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FACILITIES & TECHNOLOGY: THE TRANSFORMATION OF "CAMPUS"

PART 1

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LEADERSHIP IN EDUCATIONAL FACILITIES

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Introduction:
Facilities & Technology: The Transformation of "Campus"

Hardly an aspect of higher education remains untouched by technology. Nearly every classroom, library, and lab has been reshaped in some way by fast microprocessors, near-limitless data storage, and creative software.

Furthermore, technology is not finished transforming higher education. Massive open online courses (MOOCs), flipped classrooms, and adaptive learning systems are disrupting the Socratic sage-on-a-stage model of teaching that has dominated since the Middle Ages. Research projects are evolving into multi-institution, multinational collaborations dependent on the visualization and analysis of petabytes of data. Institutional management now depends on the functions of millions of lines of code running in vast enterprise resource management systems.

The campus—the actual physical campus, composed of buildings and grounds, parking lots and sports facilities, dorms and research labs—might appear only slightly affected by technology. Yet, technology is indeed reshaping the planning, design, operations, and management of the entire campus built environment. Campus facilities are designed using advanced modeling systems; they are managed via complicated building automation systems. Moreover, the potential for transformative technological change in facilities is growing rapidly. Sophisticated sensors will soon measure water pressure or current flow at thousands of points. Comprehensive energy management systems will balance electrical generation and consumption across entire campuses. Business intelligence systems will leverage facilities investments.

However, technology will actually change the campus in even greater, more fundamental ways. Technology is transforming the whole idea of "campus."

Not so long ago, almost every interaction between the student and the institution took place on campus grounds. Today, students can graduate without ever setting foot on an institution's campus. That is, if the institution even has a campus to begin with—a handful of online colleges and universities do not have traditional campuses at all.

Few institutions will go that far. The campus environment will remain essential for the vast majority of colleges and universities, but its role will change. It will serve a strategic purpose, providing a hub for collaboration, a home for research, and a socio-emotional anchor for the campus community. The whole notion of the campus is changing, thanks to innovations in technology.

Where we are now

Higher education faces numerous pressures, and these pressures are continuining to take their toll on the campus', physical infrastructure. **Financial pressures** make it difficult for institutions to invest in new construction, renovations, and maintenance. At the same time, **pedagogical shifts** are placing the focus of the classroom on the learner rather than the instructor. This situation is exposing the constraints of traditional building designs and creating the demand for new learning environments.

Demographic changes are accelerating, increasing the number of minority and nontraditional students. Colleges and universities are struggling to adapt the campus to these new learners, but clearly the entire institution, the campus infrastructure included, will need to become more flexible and responsive to their needs.

Competition plays a mixed role on campus. On the one hand, institutions competing for students can be forced to offer deep discounts, therefore limiting the funds available to update and maintain the built environment. On the other hand, the campus remains a showpiece, with visiting students and parents scrutinizing recreation

centers, residence halls, dining options, and the actual buildings associated with their targeted program or major.

How buildings and the built environment are changing

New campus facilities are generally "lighter"—that is, they have less internal mass. They are more like shells in which functions can take place. Buildings can be considered as "event space"—space that is **adapted and configured** for a particular use and then readapted and reconfigured when needs change.

Campus uses increasingly overlap on campus spaces. Facilities were once single-use buildings, but today **boundaries are blurring**. A residence hall might include classrooms and a coffee shop; an academic building might house a variety of units or functions engaged in collaborative projects. Mixed-use buildings require sensitive design as well as flexible management. The needs of different users must be balanced for the good of the whole institution.

The changes swirling around the campus only serve to increase the **importance of the core**. The central heart of the campus anchors the institution. It supports the identity of the college or university and provides a potent socio-emotional symbol for students, faculty, alumni, and the community. Even if institutions choose to reduce their campus functions, shedding nonessential facilities on the periphery, they should invest in the core. Its socio-emotional worth outweighs other costs.

Where technology is taking us

Technology is driving higher education to become more connected and more flexible. Students arrive on campus with multiple Internet-connected devices—as many as seven each, according to some surveys. They expect to be **online nonstop**, and they demand ubiquitous high-speed access as an entitlement. Interactions among faculty members and students are likely to become more informal—an ongoing exchange online rather than a potential biweekly encounter across a desk.

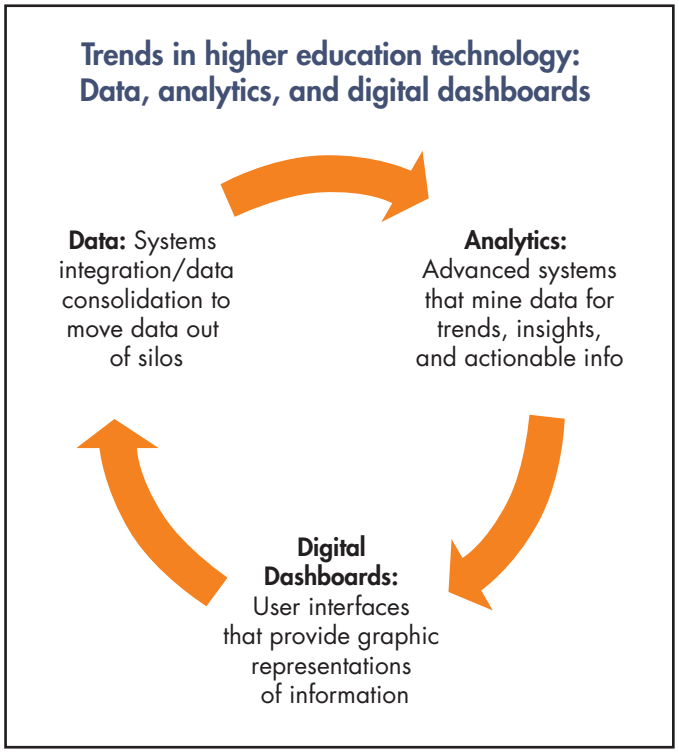
Meanwhile, technology is steadily increasing the options available to learners. Most students likely will take advantage of **multiple types of learning experiences** in their college careers. A few courses will be traditional lectures, delivered by a professor at a podium. Many others will be hands-on collaborative classes or even flipped courses, with lectures online and "homework" moved to class time. Some classes, perhaps those outside of the student's major, will be taken online, and some grades might not be for courses at all but will be assessed via an e-portfolio for a student-driven competency-based learning experience.

Looking ahead: Big trends in big data

Digging into the technological innovations that will change the campus going forward, the theme of big data is inescapable. In the context of higher education, big data encompasses three major trends.

Data/systems integration. The era of stand-alone systems is quickly coming to an end. Colleges and universities recognize that data has limited value when isolated in a single database but enormous potential when systems are integrated and data is consolidated.

Analytics. With data resources at their fingertips, institution personnel can use advanced analytics to make predictions, draw conclusions, and support decisions.



Digital dashboards. The results of data analysis need to be presented to users in clear easy-to-understand ways. Well-designed real-time interfaces will provide graphical representations of critical information and enable users to drill down to critical details.

These trends are shaping technology across higher education. Learning analytics systems promise to integrate data from multiple student information systems, analyze it for trends and insights, and present it to students and instructors via dashboards and alerts. Administrative systems will consolidate and present financial data to senior administrators, while human resources (HR) systems will do the same for employee information. Senior facilities officers anticipate a day when detailed data about buildings is consolidated, analyzed, and displayed in clear actionable ways.

Although the details of big data vary from use to use, the potential impacts are huge. Students will thrive in courses when they know exactly where they are succeeding and where they are falling behind goals. Facilities organizations will achieve greater efficiencies when they understand exactly where building systems are failing to perform at optimal levels. Integration, analysis, and digital dashboards could result in changes on campus that are as dramatic as the introduction of cheap personal computers or the development of the Internet.

Understanding the evolving role of technology in the built environment

APPA developed the Thought Leaders series to examine important trends and issues shaping college and university campuses—and few trends are having more impact than technology. For the 2015 symposium, experts in technology joined senior facilities officers as well as leaders in academics, finance, HR, and student affairs to consider where technology is taking higher education.

The group began by considering where technology and facilities stand today. They looked at trends changing college and university campuses and evaluated the state of the art in higher education technology. The symposium then focused on the role of technology in critical campus functions, including student success, research, HR, campus security, and energy management. Big data plays a major role in all of these functions; implementation of new analytics systems will be challenging, but the benefits will include improved campus services, reduced costs, increased efficiency, and a safer, more sustainable campus. Finally, Thought Leaders participants turned their attention to the nuts and bolts of integrating technology and to identify the characteristics of successful facilities organizations and facilities professionals in the future.

The results of the participants' two days of hard work are captured in this report. This whitepaper summarizes the discussions at the symposium and also provides additional context about major points. The purpose of the report is both to inform readers and to prompt discussion on campuses. At institutions across North America, senior facilities officers have come to rely on the annual Thought Leaders publications to generate new ideas about the built environment and facilities management.

Conclusion

Technology poses both challenges and opportunities for higher education. Innovation happens so fast that institutions fight to keep up with change. Time, effort, and insight are needed to prioritize the investment of college or university resources. IT departments face nonstop demands from all sides, and at the same time cope with the same slashed budgets as every other campus unit, while facilities organizations must adapt to new operational and strategic environments.

The institutions that embrace and integrate new technology will have an edge in the increasingly competitive higher education landscape. They will better serve learners and support faculty. They will make smarter use of limited resources and advance the safety and sustainability of the institution.

Most important, the colleges and universities that leverage technology will be ahead of their peers in adapting the campus to meet the needs of the 21st century. Institutions must look beyond traditional ideas of the value and function of their built environments. They must see that their campuses extend beyond the physical grounds and buildings into the vast dimensions of cyberspace. The new campus will be more than bricks and mortar; it will comprise lines of code, blinking dashboards, and vast databases. The mission of higher education will advance in positive yet new and unexpected ways as institutions come to understand everything that the "campus" can and should mean.

Section I:
Integrating facilities and technology on campus: Where we are today

The notion of campus is going through a remarkable period of transition and transformation. Once a hub of learning existing in relative isolation—think of the proverbial ivory tower—today the campus accommodates multiple purposes and serves the needs of diverse populations.

The next decade will see the campus change even more rapidly, contracting in some ways and expanding in others. The greatest expansion will be into cyberspace as the current outposts of online teaching and learning grow into full-fledged cyber institutions.

Pressures on higher education and how they shape the campus

The challenges faced by higher education institutions are well known, but their effects on the physical campus are rarely considered. In fact, the campus is changing as the entire academic environment changes.

Institutions continue to face **financial pressures** as state support remains at historic lows. State funding inched up last year, growing at 5.7 percent between 2013 and 2014, according to the State Higher Education Executive Officers Association. Most state colleges and universities continue to rely on tuition dollars for nearly half of their revenue. However, state support for public institutions does not seem to be rebounding to previous levels, as it did after significant economic downturns in the second half of the 20th century. Campus facilities budgets have suffered along with those of other departments. Research shows increases of about 2 percent per year on average for facilities operations and maintenance budgets since 2007. This 2 percent is less than the inflation rate for the same period, so the real dollars available have dropped. Facilities departments have increased productivity, but pressures on the organization mean that it is more difficult every year to keep campuses operating at static, let alone, desired levels.

Data Point:
State support of higher education

Welcome to the new normal

"The new normal no longer expects to see a recovery of state support for higher education such as occurred repeatedly in the last half of the 20th century. The new normal expects students and their families to continue to make increasingly greater financial sacrifices in order to complete a postsecondary education. The new normal expects schools and colleges to find ways of increasing productivity and to absorb reductions in state support while increasing degree production without compromising quality."

—State Higher Education Executive Officers Association, State Higher Education Finance: FY 2014, April 2015

Changing teaching and learning practices shape campuses in significant ways. Institutions today recognize the limitations of traditional lectures and encourage faculty members to adopt more student-focused teaching. The result is a vast **pedagogical shift** on campus. Instead of passive recipients of content, students engage in active learning environments in which they drive their own education. While an exciting trend for students, new learning methodologies present a challenge for campuses. Tradi-

tional lecture halls are an ideal environment for traditional lectures, but they are awkward and clumsy for group projects, in-class work, and discussions. Institutions are recognizing the lack of flexibility in their existing classroom inventory and are developing new designs that support instructors in their efforts to challenge learners.

College and university students are themselves changing as **demographic shifts** ripple across higher education. The diversity of college and university students is growing at a rapid rate as minorities become majorities around the country. For example, the University of California system announced last year that it admitted more Latino students (29 percent) than white students (27 percent.) Diversity in the classroom also encompasses gender (women make up about 57 percent of students) and age (40 percent of undergraduates are over age 25). Institutions are working to understand the wants and needs of a more diverse student body, and clearly the campus will play a changing role. Traditional students who enroll at age 18 often live in residence halls and look to the college or university for both friends and activities, but most nontraditional students are less dependent on the campus. The institution can serve nontraditional students, however, by enabling easy access to resources and support and by increasing the flexibility of when and where courses are offered. Nontraditional students may prefer to attend satellite campuses located near employment centers.

Economic theory says that **competition** is supposed to improve services and cut prices, but the situation is more complicated in higher education. The "arms race" among institutions—the competition for the best and brightest students, faculty, and programs—has created situations such as ever-rising sticker prices for private colleges and universities and correspondingly deep discount rates (the average is 48 percent.) The impact on the campus is dramatic. Students and parents making campus visits value what they can see, and they cannot see intangibles such as excellent teachers and cutting-edge research. They can see comfortable new residence halls, vast variety in dining options, rock-climbing walls in the recreation center, and, as important, existent *and* well-kept buildings in their major of choice. Institutions feel pressured to invest in whatever will attract tuition dollars, and the result can be skewed priorities on campus.

30,000-foot view of the college and university campus

Trends in higher education will combine with trends in building design and technology to create the campus of tomorrow. Another important trend is **the fate of the physical campus**. The growth of online education raised fears that the traditional campus was under threat—that the campus could disappear, replaced by a server farm. Although important concerns, campuses are not going away anytime soon. In fact, the majority of institutions need a physical space dedicated to teaching, learning, and research—a physical *core*.

Nevertheless, how the campus is built and operated is indeed changing. Among the many factors changing the campus, three issues stand out:

1. **Increased demand for flexibility.** Campus buildings have traditionally been purpose-built for a single use. This approach allowed for customization but also limited options for the space. Those limits impose a real cost on the institution, which must build new spaces or remodel existing ones as needs change. New facilities will be designed for maximum flexibility. Higher education facilities experts suggest that institutions think of buildings as "event space"—space that is adapted and configured when a purpose arises, then disassembled when that purpose concludes. To this end, buildings are becoming "lighter"—that is, they are shell structures with quickly configurable internal spaces.

2. **Decline of the empire.** The rigid academic divisions that once split the campus are breaking down now. Academia is growing more multidisciplinary; cross-discipline research is increasingly important. This blurring of boundaries impacts campus space; instead of academic buildings with single owners, spaces now have multiple owners. This situation complicates the control and ownership of buildings. For example, while the school of engineering might have had near total control of the space in its building, matters become complicated when academic divisions need to use that same innovation lab. Shared use, shared access, and shared responsibility will be required.

Data Point:
Public-private partnerships on state campuses

Expansion of private sector investment across the United States

State higher education systems across the country are turning to innovative service and delivery models to meet the needs of their campuses. Recent projects around the country include:

- In 2013, Brown University, the University of Rhode Island, and Rhode Island College, in cooperation with the State of Rhode Island and the City of Providence, announced a $206 million deal with a private developer to redevelop the former South Street Power Station in Providence. The 1.76-acre project will include a new shared nursing education center, student housing, administrative offices, parking facilities, and retail and restaurant space.
- In 2014, the University System of Georgia announced that it had selected a private partner to develop, construct, manage, and maintain student housing on nine university campuses. The $517 million, 65-year concession includes the addition of nearly 3 million square feet of housing.
- In 2012, Montclair State University announced a partnership with Energenic-US, LLC to develop a $90 million combined heating, cooling, and power system for the campus; the company will finance, design, build, and operate the plant under a 30-year agreement.
- In 2012, Ohio State University closed a 50-year, $483 million deal leasing its parking assets to a private consortium.

— Multiple news sources

3. **Growing reliance on the private sector.** Colleges and universities have traditionally been self-sufficient units, but institutions today recognize that the private sector can sometimes meet campus facilities needs more quickly and cost-effectively than the institution itself. Both public and private colleges and universities are forging partnerships with developers and other service providers to build residence halls, manage dining services, maintain buildings and grounds, and finance new construction.

Importance of the core. With the changes coming to college and university campuses, the core of the campus will **grow in importance**. In fact, the changes elsewhere make it essential that the institution retains a central hub—a core. Often this core is historic and imbued with tradition. It both reflects and reinforces the identity of the college or university. Campuses will likely contract around their core, shedding facilities on the margins or handing them over to the private sector. The institution will get the most value from its campus by bringing as many students as possible into the central hub; this valuable asset should be used for core academics so that its importance is reinforced.

Campus experts suggest a **hub-and-spoke model**: the core of the campus is a fixed space (traditionally a long quadrangle with buildings surrounding it) but as the campus extends outward, the flexibility of structures increases as their iconic status decreases. At the outer ring of the campus, facilities could be the responsibility of the private sector, or they could be intended to have an abbreviated life cycle. The edge of the campus could be designed for impermanence, in acknowledgment that we cannot anticipate the needs of the academy of 2040, 2065, or 2115.

Impact of technology on campus design and management. While most discussions of technology in higher education focus on technology use by students, faculty, and staff, advanced systems also play a growing role in the **design and maintenance of facilities** and are changing the campus. Building systems unheard of even a decade ago are rapidly becoming commonplace. New systems track and manage rainwater harvesting, exterior shading, and renewable energy generation. At the same time, traditional systems such as heating, ventilation, and air conditioning (HVAC) and power have grown more fine-grained, adjustable, automated—and complicated. Integrating and optimizing these systems are technically challenging and time-consuming jobs.

Smart building sensors are one of the most promising new technologies. Part of this broader trend is the "In-

ternet of Things" (IoT)— objects that are connected to, communicate with, and can be controlled via the Internet—smart sensors **track building information** (such as temperature, lighting, or water use) and automate operations. The greatest potential of smart systems is to **prevent failures** before they occur. Sensors can identify spikes in water use that point to a leak or can notify building managers if the pressure in a fire extinguisher tank falls below safe operating levels. Data from different systems can be combined for a detailed and larger picture of how well a building is operating, and analytics systems can suggest maintenance schedules. Ultimately, automation will become streamlined. The system will identify a failed part, order a replacement, and schedule repairs all on its own.

Sensors will also help planners and architects **design more effective buildings**. Sensors can generate enormous quantities of data about how buildings are actually used. Corporations are beginning to use employee tracking systems to better understand how staff members are using offices, conference rooms, and shared spaces. Colleges and universities will likely make use of similar systems to gain insights into the actual use of campus space in the next decade.

Data Point: The Internet of Things

Growth in Internet-connected devices predicted to soar

Technology analysis firm the Gartner Group predicts that the Internet of Things (IoT) will grow to 26 billion installed units or specific items in 2020—an almost 30-fold increase from 0.9 billion in 2009.

Defined as "the network of physical objects that contain embedded technology to communicate and sense or interact with their internal states or the external environment," the IoT will outpace the growth of other connected devices such as smartphones and tablets, which will reach about 7.3 billion units in 2020. Gartner says that the IoT installed base will grow to 26 billion units by 2020.

— Information from: Gartner Group, press release, December 12, 2013

Data Point: Smart sensors and building use

New technology that provides insights into how space is actually used

"The loft-like San Francisco office of software maker Atlassian has an open central amphitheater, where all-staff gatherings and midday boot camp exercises are held. But the office's rapid expansion to 300 employees has led to gripes about conference room shortages. 'We're butting up on growing out of the space,' says Jay Simons, Atlassian's president.

"So, early this year, Atlassian installed heat and motion sensors to track when and how often every desk, room and table was used. The result? Desks were used only 20 percent of the workday; conference rooms an average of 40 percent, with peak use at midmorning.

"Simons says tracking employees' movements in an anonymous way will help guide choices to convert desk space into meeting rooms, or to stagger meetings to accommodate a growing staff.

"'If we're using data to make an environment that people can be more productive in, ultimately that saves us money or helps us make more,' he says."

— Excerpt from: Yuki Noguchi, "How a bigger lunch table at work can boost productivity," All Things Considered, *May 20, 2015*

30,000-foot view of IT in higher education

If technology seems ubiquitous on campus today, hold on to your smartphone, because higher education is only going to grow more connected. Students, faculty, and staff expect high-speed access anywhere, and they demand blazing speeds. Students routinely arrive on campus with **multiple connected devices**—according to the 2014 ECAR Study of Undergraduate Students and Information Technology, 92 percent of surveyed students own at least two devices, and 59 percent own three or more. Along with their laptops and smartphones, students bring tablets, wireless printers, digital gaming systems, smart televisions, and e-readers. The load on campus WiFi is immense and growing.

Even with a wealth of technology at their fingertips, students are still more likely to use their devices for fun than in the classroom. While course management systems (CMSs) are nearly ubiquitous themselves (99 percent of colleges and universities have one), only about one in two students use the institution CMS in all or most of their courses, according to the EDUCAUSE Center for Analysis and Research (ECAR). Furthermore, the majority of interactions with the CMS use its most basic functions, such as accessing course content or managing assignments. Advanced features, such as interacting with instructors or receiving feedback on course progress, still receive little attention from students. ECAR also reports that **students welcome technology in their classes** and would embrace more in-depth use of technology by faculty—72 percent said that they prefer courses with some online components.

Students also welcome the use of **learning analytics**. In the ECAR survey, 60 percent of students said that they were very or extremely interested in receiving real-time feedback about their course progress through personalized dashboards in the CMS. Few institutions currently provide this sort of information. Nevertheless, the analytics trend is increasing, and tools to manage and mine the data reserves of colleges and universities will become widespread in the next decade. A recent EDUCAUSE survey found that 84 percent of institutions considered analytics as more important for institutional success today than two years ago.

What is taught and how we teach it. Looking ahead, technology will have a growing effect on the classroom as new generations of faculty advance through the institution, academic software becomes easier to use, and integration problems are solved. Experts predict that students will engage in **multiple types of learning experiences** when earning degrees. Students might take one course in a traditional lecture-based classroom; another course might be a MOOC; and another might be an informal student-driven learning experience assessed via an e-portfolio. Learning will be adaptive, with technology providing the necessary flexibility.

Ready access to technology will also shift the emphasis from absorbing large bodies of facts to **learning how to think**, reason, solve problems, and communicate. Facts will always be available at the touch of a button, so students need to learn how to access information, use and understand advanced analytics systems, think logically about problems, and present solutions clearly and concisely.

Data Point:
Campus spaces for multiple teaching methods

Teaching online and on campus, from one mixed-use space

Three new classrooms at Purdue University allow instructors to teach both online and on-campus students without compromising quality for either audience. Previously, courses in the Engineering Professional Education program were taught in classrooms designed specifically to record lectures. Tables and chairs were bolted to the floor; huge monitors blocked sightlines; and microphones intended to capture questions from on-campus students had such poor sound quality that students online could not understand a word.

Purdue faculty and technical operations staff members developed requirements for the new rooms, including high-quality sound and a more engaging space for students attending class in person. The final design enables faculty members to move around while lecturing, with the class recorded by a student worker in a control room behind an unobtrusive window. The bad microphones and big monitors were replaced with ceiling-mounted microphones and 90-inch screens mounted on the walls. On-campus students are hardly aware that lectures are recorded; they experience the room as any student-focused classroom. Online students get a more dynamic presentation of material and higher-quality recordings. Already the team is contemplating how to increase the flexibility of the spaces and how they can be used for both on-campus and online learners.

— Information from: Dian Schaffhauser, "Designing learning space for both online and on-campus delivery," Campus Technology, *June 24, 2015*

Challenges and changes in the IT department. The IT department is being asked to serve as a strategic partner within the institution rather than a provider of commodities such as e-mail. Successful IT departments are positioning themselves as **trusted campus experts**, aligned with the institutional mission and vision.

This strategic role is made possible in part by **outsourcing**, which frees the IT staff from the demands of providing campus basics. Colleges and universities have turned to cloud computing to provide commodity services such as e-mail, calendars, and collaboration. The size of the cloud market in higher education has reached $4.4 billion, according to a study by government IT experts at MeriTalk.

Outsourcing helps colleges and universities control costs but generally does not reduce staffing levels; staff members are still needed to manage outsourcing contracts and to provide strategic oversight. In fact, nearly half (46 percent) of higher education IT organizations surveyed by EDUCAUSE in 2014 added new staff members, with many of these new hires—38 percent—brought on to fill new roles within the organization. Some of the most in-demand positions are in vendor management analytics and in project and process management. **Integration and analytics** will be critical in the next decade. IT professionals will need to operate across platforms and functions to solve problems. Getting different systems to work together and share information will be one of the most important tasks of IT; many IT staff members reported in an ECAR focus group that campus leaders did not have a good understanding of the time and expertise required.

Data Point:
Trends in technology in higher education

Important developments in educational technology for higher education

Time to adoption: One year or less

Bring Your Own Device (BYOD): Institutional policy that students supply their own devices—such as laptops or tablets—rather than use institution-supplied or -mandated equipment

Flipped classroom: A teaching format where instructional content is delivered online to be studied outside of class while what would have been homework is performed within class

Time to adoption: Two to three years

Makerspaces: Spaces equipped with three-dimensional printers, electronics, and tools, where individuals can share resources and knowledge, work on projects, and experiment with technology

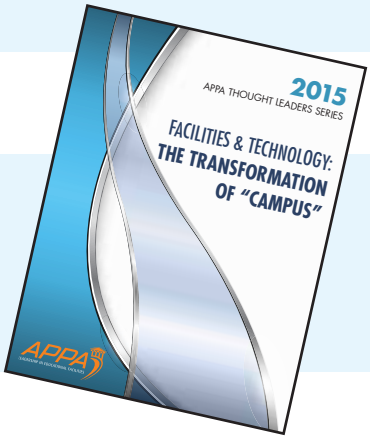
Wearable technology: Clothing and accessories that incorporate computers and advanced electronic technology

Time to adoption: Four to five years

Adaptive learning technologies: Software and online platforms that adjust to individual student needs as they learn

Internet of Things: Objects that are connected to, communicate with, and can be controlled via the Internet

— *New Media Consortium*, NMC Horizon Report: 2015 Higher Education Edition, *2015*



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