Maher II**, Executive Director of Information Technology Services, Saginaw Valley State University
- **Leslie Riester**, Director, Special Projects, Portland Community College
- **Angela M. Svoboda**, Associate Vice President for Digital Effectiveness, Information Technology, St. Edward's University

Issue #5: Institutional Data Management
Improving the management of institutional data through data standards, integration, protection, and governance

How is your institution addressing this issue?
Svoboda: A data access and delivery team with representation from multiple campus offices discusses data issues such as standards, naming conventions, definitions, and governance. We have been able to methodically address issues where data integrity is lacking.
Berman: We brought in a consultant who talked about the importance of data definitions. We are working to be sure everything is clearly defined and everyone understands the definitions.
Riester: We have data custodians who are in charge of data standards in each of their areas. They meet regularly to work toward consensus.

What advice would you give others?
Berman: Make sure the data is consistent as you move toward a data-driven culture. You need a data dictionary, and you need to make sure people stick with it.
Maher: When looking at vendor-provided reporting solutions, make sure to assess current data customizations and how well end users know their data.

What are the biggest opportunities for the future?
Svoboda: There are opportunities to use data as a campus asset and to build an understanding of the importance of data for decision making and predictive analysis.

Riester: There's a leadership opportunity for the IT organization in these conversations, particularly related to data governance and security.

Issue #7: BI and Analytics
Developing effective methods for business intelligence, reporting, and analytics to ensure they are relevant to institutional priorities and decision making and can be easily accessed and used by administrators, faculty, and students

How is your institution addressing this issue?
Berman: Historically, our decision making has been seat-of-the-pants, but we're starting to move toward data-informed decisions. We have the data, but we don't have the tools to work with it yet.
Maher: We recently purchased a new reporting infrastructure to put the data in the hands of the decision makers. Not every department has the skillsets to be report writers and data analysts, so we enable those who have that talent to help interdepartmentally.

What advice would you give others?
Svoboda: Analytics is critical, but without institutional data management and without a strategy for analytics, the efforts will fail. To get started, work with the offices—such as institutional research—that are onboard with business intelligence.
Berman: Work with institutional leaders to show the value of data-driven decisions. If people start asking for analysis, that's a big step toward a data-driven culture.

What are the biggest opportunities for the future?
Svoboda: There is an opportunity to collaborate across the institution to define the questions most important to the college/university.
Riester: Community colleges are very focused on access, but access by itself doesn't ensure student success. We have the opportunity to analyze what will help students be successful.
Maher: Analytics has the potential to solve a lot of the issues we're facing by helping us make decisions to align better with institutional missions and with what students need.

Issue #8: Enterprise Application Integrations
Integrating enterprise applications and services to deliver systems, services, processes, and analytics that are scalable and constituent centered

How is your institution addressing this issue?
Johnson: We have a group focused on system integration. We've moved past a world where we use one monolithic system for everything. Departments find systems they want to use, and they need to be able to share institutional data to be successful. They often come to us late in the process and ask us to integrate something they've already purchased. We continue to work hard to get involved very early on.

Svoboda: We assessed the state of identity issues that affect integrations and created a multiyear strategy and roadmap. We also created developer standards for data and business process integrations.

Maher: We're minimizing customizations and cleaning up our data. We now understand the difficulty of integrating solutions into our ERP. We convey that to stakeholders and build it into project costs and duration.

Riester: Enterprise vendors sometimes go right to the end users, and the IT organization doesn't get involved until users need integration. We try to market ourselves as people who want to help, so that we can be a part of the process from the beginning.

What advice would you give others?

Svoboda: Work to fully understand what people mean when they ask to have systems integrated. Educate them about identity integrations, data integrations, and business process integrations.

Corb: What was once hardcore development and software engineering is becoming systems integration, and you have to find the technologies that make it easier to do those integrations. With new systems to integrate and expectations for quick turnaround, it's important to know the technological options and understand the possibilities.

Johnson: Not all systems are housed on campus, so you need authentication that allows for the system to live somewhere else. Whether you use Shibboleth or some other authentication system, it needs to work for both on- and off-campus systems.

What are the biggest opportunities for the future?

Svoboda: Standards such as those developed by Internet2 are helpful.

Berman: With every IT acquisition, try to meet more than one need. Consolidation of IT resources and support can improve the overall efficiency of the institution and decrease the need for system integration.

Johnson: Standard data definitions that we can use between systems will help make things more plug-and-play. Every system integration is still work, but agreeing on definitions would help.

Issue #9: IT Organizational Development

Creating an IT organization structure, staff roles, and staff development strategies that are flexible enough to support innovation and accommodate ongoing changes in higher education, IT service delivery, technology, and analytics

How is your institution addressing this issue?

Maher: We're going through every service and thinking about what its future is going to be and whether a cloud solution is appropriate. Our goal is an infrastructure that's fluid and flexible so that we can shorten "time to market." And every year we put together a training plan to address staff skill issues related to upcoming projects.

Svoboda: We are rethinking our organization every time we have a vacancy. About half the time, we restructure a vacant position to meet new needs.

Johnson: We're developing project management and communication skills in existing staff. We're a small institution, so we don't have a separate project management or communications office. Soft skills make the difference, not the technical skills.

What advice would you give others?

Berman: Help institutional leaders understand that IT success is critical to institutional success. Participate in strategic planning to make sure the institutional leaders understand the IT resources that are necessary to be successful.

Riester: Set performance standards for new competencies, and then help staff reach them. Provide training, set expectations, and give positive support. But be prepared to take action if some staff are not able to meet new standards.

Corb: Fully understand your major vendors' product directions and roadmaps. You make a substantial investment in an ERP, and you'll have it for a long time, so you need to know vendors' plans for the future and be prepared to follow, align, and retool as necessary.

What opportunities do you see for the future?

Riester: You have to keep things running while you try out new things. We have a small staff, so the challenge *and* the opportunity is to carve out a small group of people who can do the testing, try out new technologies, and work actively with the user community on their ideas.

Corb: The IT organization of the past is not the same as the IT organization of the future. We used to live in a world where we had relative control of the environment. We have far less control now with BYOE and the cloud, and some institutions may not even have their own data centers anymore. This changes the shape of the IT organization, the services it provides, and the roles of the people involved—from leader down to staff and everybody in between. Rethinking what the IT organization is for is a huge opportunity in light of changing priorities and technologies. There may never be a better opportunity to partner with major campus stakeholders in areas traditionally served by information technology or in "growth areas."
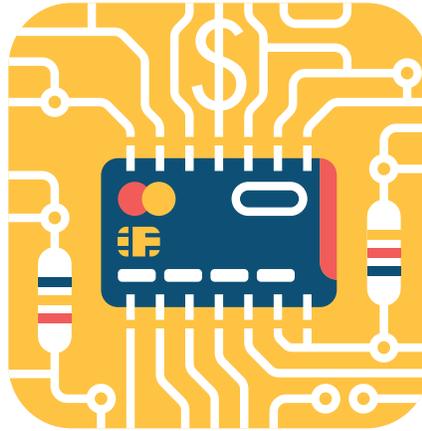
Betsy Tippens Reinitz is Director of Enterprise IT Programs for EDUCAUSE.

Advice

- Design a data architecture and infrastructure that supports both enterprise and departmental needs. Carefully consider data flows and schema, data standards, and definitions to facilitate integration between applications, data security, privacy, retention and disposition policies, and effective governance and oversight.
- Ensure that institutional leadership is involved in data governance and is willing to support and endorse data management policies and procedures, which may become contentious.
- Ensure that data management activities are realistically resourced. This is an added responsibility and should be staffed and funded accordingly. Don't wait for a data breach or analytics initiative failure to invest in data management.
- Those just beginning to address data management should take a methodical approach:
  - *Investigate:* Bring together those with a vested interest in institutional data to discuss the pain points, needs, untapped opportunities, and questions. Get a conversation started about how to best manage institutional data.
  - *Define:* Select a data governance framework for assigning data ownership and accountability and for defining a decision-making process.[30]
  - *Inform:* Once data roles have been defined, start asking what information people in each role need in order to make informed decisions.
  - *Prioritize:* Focus on the largest pain points and greatest opportunities. This can be a very interesting process, as it will combine the priorities for different data groups. If data retention is the #2 issue for student data, but the #12 issue for HR data, where does that place the priority for data-retention processes overall?

Issue #6: IT Funding Models

Developing IT funding models that sustain core services, support innovation, and facilitate growth

IT funding is the only issue that has made the EDUCAUSE Top 10 IT Issues list every year. Since the challenges in 2016 are not appreciably different from those of 2015, the advice and analysis from last year are worth reviewing.[31]
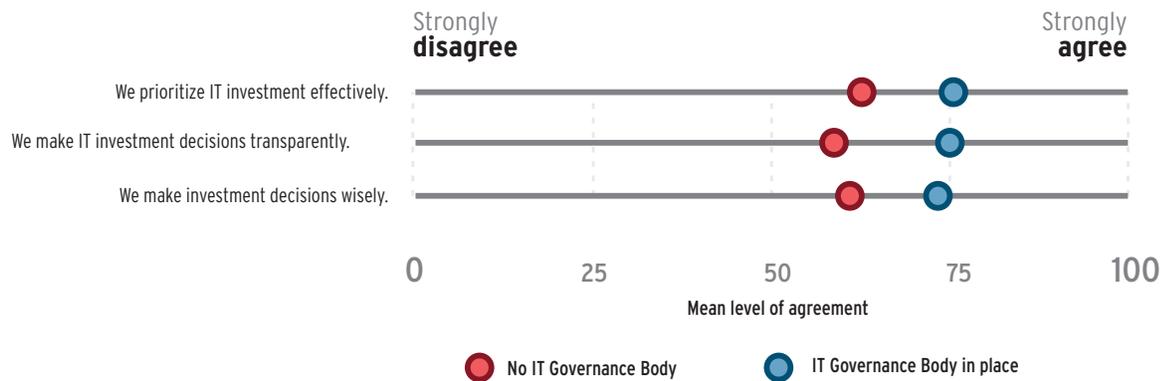
The role of technology in higher education has undergone a metamorphosis, but the budget processes at many institutions have largely remained the same. At a time when information technology needs to be agile and flexible, financial resources are often stringently allocated and unavailable to assist institutions in transformational work. In 2014, respondents to the EDUCAUSE Core Data Survey reported that 79 percent of the central IT budget is allocated to running the institution, 13 percent to meeting growth in demand, and only 6 percent to transformation. This 6 percent level of spending on innovation is less than half the cross-industry average of 13 percent, according to Gartner.[32] The 2014 Core Data Survey also reported that the central IT organization's median spending

as a percentage of institutional expenses was 4 percent. These numbers conflict with the realities of widespread interest in technology investments to improve student success, increase operational efficiency, and advance research. Considering the multidimensional challenges facing colleges and universities, campus communities should feel impelled to critically examine and address the issues that impede technology funding.

Most CIOs state that they long ago trimmed the budgetary fat. EDUCAUSE IT Issues Panel members reported:

- "IT organizations survived the recession by cutting and renegotiating contracts and agreements, but now they are running out of things to cut and there are many needs on campus."
- "It is becoming more and more difficult to sustain the giant infrastructure that we built and maintained over the past 10–15 years without a fundamental, sustainable budget. We have a $3 million investment in infrastructure and $50,000/year to replace it. That equipment needs to be updated or refreshed every 5–7 years. If we can't maintain that infrastructure, then eventually none of the other stuff will matter because the infrastructure won't be there."
- "Our institution leaders seem very willing to invest in new things and new services, but they don't want to hear the conversation about the millions of dollars in infrastructure and the fact that we never had a capital budget. Our one-time fund is gone. So leadership views requests for infrastructure maintenance as IT asking for money; but we view it as the money we used to have to maintain the infrastructure."

The solution involves improved financial management and reporting and more-effective IT governance. CIOs and CFOs need to develop a shared understanding of and commitment to realistic IT funding. CFOs have the financial

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FIGURE 11. Relationship between an IT Governance Body and IT Investment Decisions

Strongly **disagree**   Strongly **agree**

We prioritize IT investment effectively.

We make IT investment decisions transparently.

We make investment decisions wisely.

0   25   50   75   100

Mean level of agreement

● No IT Governance Body   ● IT Governance Body in place

Source: Jacqueline Bichsel and Patrick Feehan, *Getting Your Ducks in a Row: IT Governance, Risk, and Compliance Programs in Higher Education*, research report (Louisville, CO: ECAR, June 2014), figure 23

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knowledge; CIOs understand the magnitude of the investments needed not only to complete a project but also to maintain ongoing operations. A strong partnership can resolve the IT funding challenge (see figure 11). CIOs working with CFOs thus need to make the case for IT investments. Funding for projects that directly affect the mission of the institution (e.g., teaching and learning) is always easier to get than is funding for obscure or hard-to-understand infrastructure. In addition, CFOs hate surprises (who doesn't?). CIOs need to use strategies to minimize surprises: prepare a long-range (five-to-ten years) financial plan for the IT department; present multiyear budgets to the CFO; ask to have carry-

> ## "Savings, if they can be identified (even though not necessarily captured) are still important to highlight. Similarly cost avoidance."
>
> **—John C. Meerts, Vice President for Finance and Administration, Wesleyan University**

forwards to allow underspending in some years and overspending in other years, provided they cancel out within an agreed-upon time frame; and negotiate with the CFO for a fixed incremental amount (or percentage) every year as "new money" and commit to work within those constraints.

For years CIOs have struggled to demonstrate the value of information technology to higher education institutions. Too often "the value of IT" is shorthand for "why we are spending so much money on IT." This framing focuses purely on the cost of information technology and is actually about efficiency rather than value. Value is a function of efficiency *and* benefits. But when IT organizations are managed as cost centers, and when strategic IT conversations are restricted to expense, information technology will be viewed as necessary but also perhaps as dead weight; an encumbrance rather than an asset.
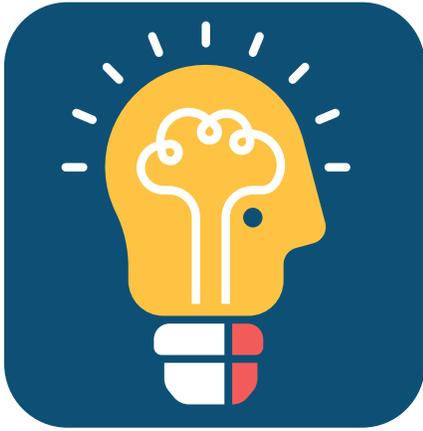
Advice
- Benchmark IT finances by participating in the EDUCAUSE Core Data Service.
- Ensure that IT projects build models for ongoing operational funding into project deliverables and expectations.
- Establish an institutional IT gover-

nance structure that is responsible for allocating funding, not just identifying IT priorities.
- Build the costs of growth and maintenance into funding models for core IT services.
- Tell the story of IT investments to help develop credibility. Help institutional leadership understand and remember the benefits and savings that came from previous investments.
- Work with the CFO to develop a budget model that shows all technology expenditures for the institution, even if they aren't all controlled by the central IT organization and even if they have to be adjusted each year (use forecast modeling). Advocate for IT funding and governance at the institutional level rather than the departmental level to reduce redundant spending and to ensure that the investments benefit the entire institution rather than just those areas that can afford them.
- Align IT services and investments with institutional goals and objectives to show information technology as an investment in the future of the institution rather than as an expense or cost center.
- Adopt ITSM (IT service management) methods for ongoing service management to contain operational costs.

Issue #7: BI and Analytics

Developing effective methods for business intelligence, reporting, and analytics to ensure they are relevant to institutional priorities and decision making and can be easily accessed and used by administrators, faculty, and students

Higher education institutions must become more data driven to capably respond to demands to become more effective and flexible and to meet both mission objectives and regulatory requirements. Business intelligence (BI) and analytics are the keys to unlocking insights that are contained in the numerous institutional data stores. Being able to see trends, ask "what if" questions, discern correlations, move to predictive models, and use those models to take action is becoming a key strategic capability. As IBM CEO Ginni Rometty asserts: "Where code goes, data flows. Cognition will follow."[33]

IT organizations have developed and managed ever-growing stores of data on students, employees, alumni, and donors, along with a realm of other data from information systems. We have an abundance of data. We also have access to an abundance of technologies and tools. Industry advances in data and analytics are presenting higher education with new opportunities to leverage data and information. IBM Watson Analytics, for example, can take various sets of data from an institution and elsewhere and look for various patterns and information. Adaptive learning tools such as Acrobatiq and Realizeit are cropping up to facilitate and personalize learning. As is all too often the case, however, the real challenge, and the right starting point, is defining the objectives of an analytics initiative and then developing the processes, policies, culture, and people needed to achieve those objectives. As is equally all too often the case, many institutions are starting with the data at hand, purchasing new systems with black-box algorithms, and seeing whether anything useful transpires. Care to wager on the ROI this approach is likely to achieve?
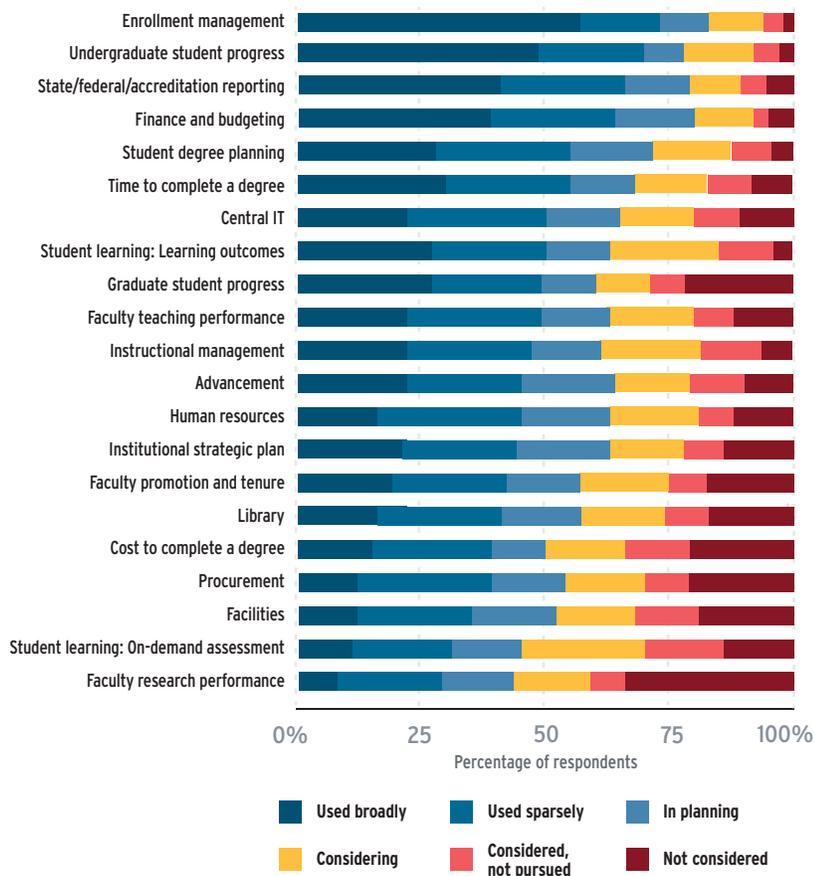
Many colleges and universities have initially focused on applying analytics to the admissions process. Now more attention is being paid to student engagement analytics, individual student learning analytics, and analytics for student success (see figure 12 p. 44). Both students and faculty are quite interested in the use of student data to achieve these outcomes. Yet whereas institutions are rich in BI reporting dashboard and learning analytics systems, they are poor in predictive analytics for student success.[34] As indicated in the *NMC Horizon Report: 2015 Higher Education Edition,* measuring learning analytics will grow significantly over the next three years.[35] We can expect to see growth in higher education analytics for information visualization, in the use of analytics to personalize learning, and in predictive analytics providing actionable insights.

As the use of analytics evolves, institutions will need to advance their

FIGURE 12. Current and Planned Uses of Analytics

Enrollment management
Undergraduate student progress
State/federal/accreditation reporting
Finance and budgeting
Student degree planning
Time to complete a degree
Central IT
Student learning: Learning outcomes
Graduate student progress
Faculty teaching performance
Instructional management
Advancement
Human resources
Institutional strategic plan
Faculty promotion and tenure
Library
Cost to complete a degree
Procurement
Facilities
Student learning: On-demand assessment
Faculty research performance

Percentage of respondents

■ Used broadly   ■ Used sparsely   ■ In planning
■ Considering   ■ Considered, not pursued   ■ Not considered

Source: Ronald Yanosky, with Pam Arroway, *The Analytics Landscape in Higher Education, 2015*, research report (Louisville, CO: ECAR, October 2015)

analytics maturity. That entails ensuring sufficient funding and resources; fostering a data-informed decision-making culture that results in clear improvements; developing policies for data and analytics security and access; ensuring that data is accurate, standardized, "clean" and useful; and strengthening partnerships between the IR and the IT organizations. EDUCAUSE has an Analytics Maturity Index against which institutions can assess their level of analytics maturity. Overall, higher education has made no measurable progress in analytics maturity in the past two years: fewer than 15 percent of institutional analytics programs might be described as strong or excellent.[36]

Some existing processes and policies will need to be changed. Data ownership and management currently conform to our highly decentralized leadership models: each office, department, division, or school owns its own data. That's an extremely useful model when the focus is on ensuring that each area has the data it needs to optimize its particular goals and mission and on limiting access to that data. It also works best when data elements are fully contained within individual distributed areas. However, when the focus moves to institutional objectives or when people, funding, and resources are fluid and have multiple "homes," decentralized data ownership can be a serious impediment to achieving such outcomes as student success, resource optimization, and greater transparency.
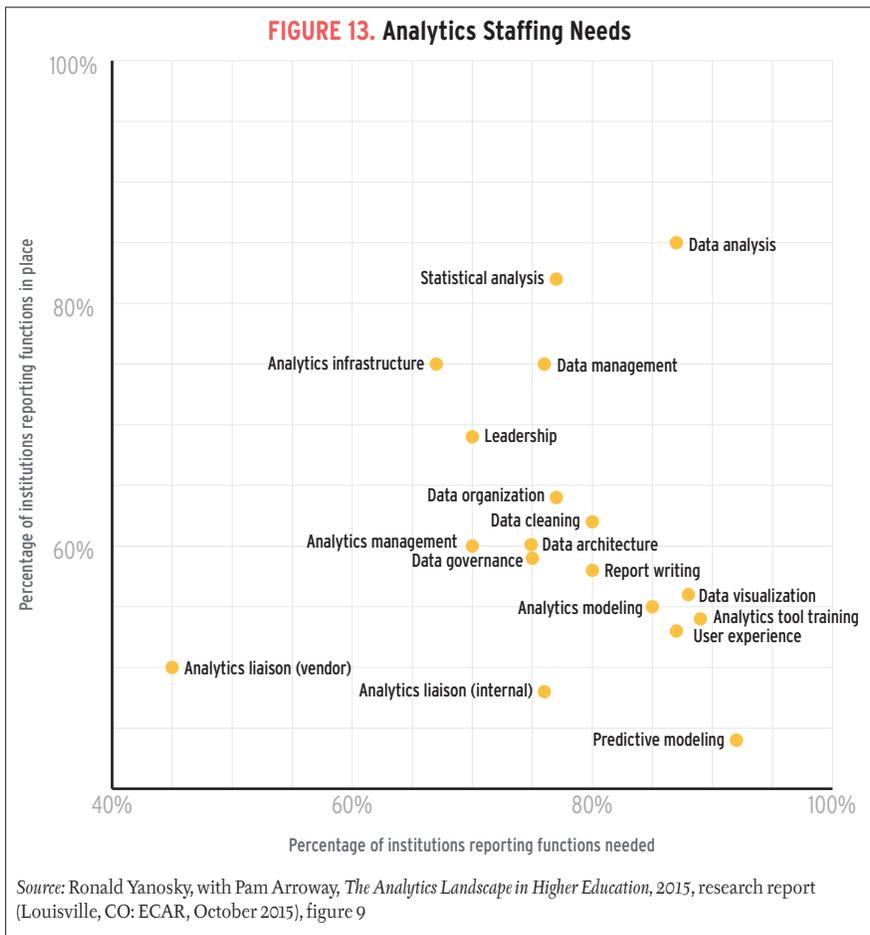
Institutions won't make progress with analytics without the right people. Higher education needs expertise to manage, analyze and model data; to present findings in creative and thoroughly useful ways; and to serve as gateways but not gatekeepers between decision makers and data and findings. Most institutions lack sufficient or any talent in key analytics roles, including analysis and modeling, data management and architecture, data visualization, and user experience (see figure 13).

Advice

- Identify the initial institutional objectives. Look for areas that have urgent, clear needs and want to get engaged. Work with them first. (Student success is often a good starting place.) Always ask what question the initiative needs to answer, how the data will be used, what actions and decisions will result, and what measures should be used to determine if the actions taken have made a difference.

- BI is a collaborative effort. No one has all the keys. A governance structure that consists of an executive steering group of key decision makers with funding authority, aligned with a cross-institution BI working group, can enable progress. At a minimum, the working group should include the IT, IR, and registrar offices.

- Ensure that the initiative has sufficient funding and the right resources. This is not a part-time effort that can be added to existing roles. Consider appointing or hiring an analytics lead whose sole responsibility is to make BI useful on campus. Such a position can provide the glue to keep the various critical data stewards and data users making focused progress and to align the workers with initiative leadership.

- Ensure that the initiative has the right data. Establish, document, and maintain an institutional data dictionary. Institute data management processes.

- After identifying analytics objectives, the data needed, and data governance models, consider business intelligence and data warehouse technology needs. Most institutions will find that initial
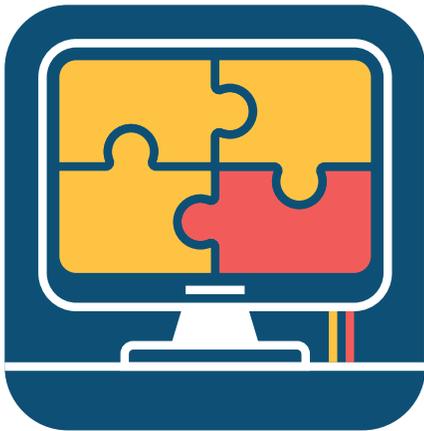
FIGURE 13. Analytics Staffing Needs

Source: Ronald Yanosky, with Pam Arroway, *The Analytics Landscape in Higher Education, 2015*, research report (Louisville, CO: ECAR, October 2015), figure 9

integrations begin with their ERP data.

- Use an agile, 30-day sprint methodology to provide focus and achieve measurable and timely results.
- Use the EDUCAUSE Analytics Maturity Index to assess the institution's current state of analytics maturity.
- Inventory the institution's current reporting and analytics, and classify items as reports, dashboards, or analytics. Further classify analytics as institutional or learning analytics. Share this taxonomy with others in the institutional community to help enrich their understanding.
- Predictive analytics can provide great insights, but the real test is the actions that are taken based on those insights.

> "In order for institutions to continue to expand their analytics capabilities a focused and dedicated effort is needed. No matter the approach, institutions are recognizing that analytics can no longer be an add-on to someone's existing responsibilities."
>
> —Celeste M. Schwartz, Vice President for Information Technology and College Services, Montgomery County Community College

Issue #8: Enterprise Application Integrations

Integrating enterprise applications and services to deliver systems, services, processes, and analytics that are scalable and constituent centered

Recent changes in the dynamics of the conversation about the value of higher education have caused more institutions to focus on improving constituent services to reduce barriers to student and faculty/researcher success. Today, virtually all services provided by institutions to constituents are delivered through or are supported by enterprise applications—not just those traditionally thought of as part of an ERP solution but also the constellation of ancillary applications that rely on data from the ERP applications or that deliver information in return.

Increasingly, the data contained in these enterprise applications is being used and leveraged through analytics in order to gain insights into what might place a student at risk or to predict certain outcomes and support interventions that might influence those outcomes. In addition, this data may provide insights into ways that service delivery

can become more targeted and personalized for each constituent—reducing service "friction," improving constituent satisfaction, and helping to eliminate barriers to success.
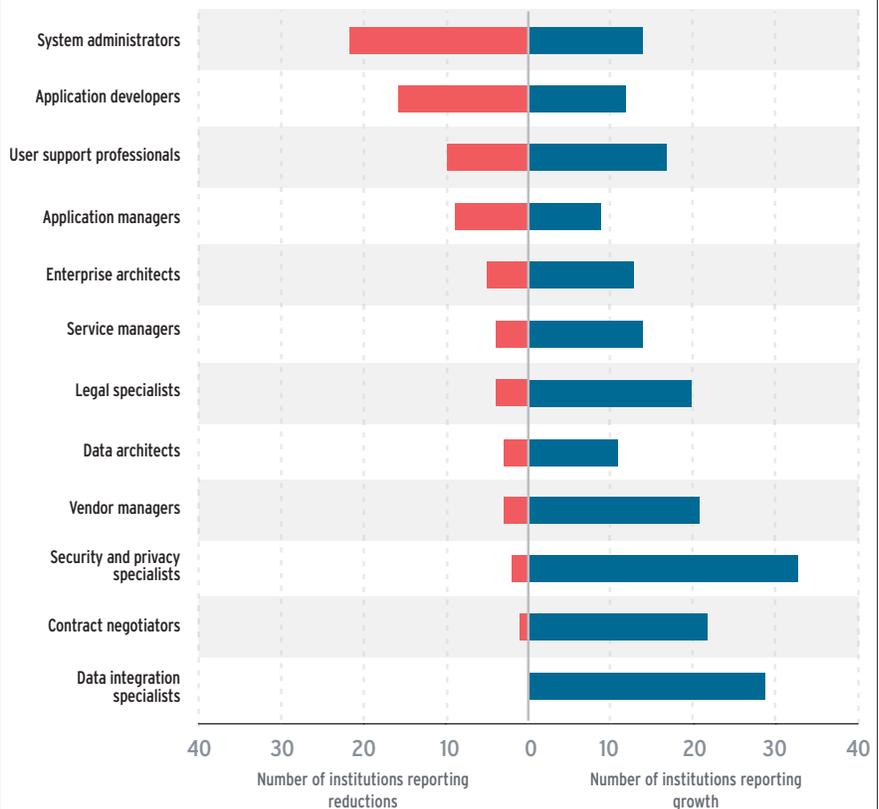
Percentage of faculty reporting that their institution

- maintains a highly qualified IT staff: 64%
- has an agile IT infrastructure approach that can respond to changing conditions and new opportunities: 31%

—Brooks, *ECAR Study of Faculty and Information Technology, 2015*

The wide range of services offered by institutions, coupled with a desire to capture and integrate an equally wide range of service-related data for further analysis, means that most institutions spend a great deal of effort to integrate those applications. The emergence of data architectures and applications that leverage APIs is making the integration challenge somewhat easier. At the same time, the number of applications and data sources is rapidly increasing, along with the amount of data being integrated, frequently resulting in very complex data and applications landscapes and increasingly emphasizing scalability (and supportability). Integration and regression testing becomes more complex and difficult

FIGURE 14. Changes in Roles/Positions Resulting from Moving Services to the Cloud

Number of institutions reporting reductions / Number of institutions reporting growth

Source: D. Christopher Brooks, T*he Changing Face of IT Service Delivery in Higher Education*, research report (Louisville, CO: ECAR, August 2015), figure 4

"For many institutions, service delivery is a competitive differentiator—the ability to deliver 'high-touch, high-quality' services to students, faculty, researchers, and other constituents at scale can have great impact on the level of engagement and, ultimately, the support an institution enjoys from its constituents, as well as on its ability to attract the most talented faculty and most qualified students."

—Gordon Wishon, Chief Information Officer, Arizona State University

while institutional programming and scheduling demands continue to shrink windows of opportunities to upgrade/update and integrate these applications. In addition, constituents' expectations for the amount of time needed to deploy new systems and services have decreased significantly, and institutions have limited resources to manage and integrate systems and services.

This is a time when both homegrown applications and major ERP and LMS suites are being rethought, reformed, and replaced. Many solutions are moving or have moved outside the institution. It is tempting to believe that the outcome will be a much simpler and smaller IT organization. The reality is not so straightforward. Some management and technical roles are indeed diminishing. But they are being replaced by other, new roles that are essential to having secure, cost-effective, and integrated enterprise applications that meet the institution's business, service, and strategic needs (see figure 14). Most

notably, institutions must develop competence in vendor and contract management, information security, enterprise architecture, application integration, and ITSM:

- Vendor and contract management can ensure that the institution is not overpaying, has appropriate terms and conditions, and is purchasing the right components and service levels.
- Information security can audit data and system security and ensure that best practices and policies exist to minimize the likelihood or impact of data breaches.
- Enterprise architecture can ensure that system and data integration is efficient, feasible, and extensible and meets business requirements.
- Enterprise application integration, or middleware, analysts can understand existing and emerging integration best practices and technologies and determine which are most appropriate for the current IT environment and business objectives.
- ITSM can ensure that IT infrastructure and services are well managed to enable fast diagnosis and resolution of problems and to minimize negative repercussions of deployments and changes.

Advice

- Identify the desired outcomes of enterprise application integrations to ensure that they guide the rest of this work.
- Ensure that institutional leaders understand the efficiency and strategic benefits of data and system standardization so that they can and will support the investments and changes needed to achieve these benefits. This work cannot succeed without leadership support.
- Develop an enterprise architecture that can take a holistic perspective on the systems, services, processes, and analytics the institution requires to meet its business needs and strategic priorities. This kind of upfront planning can enable efficiencies and flexibility later. Commit to maintaining it.
- Audit existing enterprise systems and the distributed systems that feed and connect to them to understand current data flows. When new systems and applications are purchased, consideration should be given to whether and how easily they and their data can integrate with existing systems and applications.
- Never lose sight of the importance of the data. Isolated data is of limited use. Vulnerable data is an ugly headline waiting to happen. Ensure that authority and responsibility for data governance, integration, and security are clearly assigned and accountable.

Issue #9: IT Organizational Development

Creating an IT organization structure, staff roles, and staff development strategies that are flexible enough to support innovation and accommodate ongoing changes in higher education, IT service delivery, technology, analytics, and so forth

The IT organization's ability to provide reliable, cost-effective support for daily operations and for innovations in teaching and research is critical to institutional and student success. With the pace of change and the pressures on budgets, an IT organization must be planning for constant and perhaps drastic change in workforce requirements and be preparing to keep those resources aligned with evolving strategies.

The IT organization needs to have a plan to optimize the allocation of human resources in order to maximize the productivity of the individual, the team, the IT organization, and the institution. Three layers should be kept in mind:

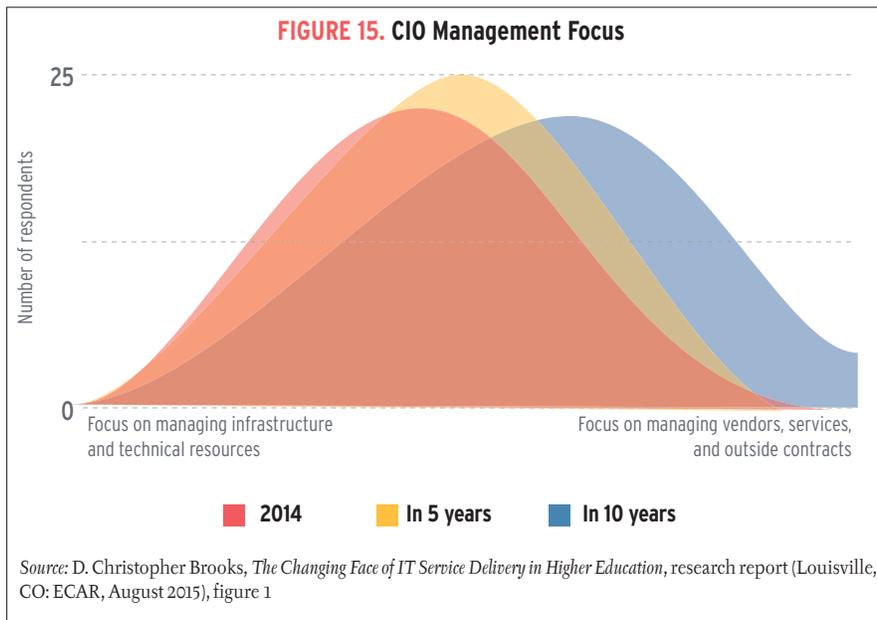- How the IT function is organized and structured at the institution

- How individuals manage their careers and skills
- How the institution supports these activities

Given that IT infrastructures are essentially a very complex system of systems, we need a wide array of skillsets that quickly evolve, and we need a culture of teamwork that supports and encourages the growth of the individual and the team. Organizational development efforts must be part of a long-term and adaptable commitment addressing the people, process, and technology dimensions. Small institutions have very different needs from larger ones. Smaller institutions especially need generalists who have multiple talents and interests, who can thus incorporate several roles into a single job, and who can flex widely as the organizational structure and job duties change.

The organization and structure of the IT function will change over time (see figure 15). It can adapt organically in response to technology changes, personalities, funding changes, day-to-day demands, occasional crises, unclear strategies, and shifting priorities. It can also evolve intentionally to help achieve an institutional vision for using information technology to advance its missions and strategic priorities. The IT organization will change either way, but the outcome will be very different. Using strategy-based organizational development, CIOs can design the organizational structure, competencies and skillsets, and processes and behaviors that the institution needs. Institutional and IT leaders can determine how to most effectively source IT services and functions in order to guide decisions about outsourcing (including to the cloud), centralization versus distributed IT structures, shared services, and even, ideally, which services to stop offering. By doing so, the IT organization can start progressing up the maturity curve and deliver better, more consistent services.

Challenges abound. As technology continues to shift, the clear lines of authority and responsibility may blur, shrink, or even disappear altogether.

FIGURE 15. CIO Management Focus

Number of respondents

25

0

Focus on managing infrastructure and technical resources

Focus on managing vendors, services, and outside contracts

■ 2014   ■ In 5 years   ■ In 10 years

Source: D. Christopher Brooks, *The Changing Face of IT Service Delivery in Higher Education*, research report (Louisville, CO: ECAR, August 2015), figure 1

Much attention is paid to the provision of IT services outside the central IT organization. However, silos can also develop *within* the IT organization. Without ongoing coordination among the IT leadership team, the IT organization can easily become a series of duplicate "services" centered on the systems and technology (or constituents) that each siloed team supports, rather than a cohesive and continually adapting collection of teams, activities, and roles organized around changing service needs.

People can expect to have ten to twenty jobs during the course of their careers.[37] So in addition to technical and soft skills, workers need career planning and management skills to optimize their working lives and earnings. Fortunate professionals with effective managers in well-run organizations will have clearly defined job duties and goals, regularly updated position descriptions, ongoing performance feedback, and specific professional development and growth plans (that advance the objectives of the IT organization and the individual). Others will not and will have to either self-manage or find a better place to work. The most competent professionals will understand and leverage their strengths, make learning and growth a habitual commitment, and nurture mentoring and collegial relationships and networks.

It all comes down to people. No matter the area or objective, that oft-repeated

> "Our ultimate challenge is shifting from high operations to high services. But these large systems did not just appear overnight, nor will they change that quickly. We need to have the long game in mind. If we do, our successors will look back favorably on our actions today."
>
> —**Dwight Fischer, Assistant Vice President and CIO, Dalhousie University**

statement holds true. Colleges and universities that understand the importance of their human capital will provide organizations and individuals with support for organizational and career development. HR organizations that are valued and empowered can make an enormous difference by ensuring that management practices are effective and by helping IT leaders with key practices such as succession and talent planning, performance development, and organizational development. They will also help the institution manage its talent by enabling professionals to move within and outside the IT organization. A strong HR function can also assist the IT organization in developing supportive and flexible working environments to offset salary and benefits competition from other industries.

Hiring a new employee and bringing that person fully up to speed costs from 1.5 to 3 times the actual salary.[38] A well-managed IT organization, a workforce of professionals who understand how to manage their careers, and an effective HR function can help make those investments last.

Advice

- Develop an IT organizational model based on "services" rather than on "systems." Allow for, promote, and encourage the "blending" of responsibilities across teams.

- Develop strategies and processes for the following:
  - Positions and teams, including roles, skills, sourcing, succession planning, career advancement
  - Organizational management, including funding, compensation/rewards, policies/procedures, communications
  - Organizational culture and engagement, including team building, motivation, expected behaviors, goal alignment, values
- Develop and annually review position descriptions and clear responsibilities for all staff. Create a culture of continual adaptation of jobs and of the organization to changing needs and conditions.
- Create a professional development and growth plan for *all* employees (including part-time). Don't limit plans to "training": incorporate individual professional growth needs as well. Start with a baseline set of professional development requirements for all employees.
- Professionals should understand that they are responsible for managing their own careers and lifelong learning/development.
- Use this article to stimulate a discussion with HR leaders to explore how the HR and IT organizations can work more effectively together.
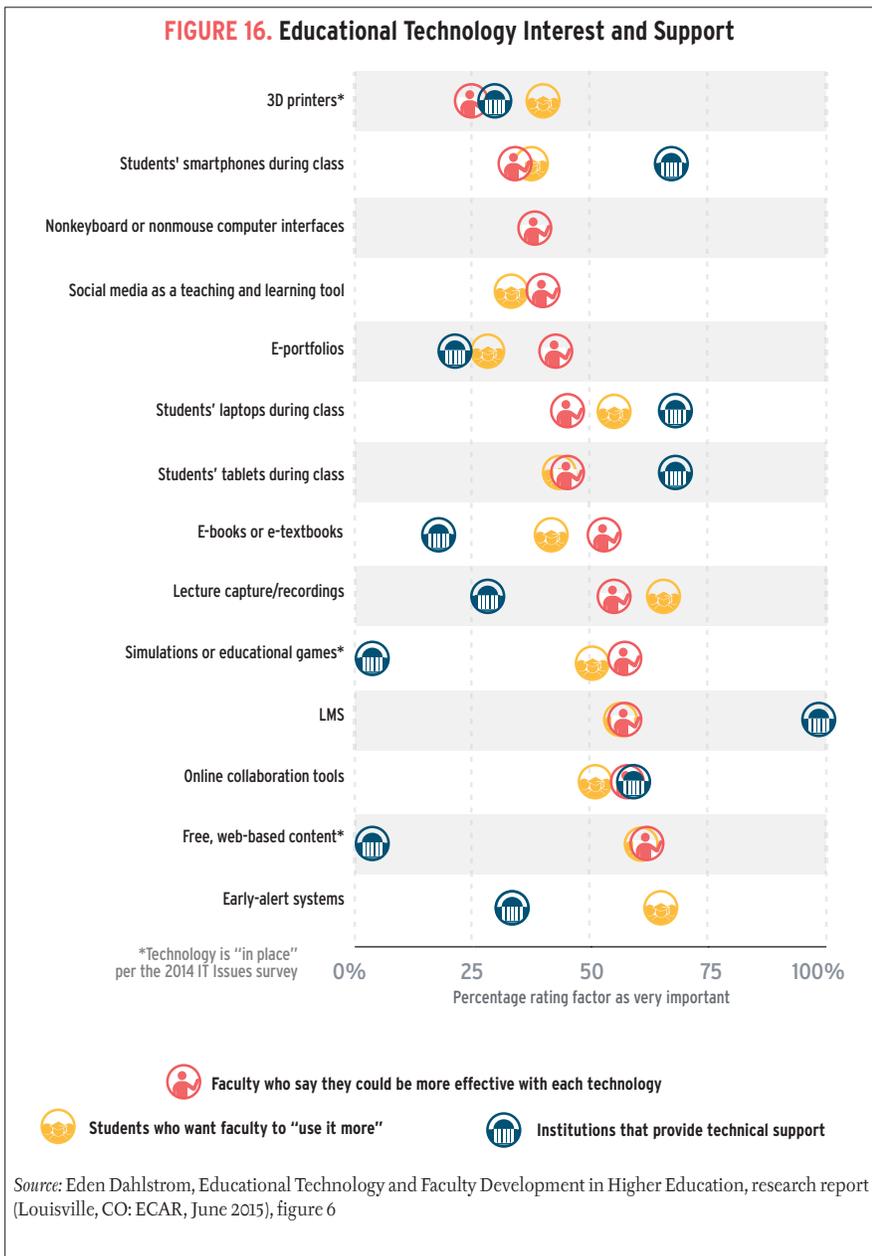
Issue #10: E-Learning and Online Education

Providing scalable and well-resourced e-learning services, facilities, and staff to support increased access to and expansion of online education

Online education is increasingly gaining legitimacy. According to a 2015 report, the proportion of academic leaders who believe online learning is critical to their institution's long-term strategy has grown from 48.8 percent in 2002 to 70.8 percent in 2014.[39] This is not a surprising finding when funding from states and the federal government continues to decrease and when the demand and growth rate for online enrollment continues to increase at a higher rate than the growth rate of the overall higher education student body. As the legitimacy of online learning grows, so does participation. More than 4 in 5 institutions (82%) offer at least several courses online, and more than half (53%) offer a significant number of courses online.[40] Almost half of students reported having taken an online course in the past year.[41] Though students choose online for a variety of reasons, the chief one is flexibility.[42] At the same time, academic leaders are

FIGURE 16. Educational Technology Interest and Support

- 3D printers*
- Students' smartphones during class
- Nonkeyboard or nonmouse computer interfaces
- Social media as a teaching and learning tool
- E-portfolios
- Students' laptops during class
- Students' tablets during class
- E-books or e-textbooks
- Lecture capture/recordings
- Simulations or educational games*
- LMS
- Online collaboration tools
- Free, web-based content*
- Early-alert systems

*Technology is "in place" per the 2014 IT Issues survey

0%   25   50   75   100%

Percentage rating factor as very important

Faculty who say they could be more effective with each technology

Students who want faculty to "use it more"

Institutions that provide technical support

Source: Eden Dahlstrom, Educational Technology and Faculty Development in Higher Education, research report (Louisville, CO: ECAR, June 2015), figure 6

increasingly concerned about retention of online students, especially minority and adult learners.[43]

Finding cost-effective ways to support students and to provide them with the resources usually offered on campus remains the main challenge. We need to try to reduce the cost of education and make the remaining investment a value that is worth the sacrifice that students and their families are making. Although student demand for more online classes will likely continue to increase, the

growth of online will be influenced by the degree to which each institution is able to scale and virtualize all other aspects of the campus environment to support online learning and liberate resources to devote to online learning.

For many institutions, providing scalable and well-resourced services, facilities, and staff to increase access and expand the online offerings
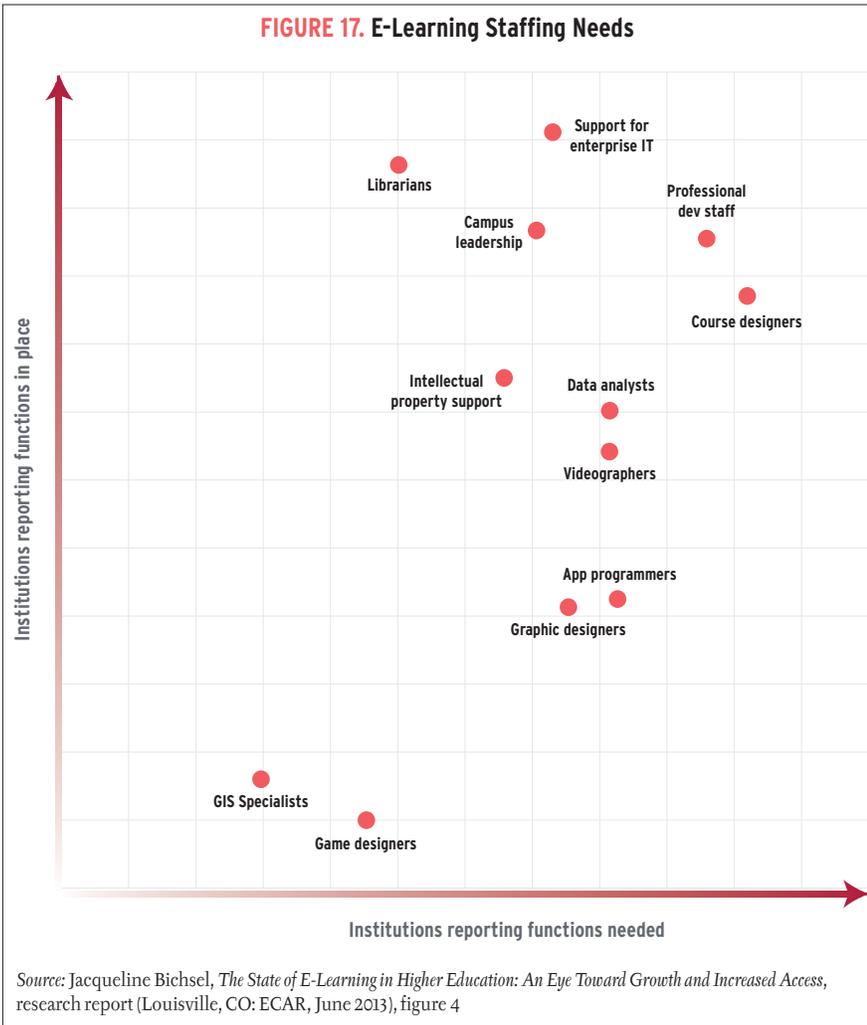
continues to be a challenge. Many institutions do not truly understand what is needed to make this a reality. Institutional leaders who are considering expanding their online offerings need to assess the readiness of institutional resources, and they should be prepared for a complicated answer. According to the EDUCAUSE E-Learning Maturity Index, effective e-learning requires five major elements:

1. *Engagement.* Involve the institutional community—faculty, students and staff—in e-learning and ensure that they are prepared to use e-learning technologies effectively (see figure 16).
2. *Operational effectiveness.* Have adaptable, scalable, and reliable e-learning services and technologies whose management is centralized and considered mission-critical.
3. *Governance, security, and accessibility.* Have appropriate policies and guidelines, effective decision making, and sufficient security and provide access to e-learning for students with disabilities.
4. *Priority.* Give priority to e-learning investments, strategy, leadership, and incentives.
5. *Analytics.* Use learning analytics to evaluate e-learning courses and use analytics to monitor the institution's strategic goals for e-learning progress.

The e-learning maturity of individual institutions varies. For 22 percent of institutions the maturity could be considered strong or excellent, for 61 percent it is still developing, and for 17 percent it is weak or emerging.

Online learning requires a broad range of technologies, including the LMS, course-delivery systems, lecture capture, e-portfolios, OERs, social networks, mobile apps, learning analytics, e-advising systems, adaptive learning technology, gaming, simulations,

FIGURE 17. E-Learning Staffing Needs

Institutions reporting functions in place (vertical axis)

Institutions reporting functions needed (horizontal axis)

Support for enterprise IT
Librarians
Campus leadership
Professional dev staff
Course designers
Intellectual property support
Data analysts
Videographers
App programmers
Graphic designers
GIS Specialists
Game designers

Source: Jacqueline Bichsel, *The State of E-Learning in Higher Education: An Eye Toward Growth and Increased Access*, research report (Louisville, CO: ECAR, June 2013), figure 4

and the resources needed for technology support and project management to deploy and maintain these technologies. And of course, stuff needs staff. Most needed are instructional/course designers, professional development staff for e-learning, app designers/programmers, data analysts, videographers, graphic designers/animators, and support staff for enterprise IT systems (see figure 17). More than 60 percent of institutions reported needing staff in these areas, adding that they need to more than double their e-learning staff to be effective.[44]

Learning leaders must develop a strategy to ensure that faculty and staff develop courses suitable for online pedagogy, which differs from traditional face-to-face teaching. More than three in four institutions report that the technological know-how of faculty is a moderate or major concern about online learning.[45] Online education has unique needs and challenges, and it needs to be managed differently. It also needs to be reviewed for quality and effectiveness to ensure that learning objectives translate to an online format and to determine how student learning will be assessed.
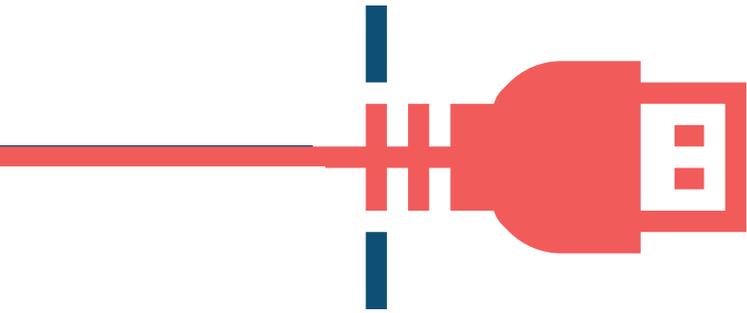
In addition, institutions must define the role that online learning plays within the institutional mission. The biggest reason institutions do not offer online courses is lack of leadership interest. Aligning priorities will allow institutions to develop comprehensive and balanced online programs that will expand the institution's reputation. Infrastructure and resources need to be designed for long-term growth and evolution.

Higher education leaders have learned how to manage facilities maintenance and expansion, but they have not yet mastered the art of managing IT investments. This presents ongoing challenges to CIOs, who can find funding for capital (or initial) investments but do not receive sufficient ongoing funds when initiatives become operational. If institutions are to remain competitive with online learning, they will have to prepare for ongoing investments, operations, and updates to maintain state-of-the-art online learning environments. They may find themselves needing to make tradeoffs in physical-versus-online learning environments while both their students and their faculty expect access to the learning environment that best suits the pedagogical goal.

The learning infrastructure may constitute a growing share of institutional differentiation. Many higher education leaders are not prepared for the potential impact that technology will have on the ability to attract and retain students and rank-and-file faculty. Baseline technology has thus far been a necessary but not distinguishing feature of the institution. This may change as technology becomes more visible, differentiated, and integral to teaching and learning. The clothes make the man, as the saying goes. Perhaps the technology will make the institution.

> "With student debt at an all-time high, families are starting to question the value of a traditional college education. They will look to online education to provide some relief."
>
> —**Jonathan Brennan, CIO, SUNY College of Technology at Delhi**

Advice

- Develop an online learning technology plan and architecture. Provide solid support for standard technologies (e.g., the LMS and collaboration tools such as Google Apps or Microsoft Office 365). Provide guidelines and best practices for adopting new technologies and mobile apps.
- Align online offerings, infrastructure, and staffing with student demand metrics to allow the institution to scale up operations seamlessly at planned intervals.
- Give technologists and the institutional community opportunities to experiment and innovate. Keep abreast of emerging technologies and continuously assess their potential to advance the institution.
- With buy-in and advocacy from the academic leadership, develop course-quality standards linked to the institution's mission to ensure a base level of quality across all courses. Using a peer-tested quality assurance rubric, such as Quality Matters, the institution will be sure that courses are being evaluated in a uniform way. Establish design standards for all courses that specify template requirements for course sites.
- Take the EDUCAUSE E-Learning Maturity Index to benchmark the institution's e-learning readiness.
- Collect data on impact, such as faculty and student feedback and expectations. Share the results with the entire institutional community.
- Invest in the faculty. Recruit faculty who have experience teaching in an online environment and who truly

believe it can be successful. Provide incentives and resources to encourage faculty to explore this new modality. Build a comprehensive training program. Faculty need to learn the differences between online and traditional classes and how to apply their content knowledge in a new way. Consider offering a summer program similar to the iTech Fellows at the University of Washington, Tacoma. Faculty take an intensive one-week "prep" course looking at design standards, best practices, and pedagogy and can begin building out their course sites. Later in the summer, they come back together for peer-review. Faculty who successfully complete this program become campus peer-reviewers and online mentors for future faculty.

- Provide training and support for students. While today's students are generally more technically able, institutions should help them get up to speed quickly on the technologies they are likely to use in their coursework.

Conclusions

The EDUCAUSE community selected the Top 10 IT Issues from a slate of 15 issues identified by the IT Issues Panel members. The 5 issues that did not make the overall Top 10 were

- *Change Management:* Increasing the IT organization's capacity for managing change, despite differing community needs, priorities, and abilities;
- *New Generation of Technologies:* Consolidating, evolving, and retiring historical services and technologies and adopting new platforms (e.g., moving from listservs to Office365 groups);
- *IT and Higher Education "Industry" Transformation:* Identifying and

communicating the ways in which information technology can be used to help the institution address disruption and advance the business of higher education;
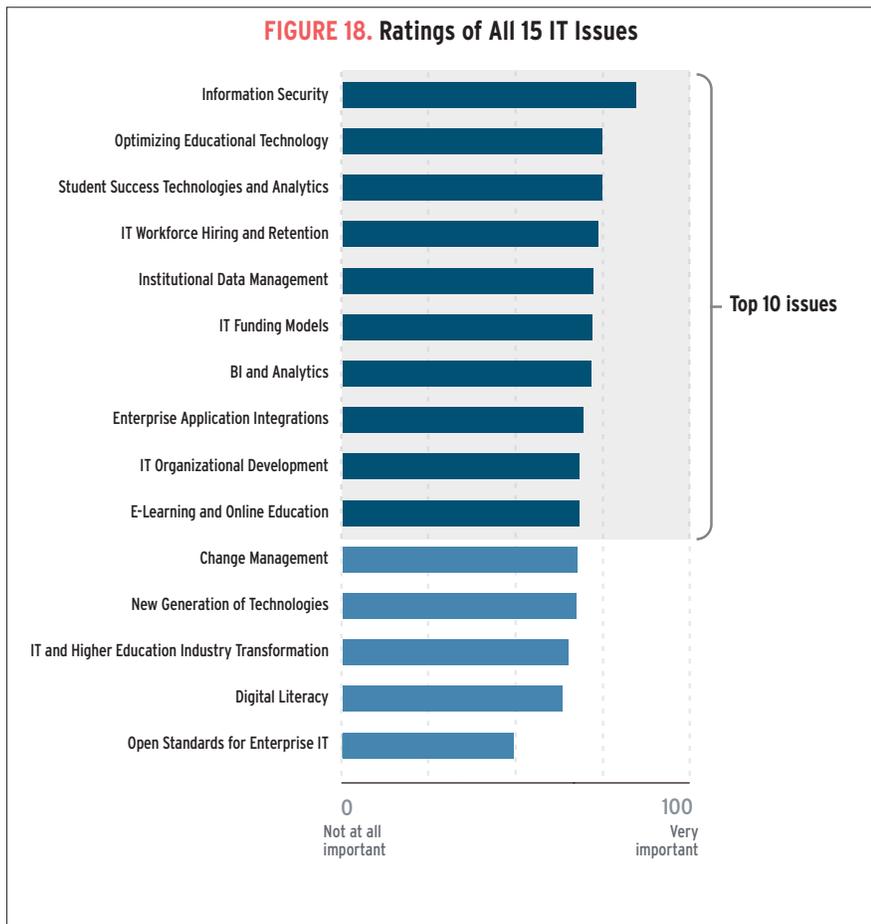
- *Digital Literacy:* Ensuring that faculty, staff, and students are informed about, and have the skills to make the most effective use of, new IT services, technologies, and applications; and
- *Open Standards for Enterprise IT:* Working in collaboration with other institutions and vendors to develop enterprise IT architectures that incorporate open standards and can respond to changing conditions and new opportunities.

The first three were among the Top 10 lists of some types of institutions.[46] Specifically, a number of institutions picked *Change Management* among their Top 10: associates, bachelors, private doctorals, non-U.S. institutions, institutions with 4,000-7,999 or over 15,000 FTEs, and institutions that tend to adopt technology later than or at the pace of their peers. *New Generation of Technologies* was among the Top 10 for bachelors institutions, private doctorals, specialized U.S. institutions,[47] smaller institutions (less than 4,000 FTEs), and institutions that tend to adopt technology earlier than others. Public doctoral universities, specialized U.S. institutions, and non-U.S. institutions chose *IT and Higher Education "Industry" Transformation* among their Top 10 issues. Most noteworthy was how close the voting was for all but the first-ranked and last-ranked issues (see figure 18 p.58).

Commonalities

It's the Data, Stupid

Information security was the highest-rated issue for all but one (specialized U.S. institutions, where it was #3) of the overlapping demographic groups tracked by EDUCAUSE. The goal of information security is to protect data.

FIGURE 18. Ratings of All 15 IT Issues

Managing, securing, and using data was common to 5 of this year's Top 10 IT issues:

1. Information Security
3. Student Success Technologies
5. Institutional Data Management
7. BI and Analytics
8. Enterprise Application Integrations

Data issues are pertinent to divestment, reinvestment, and differentiation. The data challenge of divestment is how to move away from local control in order to adopt institution-level data governance, standardization, and integration. Because data is critical to the ways in which institutions are hoping to achieve strategic differentiation—including student success, e-learning, and analytics—IT organizations need to reinvest in information security to secure this data, which is increasingly important and increasingly at risk.

Securing, managing, and integrating data is foundational to achieving higher education's most strategic technology needs. The role of data will become only more important and differentiated over time. Analytics is being applied to numeric, text, image, and even video data. However, data is only the fuel for the models and algorithms that will drive alerts, customizations, triggers, and other tools for personalized learning, student success services, and additional applications of analytics (e.g., to optimize resources, contain costs, improve service quality, increase productivity). Data is necessary and critical, but not sufficient, to produce analytics useful enough to inform decision making. Ultimately the models derived from data will prove to have more value than the data itself. In future years, the data concerns of higher education will likely extend to governing, securing, and optimizing analytic algorithms.

Leadership as the Multiplier

Again and again, the EDUCAUSE IT Issues Panel members emphasized the importance of leadership. If information technology is to have a meaningful impact, institutional leaders must be enduringly, enthusiastically, and publicly committed to investing in information technology and to accommodating institutional practices to IT solutions. IT leaders are masters of the workaround: they know how to adapt, pivot, and make do in the face of roadblocks and setbacks. But there are no workarounds for tepid or reluctant leadership.

Information technology is now embedded in every institutional activity and mission. IT organizations can accomplish little on their own.

"IT professionals should adopt the perspective, culture, values, and language of a business professional and frame their work within this context. Once viewed as a business professional in their own right, managing change within the broader community of end users becomes much, much easier."

—**Timothy M. Chester, Vice President for Information Technology, University of Georgia**

> "How do we know when is the right time to implement a new technology? How close to the 'bleeding edge' should we be? How do we know when we've stepped over the edge? How do we overcome the natural resistance to change, especially when the cost/pain of change is high? How do we gauge an institution's readiness for change? How do we influence it?"
>
> —**Gordon Wishon, CIO, Arizona State University**

Even divestment decisions cannot be taken without some business leader's support. Moving to the cloud and outsourcing carry potential risks that institutional counsel must approve. Application integration means data integration. And that means negotiating data standards and definitions with constituent stakeholders. Information security affects usability and so must be negotiated and communicated with the institutional community. Leadership commitment to information technology facilitates buy-in, which is critical for success.

An Existential Threat?

IT leaders and professionals face high stakes in this changed and changing world. The stakes are even higher for colleges and universities. Is the transformative ability of information technology the promise of a new, more enlightened, and empowered age of learning, scholarship, and research—enabling knowledge to be created, preserved and disseminated to previously unimagined extents? Will information technology destroy as well as create?

IT professionals have certainly seen both sides. Many jobs that were the bedrock of IT organizations have disappeared, prompting some professionals

to switch roles but forcing many others to retire earlier than they had hoped. Nonetheless, IT organizations' staffing needs are not diminishing (to the dismay of budget managers). But they are changing, and a gap exists between the skill and experience requirements of the new roles and the preparedness of many existing staff. Some staff will bridge the gap, with perseverance, energy, and (critically) leadership support. Others will not and have not. That is when the HR department needs to lead creatively, help those staff at risk of displacement to reimagine and re-create their professional identity, advocate for them, and assist them in locating new jobs.

Estimates vary, but some predict that as many as 30 percent of colleges and universities are in significant financial jeopardy because their operating models are not sustainable.[48] This is one of the reasons why institutions are exploring the potential of information technology to reduce operational expenses through greater automation and to make learning more affordable and accessible. Another motivator is the competition arising from new nontraditional alternatives to higher education, many of which are applying information technology innovatively to the learning and student experiences. Using technology as a strategic differen-

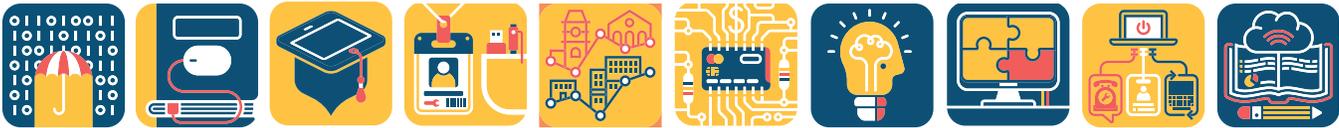tiator might indeed make the difference between success and failure for some institutions.

Information technology is shrinking, enriching, and remaking the world just as surely as (and perhaps even more dramatically than) transportation technology did over a century ago. Higher education is trying to navigate this new opportunity, this new challenge. The 2016 Top 10 IT Issues provide institutional IT leaders with a clear roadmap:

- *Divest* technical encumbrances such as custom infrastructure that has become a commodity in the market, idiosyncratic processes that are expensive to automate, and redundant and nonstandard data and systems.

- *Reinvest* in the IT workforce and in the IT organization to best plan, manage, and optimize the technology assets and services of the institution. Expand information security investments to manage security proactively rather than reactively.

- *Differentiate* the institution by making technology investments in its most strategic priorities. Translate what is most distinctive about the institution's mission into the rapidly developing new technology-enabled paradigms.

Information technology offers tremendous potential to higher education, if we can harness it. By divesting, reinvesting, and differentiating, we will be able to embrace—and also flourish in—this digital age.

are the data and visualization mavens who ensure the data and graphics in this article are accurate relevant, and appealing (thank you, Kate!). Teddy Diggs is an extraordinary and generous editor, who makes sure this article makes sense and flows well. EDUCAUSE members supported by EDUCAUSE staff: that is the magic of EDUCAUSE.

Notes

1. Once a year, members of the EDUCAUSE IT Issues Panel select a slate of 15-20 topics they believe will be the most strategic IT-related issues facing higher education institutions. EDUCAUSE members receive a survey with those issues and are asked to prioritize them. The 10 issues with the highest priority scores become the Top 10 IT Issues. This methodology also enables EDUCAUSE to determine the Top 10 IT Issues among various types of institutions. For 2016, of the 10,140 EDUCAUSE member representatives who received an e-mail invitation to complete the survey, 338 (3%) responded.
2. Susan Grajek, *Trend Watch 2016* (ECAR, forthcoming).
3. Ibid.
4. The issue scores ranged from 84 for #1 to 49 for #10. Issues #2 through #9 were clustered, with scores ranging from 75 to 68.
5. Jacqueline Bichsel, *IT Service Delivery in Higher Education: Current Methods and Future Directions,* research report (Louisville, CO: ECAR, April 2015), http://www.educause.edu/library/resources/it-service-delivery-research.
6. For more on where to divest and where to reinvest, see the EDUCAUSE Maturity Indices on the EDUCAUSE Higher Education IT Assessment and Benchmarking Projects web page: http://www.educause.edu/focus-areas-and-initiatives/enterprise-and-infrastructure/higher-education-it-assessment-and-benchmarking-projects.
7. Brian Voss, "Special Snowflakes?" *EDUCAUSE Review,* September 6, 2013, http://www.educause.edu/blogs/bdvoss/special-snowflakes.
8. Niel Nickolaisen, "Aligning to Purpose," *EDUCAUSE Review* 49, no. 3 (May/June 2014), http://er.educause.edu/articles/2014/5/aligning-to-purpose.
9. Jacqueline Bichsel, *The State of E-Learning in Higher Education: An Eye Toward Growth and Increased Access,* research report (Louisville, CO: ECAR, June 2013), http://net.educause.edu/ir/library/pdf/ers1304/ERS1304.pdf; Ronald Yanosky, with Pam Arroway, *The Analytics Landscape in Higher Education, 2015,* research report (Louisville, CO: ECAR, October 2015); Ronald Yanosky, *Integrated Planning and Advising Services: A Benchmarking Study,* research report (Louisville, CO: ECAR, March 2014), https://net.educause.edu/ir/library/pdf/ERS1312.pdf.
10. EDUCAUSE has curated a relevant set of resources at http://www.educause.edu/library/integrated-planning-and-advising-services-ipas.
11. "Embracing Differentiation and Reclaiming Audacity: An Interview with James Hilton," *EDUCAUSE Review* 50, no. 6 (November/December 2015), http://er.educause.edu/articles/2015/10/embracing-differentiation-and-reclaiming-audacity-an-interview-with-james-hilton.
12. Anne Fisher, "Why Most Innovations Are Great Big Failures," *Fortune,* October 7, 2014, http://fortune.com/2014/10/07/innovation-failure/.
13. Bichsel, *IT Service Delivery in Higher Education.*
14. D. Christopher Brooks, *The Changing Face of IT Service Delivery in Higher Education,* research report (Louisville, CO: ECAR, August 2015), http://www.educause.edu/library/resources/it-service-delivery-research.
15. EDUCAUSE research shows that in educational data breaches from 2005 to 2013, user error, such as unintentional disclosures and lost devices, was a greater threat than hacking. See Joanna Lyn Grama, *Data Breaches in Higher Education,* Just in Time research (Louisville, CO: ECAR, May 2014), https://net.educause.edu/ir/library/pdf/ECP1402.pdf.
16. EDUCAUSE Center for Analysis and Research, *2015 Strategic Information Security Issues,* infographic (Louisville, CO: ECAR, April 2015), http://net.educause.edu/ir/library/pdf/HeiscInfographic15.pdf.
17. Except where otherwise noted, all data points were first published in the *2014 EDUCAUSE Core Data Service Almanac,* "All Non-Specialized U.S. Institutions," February 2015, https://net.educause.edu/ir/library/pdf/CDA1401.pdf.
18. ECAR, *2015 Strategic Information Security Issues,* infographic.
19. Comparisons of the 2005, 2010, and 2015 ECAR studies of undergraduate students and technology show massive shifts in mobile device ownership and substantial growth in learning support services and technology-enabled classrooms. In 2005, 56% of undergraduates owned a laptop, and smartphone and tablet technologies were nascent. In 2015, 91% of undergraduates owned a laptop, 91% owned a smartphone, and 54% owned a tablet. See Eden Dahlstrom, with D. Christopher Brooks, Susan Grajek, and Jamie Reeves, *ECAR Study of Students and Information Technology, 2015,* research report (Louisville, CO: ECAR, November 2015), http://www.educause.edu/library/resources/2015-student-and-faculty-technology-research-studies. Institutions are adapting practices to support students' nearly ubiquitous ownership of mobile technology. Teaching and learning support services have been on the rise: 75% of institutions report having a faculty teaching/excellence center, 73% offer special grants/awards for innovative use of instructional technology, and 87% employ instructional designers to help faculty develop courses and course materials in order to leverage students' mobile devices for teaching and learning. See EDUCAUSE Core Data Survey, 2014.
20. EDUCAUSE Core Data Survey, 2014; D. Christopher Brooks, *ECAR Study of Faculty and Information Technology, 2015,* research report (Louisville, CO: ECAR, October 2015), http://www.educause.edu/library/resources/2015-student-and-faculty-technology-research-studies.
21. Amanda Lenhart, "Teens, Social Media and Technology Overview 2015," *Pew Research Center,* April 9, 2015, http://www.pewinternet.org/2015/04/09/teens-social-media-technology-2015/.
22. According to ECAR research, 73% undergraduates prefer to keep their academic lives and social lives separate, a figure that has risen steadily from 57% in 2012 (Dahlstrom, Brooks, Grajek, and Reeves, *ECAR Study of Students and Information Technology, 2015).* See also danah boyd, *It's Complicated: The Social Lives of Networked Teens* (New Haven: Yale University Press, 2014).
23. Brooks, *ECAR Study of Faculty and Information Technology, 2015.*
24. Dahlstrom, Brooks, Grajek, and Reeves, *ECAR Study of Students and Information Technology, 2015.*
25. Ibid.
26. Based on rated importance of working in higher education combined with reported likelihood of pursuing opportunities outside the institution. From Jacqueline Bichsel, *Today's Higher Education IT Workforce,* research report (Louisville, CO: ECAR, January 2014), http://net.educause.edu/ir/library/pdf/ers1310/ers1401.pdf.
27. Ibid.
28. Catherine Ashcraft, "How Can Companies Promote Innovation with Diverse Employees?" *National Center for Women & Information Technology,* https://www.ncwit.org/resources/how-can-companies-promote-innovation-diverse-employees/how-can-companies-promote; J. Richard Hackman, *Leading Teams: Setting the Stage for Great Performances* (Boston: Harvard Business Review Press, 2002).
29. Yanosky and Arroway, *The Analytics Landscape in Higher Education, 2015.*
30. See *The Compelling Case for Data Governance,* ECAR Working Group paper (Louisville, CO: ECAR, March 2015).
31. Susan Grajek and the 2014–2015 EDUCAUSE IT Issues Panel, "Top 10 IT Issues, 2015: Inflection Point," *EDUCAUSE Review* 50, no. 1 (January/February 2015), http://er.educause.edu/articles/2015/1/top-10-it-issues-2015-inflection-point.
32. Linda Hall, Shreya Futela, and Disha Gupta, "IT Key Metrics Data 2015," summary, *Gartner,* December 15, 2014, https://www.gartner.com/doc/2939218/it-key-metrics-data-.
33. Ginni Rometty, "Prepare for the Cognitive Computing Era," Gartner Symposium, Orlando, FL, October 6, 2015.
34. EDUCAUSE, "Key Questions for Personalized Pathways: Navigating Higher Education," August

2014, http://net.educause.edu/ir/library/pdf/ekq02.pdf.

35. *NMC Horizon Report: 2015 Higher Education Edition* (Austin, Texas: New Media Consortium, 2015), http://www.nmc.org/publication/nmc-horizon-report-2015-higher-education-edition/.

36. As measured by the percentage of institutions scoring 4.0 or higher on the 5.0-point EDUCAUSE Analytics Maturity Index.

37. In January 2014, the median number of years that wage and salary workers had been with their current employer was 4.6 years. U.S. Department of Labor, Bureau of Labor Statistics, Employee Tenure in 2014 (September 2014).

38. Annie Mueller, "The Cost of Hiring a New Employee," *Investopedia,* November 13, 2015, http://www.investopedia.com/financial-edge/0711/the-cost-of-hiring-a-new-employee.aspx.

39. Online Learning Consortium, *Grade Level: Tracking Online Education in the United States,* February 2015, http://onlinelearningconsortium.org/press-release-online-learning-survey-report-2014/.

40. Bichsel, *The State of E-Learning in Higher Education.*

41. Dahlstrom, Brooks, Grajek, and Reeves, *ECAR Study of Students and Information Technology,* 2015.

42. Carol B. Aslanian and David L. Clinefelter, *Online College Students 2012: Comprehensive Data on Demands and Preferences* (Louisville, KY: Learning House, 2012), http://www.learninghouse.com/files/documents/resources/Online%20College%20Students%202012.pdf.

43. Daphne Koller, Andrew Ng, Chuong Do, and Zhenghao Chen, "Retention and Intention in Massive Open Online Courses," *EDUCAUSE Review,* June 3, 2013, http://er.educause.edu/articles/2013/6/retention-and-intention-in-massive-open-online-courses; Floralba Arbelo-Marrero, "Staying the Course: Engaging and Retaining Non-Traditional Students in Online Education," *EvoLLLution,* March 4, 2015, http://evolllution.com/opinions/staying-course-engaging-retaining-non-traditional-students-online-education/.

44. Bichsel, *The State of E-Learning in Higher Education.*

45. Ibid.

46. For Top 10 IT Issues lists for different types of institutions, see the EDUCAUSE Top 10 IT Issues website: http://www.educause.edu/research-and-publications/research/top-10-IT-issues. EDUCAUSE research examines institutional differences within (a) major Carnegie groups plus non-U.S. institutions, (b) institutions of varying size, and (c) institutions with different paces of technology adoption (late, mainstream, early).

47. These institutions have a specific disciplinary (such as engineering, health, business, faith, technology, law, or art) or constituent (tribal) focus. EDUCAUSE research tracks this group separately from non-specialized associates institutions, bachelor's institutions, private and public master's institutions, and private and public doctoral institutions.

48. Jeffrey J. Selingo, "Colleges Struggling to Stay Afloat," *New York Times,* April 12, 2013, http://www.nytimes.com/2013/04/14/education/edlife/many-colleges-and-universities-face-financial-problems.html?_r=1.

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