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2015–16
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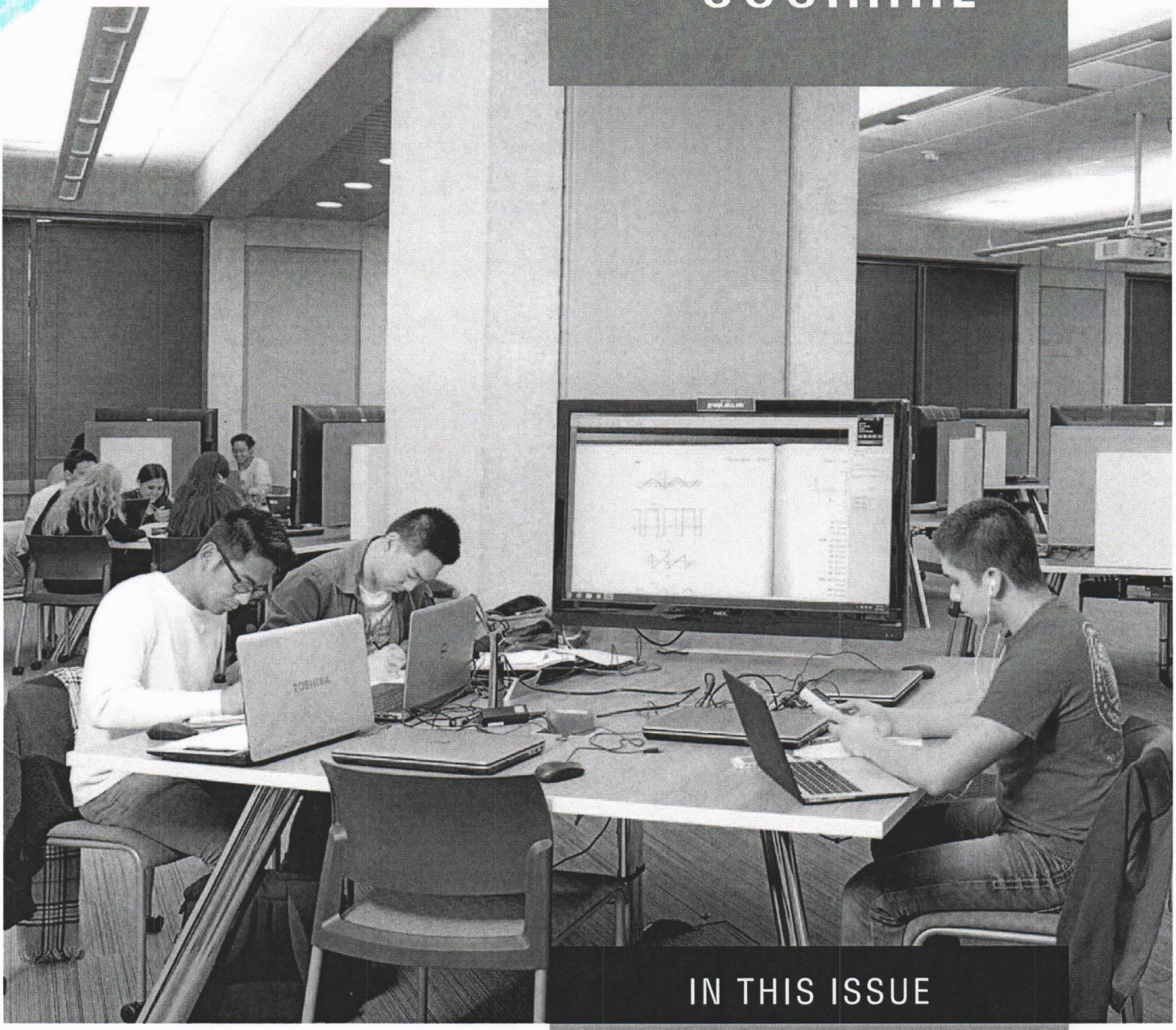
Number 4

Association for College and University Technology Advancement

ACUTA JOURNAL



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THE ACUTA JOURNAL

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Cynthia Yewdall Thackeray

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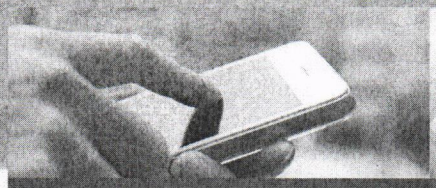

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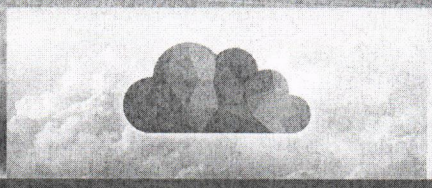

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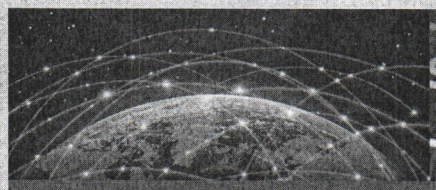

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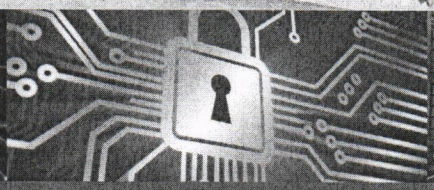

Security

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- Web client keeps messages out of email
- Mobile client keeps data off of your mobile device
- Mobile number protection
- TLS to encrypt SIP signaling
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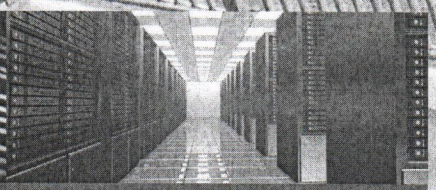

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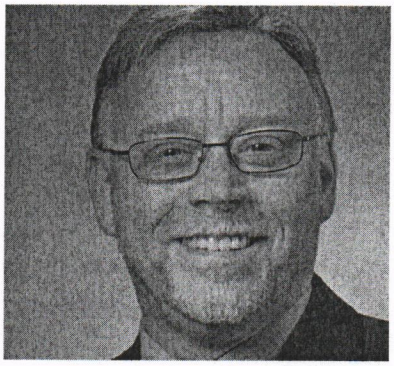


Classroom innovation always comes from a faculty desire to convey something in a new way to students. Our job is to understand their unique pedagogical needs, inform them on the newest teaching technologies, help jumpstart that connection, and get out of the way as they create something special with their students.

Keith Fowlkes
Chief Information Officer
Centre College
Danville, KY

The challenge of using academic technology is in the diversity of the learning needs (classrooms can be physical or virtual spaces where students with differing abilities and learning styles meet synchronously or asynchronously to learn about a wide variety of topics) and the technology to support that learning.

Mona Brennan-Coles, PMP
Telecommunications Business Solutions Manager, Information Technology Services
Western University
London, ON

The Year Ahead

Winter Seminar	January 17 – 20, 2016	Hyatt Regency Hotel New Orleans, Louisiana
45th Annual Conference	April 24 – 27, 2016	Manchester Grand Hyatt Hotel San Diego, California
Fall Seminar	October 16 – 19, 2016	Grand Hyatt Hotel Denver, Colorado

Core Purpose and Values

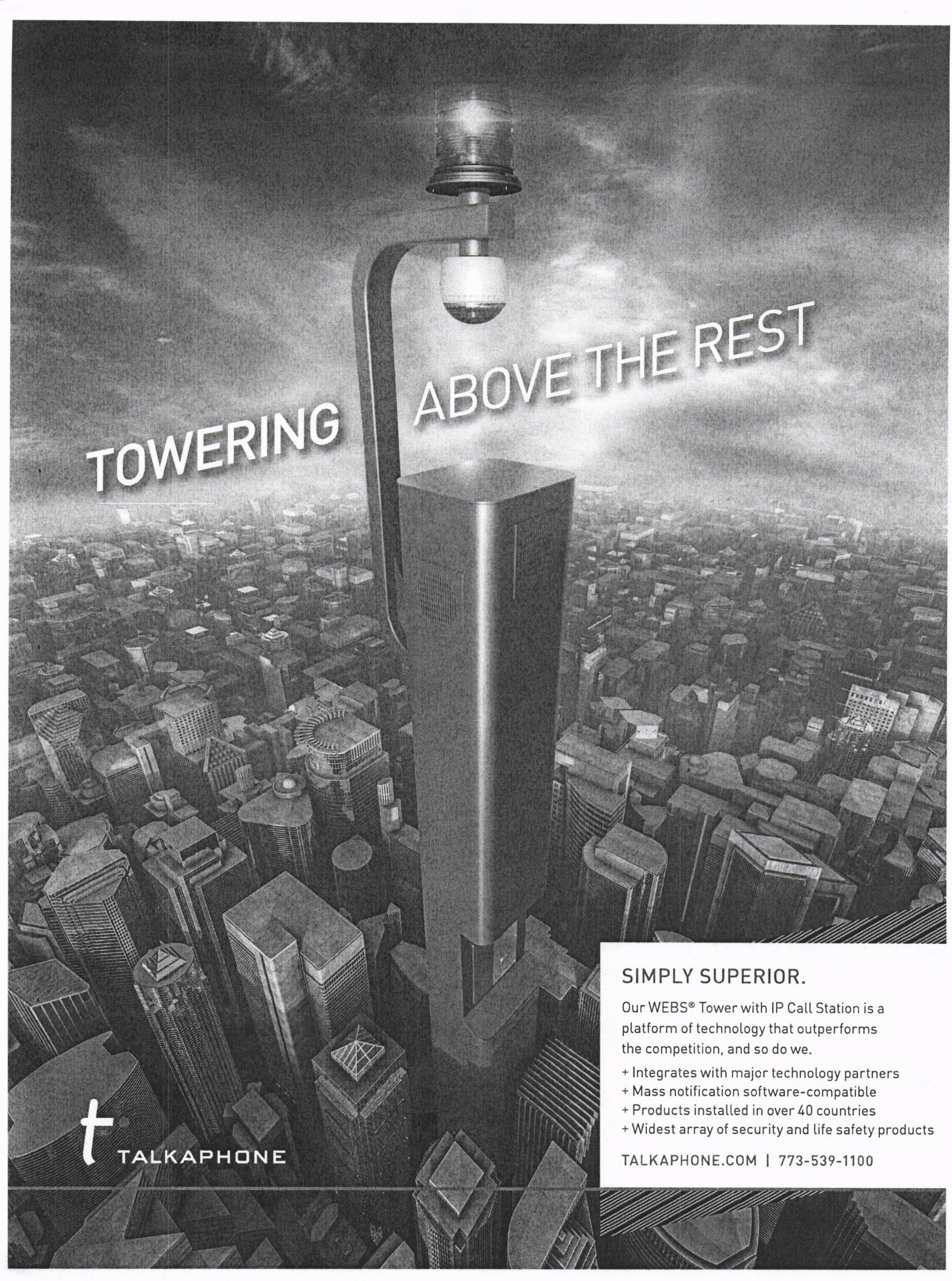
ACUTA's mission is to advance the capabilities of higher education communications and collaboration technology leaders.

ACUTA's core values are to:

- encourage and facilitate networking and sharing of resources
- exhibit respect for the expression of individual opinions and solutions
- fulfill a commitment to professional development and growth
- advocate the strategic value of communications and collaboration technologies in higher education
- encourage volunteerism and contributions by individual members

ACUTA

Association for College and University Technology Advancement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Cynthia Yewdall Thackeray

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PRESIDENT'S MESSAGE

Partnering Internally Improves Service at BCIT

by Michele Morrison
British Columbia Institute of Technology
ACUTA President, 2015–2016

The topic for this issue of the *ACUTA Journal* is Innovative Technologies in the Classroom, and a number of articles in this issue explore a variety of interesting, innovative technologies.

At British Columbia Institute of Technology (BCIT), we have very active discussions on campus regarding innovative, emerging, and disruptive technologies. Some recent discussion threads that I have been following in our Business Social Network include topics such as

- digital resource strategies;
- simulations and virtual-reality teaching tools; and
- maker spaces.

The discussion has also explored how classrooms and teaching spaces need to be reconfigured to enhance some of the collaborative aspects of these technologies.

Digital resource strategies are being explored by all of our schools, with our School of Health Sciences leading the way in both creation and consumption of digital content. Digital content goes far beyond e-books and may include any content that is published or distributed in digital form. This may be text, data, sound recordings, photos and images, video or motion pictures, and software.

Simulations and virtual-reality tools are really an extension of digital resources and allow students a more immersive experience with the learning materials by allowing them to participate while learning. We are seeing all sorts of applications in this area with a variety of programs across all of the schools taking a lead. Our Learning and Teaching Department is exploring the use of drones to help bring students closer to the physical spaces that they are learning about. (Don't miss the two articles in this issue about drones on campus.) This has been particularly useful in programs like Geomatics; Fish, Wildlife, and Recreation; and Forest and Natural Resource Management. Innovative teaching tools can also help us with environmental sustainability initiatives. For instance, virtual welders help reduce energy consumption since "real" welding tools are heavy consumers of electricity. They also reduce waste and scrap materials and avoid the creation of toxic off-gases.

Maker spaces are of particular interest to our engineering and trades students as well as our Applied Research Department. Maker spaces should not be limited to just 3-D printers and maker kits. All sorts of equipment and tools should be available to advance a creative idea into reality.

Here are some things to think about as your institution integrates innovative technologies into mainstream learning. Do your IT service/help desks and library staff have the ability to support students and instructional staff who are working with digital resources—especially if these are provided by a third party? Will there be dedicated staff managing maker spaces? What is the cost of these technologies, and are they financially prohibitive for students to access? If digital resources are being used, there is also the issue of intellectual property...not only must ownership be acknowledged, but in some cases compensation is required for usage. These considerations should not be barriers to exploring innovative technologies but should be evaluated when making decisions to adopt.

BCIT is one of British Columbia's largest postsecondary institutions with more than 48,000 students enrolled annually (16,600 full time and 31,600 part time). It has five campuses across the metro Vancouver area, with its main campus located in the city of Burnaby.

Higher-education institutions need to make sure that the planning for and ongoing management of innovative technologies both follows good technology practices and supports good pedagogy to enhance quality teaching and learning.

Reach Michele at michele_morrison@bcit.ca.

FROM THE CEO

Supporting Innovative Technologies in the Classroom

by Corinne M. Hoch, PMP
ACUTA CEO

What all of us do in IT and telecom services has a direct impact on what happens in the classroom. At the same time, only a few of our members have academic responsibilities on their campuses. Connecting these two disparate statements, ACUTA's Publications/Media Committee chose Innovative Classroom Technologies as the theme for this issue of the *Journal.*

Today's students and faculty bring a different set of expectations, skill sets, and devices to their academic endeavors. Innovation in today's physical and virtual classrooms is critical to providing the most effective and motivating learning environment. The "flipped" learning environment necessitates that faculty teach and students learn in new and different ways. The digital generation has matured into the new faculty of today, and millennials have already experienced technology-enhanced classrooms in their K–12 experiences. Innovative classroom technologies are abundant, but implementing them successfully in order to increase mastery of content and critical thinking skills is challenging.

This issue of the *Journal* highlights innovative technologies that have enabled the maximum learning experience and resulted in positive effects on learning across higher-education institutions. New classrooms may include student-centric technologies, smart boards, mobile instructional control systems, and wireless projection devices as well as other exciting technologies. Dramatic advances and dropping price points have even enabled HD and 3-D projection to satisfy the graphics-driven curricula of art, art history, medical sciences, and other disciplines.

Most courses today are hybrid—they have both virtual and physical components. Many are exclusively virtual. The days of the "does everything," Swiss army knife, learning-management system model are waning. Consumer-selected, individual e-learning tools/applications are enabling faculty and students to select those that work best for their situation and preferences. Supporting this potpourri of choices requires the IT organization to prioritize integration points and to develop vendor relationships and agreements quickly and carefully. This issue addresses some of the obvious (and perhaps not-so-obvious) challenges that come with the new technology environment and spotlights a number of campuses that are doing many things right.

Applying these principles to our own ACUTA family, we constantly strive to introduce you to innovative ideas and to explore supporting technologies to enhance your learning experience. For example, Aaron Fuehrer, ACUTA CTO, is always in search of the best lecture capture methodologies that support your needs. We've recently changed lecture capture providers—which you may have noticed because of the improved quality. We have tested live streaming and have found that a better fit for you is to provide archived streaming video so that you may view it when you choose the time yourself. Video recordings are available at no additional charge to all registered event attendees, and a link to the streamed video recordings may be purchased at a nominal charge to cover our costs.

To keep costs to a minimum we select eight sessions per event to record and try to provide equal sessions per educational track. As you can imagine, it is challenging with only one videographer to move from track to track, and we record only the sessions for which we have permission.

I asked Aaron to provide his hands-on view of ACUTA's innovative classroom technologies. The rest of my column is his comments, which I'm happy to share with you:

Technologies that help create an innovative classroom environment are also in use by ACUTA to better serve its members. Bridging technology solutions that combine digital publishing and lecture capture can create interactive new products to enhance the educational or professional development experience. In most cases, a cost savings can also be realized to create a win-win situation.

ACUTA began almost 17 years ago capturing video from its annual conference sessions and streaming it over the Internet after the event. By today's standards, that technology is like watching an

old silent movie. As the years progressed, increased bandwidth availability allowed for larger video, increased frame rates, and clearer sound.

Today ACUTA routinely records selected sessions from its annual conference and seminars, complete with synced PowerPoint presenters' slides to provide a total educational experience. What started out as a value-added service has turned into the expected norm from today's meeting attendees. The ability to time shift what attendees see on-site, depending on what is being recorded, allows the attendee to attend other sessions in the same time period. It also allows the material to be viewed by other individuals off-site.

One interesting thing we learned was that our members preferred archived postmeeting recordings over live streaming. Having the material available for anytime viewing postmeeting provided flexibility, while live streaming required a fixed time-frame for viewing. After the live streaming was over, the video was archived, but that often defeated the intent of the live streaming—not to mention the additional cost. An example of our video capture and PowerPoint web technology from the 2015 Fall Seminar can be found at www.acuta.org/fs15streaming.

Another technology that has matured in recent years is in the area of online digital publishing. The driving factor has been the ability to realize a significant cost savings by eliminating the cost of printing and mailing. ACUTA began about 15 years ago by not printing its monthly newsletter and having an HTML version and an Adobe Acrobat PDF version available on its website. Several years later the focus moved to providing the newsletter in a Flash-based environment alongside a PDF version. Today ACUTA uses a hosted publishing service that can take a PDF and turn it into an interactive publication that can be viewed on desktop environments using Flash as well as HTML5 for mobile devices. The ability to print pages, as well as download a PDF version is also made available to readers. What used to be locked into a static printed piece can now have video overlays embedded within related articles.

In addition to the monthly *eNews*, ACUTA has moved its quarterly *Journal* to the same publishing platform. Readers of the *eNews* and *ACUTA Journal* now read and search content using powerful tools that, at the same time, provide cost savings and use fewer resources. Examples of current and back issues of the *eNews* and *ACUTA Journal* can be found at http://enews.acuta.org and http://journal.acuta.org respectively.

It is an exciting time to be providing learning resources, and the tools have never been better. In most cases, a solution can now be found that provides a better end-user experience combined with cost savings for the provider.

Reach Corinne anytime at choch@acuta.org.

LEGISLATIVE & REGULATORY AFFAIRS COMMITTEE

Drones on Campus: The Challenges and Potential of Unmanned Aircraft

by Ken Salomon, Sean McGowan, and J. Tyler Black

Model airplane enthusiasts have long flown in the lower fringes of the national airspace system without major issue. Over time, these unmanned aircraft, their onboard technologies, and flight software have advanced, bringing with them new and more sophisticated opportunities for imaginative use, including in commercial and academic contexts. Drones, or unmanned aircraft systems (UAS), can be an incredible enhancement: an eye in the sky, cheaper and safer than a manned helicopter, and a mobile platform that extends human reach unlike anything fixed to the ground. Commercial operators have acknowledged the potential of this "new" technology as evidenced by the approximately 2,500 applications (and 1,700 grants issued to date) for commercial operations. So, too, has academia, with dozens of schools launching UASs into the sky.

But the risks posed by such a rapid technological development can be substantial. Chief among them, at least for drones, are personal injury and privacy concerns. Drones recently have been in the headlines for crashing into sporting events, both collegiate (an NCAA football game) and professional (the U.S. Open tennis tournament). UASs also present new dangers to the national airspace system, evidenced by the precipitous uptick in drone sightings near aircraft and airports, mostly because of their newfound popularity. The structure of the rules currently in place and the coming changes to that structure will undoubtedly influence the extent to which drones become integrated into businesses, academia, and society. Knowing how drones can be used, what the rules are, and what policies are appropriate to ensure safety and privacy is critical for anyone hoping to unlock their potential.

Drone Use on Campus

Unmanned aircraft have begun to make their way onto college campuses in a variety of forms, ranging from sanctioned academic research to rogue student flights over sporting events. To date, some campus uses have included: enabling student projects and academic research, such as gathering data and mapping natural phenomena; performing aerial marine, wildlife, and agricultural study; permitting students to check out drones for recreational and experimental uses; capturing unique footage of collegiate sporting events and using it to enhance team film study; creating marketing materials that display prominent campus buildings from unique vantage points; producing campus greeting videos; documenting and reporting unique campus events; inspecting campus buildings; monitoring construction projects; creating detailed 3-D mapping of archeological sites; developing programs to train drone operators and teach students about commercial drone applications, including designing, building, and operating drones; and experimenting with less familiar drone types such as tethered drones and microdrones.

All of these uses, however, are subject to Federal Aviation Administration (FAA) jurisdiction in one form or another, unless they occur entirely indoors. Understanding the applicable rules, therefore, is vital.

The Regulatory Setting

Although recreational or hobby use of unmanned aircraft has existed for generations, its explosion into popular culture and as a practical advantage for businesses and governments has been much more recent. The FAA initially sought to clamp down on widespread commercial drone use via a 2007 Notice of Policy on Unmanned Aircraft Systems Operations in the United States National Airspace System. In February 2012, Congress passed the FAA Modernization and Reform Act (the 2012 Act), which required the FAA to develop a plan and final regulations for integrating civil drones into the national airspace system.

On February 15, 2015, the FAA published a Notice of Proposed Rulemaking setting forth draft regulations required to implement the 2012 Act entitled Operation and Certification of Small Unmanned Aircraft Systems (NPRM). It is anticipated these regulations will not become final until sometime in late 2016 or perhaps 2017. In the interim, the FAA regulates commercial drone use in accordance with an exemption under Section 333 of the 2012 Act and other forms of drone use through separate civil and government UAS processes.

In the 2012 Act, Congress prioritized the immediate expansion of commercial drone flights and walled off recreational drone use from excessive regulation. Other avenues of drone operation such as experimental classifications and the Certificate of Waiver or Authorization (COA) process continue to exist. In the current regulatory environment, the nature of the drone use (i.e., commercial vs. hobby, etc.) determines what laws and regulations apply.

Process for Obtaining FAA's Authorization to Fly UASs for Commercial Reasons

The FAA evaluates Section 333 Exemption applications for entities wishing to use UASs for commercial purposes. Generally speaking, commercial uses are flight operations involving the transportation of persons or property for compensation or hire, and may include drone use by colleges and universities as a part of any promotional, research, commercial, or revenue sport operation. As of now, the most expedient avenue to commercial operation is via the Section 333 Exemption process. This process allows the FAA to make a case-by-case determination regarding whether specific drone operations are appropriate for use in the national airspace system. The process requires the applicant to identify the specific drone(s) that will be used, the purpose of the use, locations of planned use, any proximity to airports, and how the UAS will be operated. The FAA will review the application to determine whether the proposed commercial use poses any potential hazards to the national airspace or national security, and whether it is appropriate and safe with respect to other aircraft and people on the ground. This review process generally takes approximately 120 days, but it can vary considerably depending on the nature of the application.

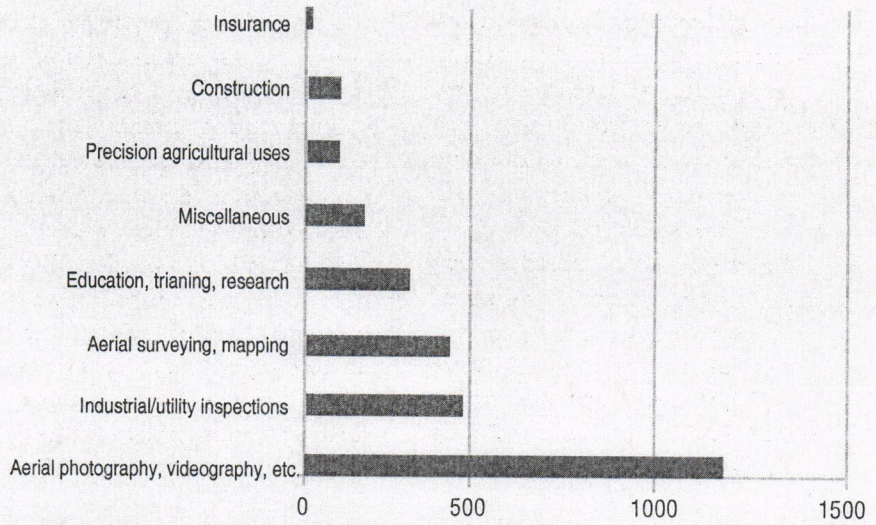
If the FAA approves a Section 333 Exemption application, the exemption holder must use at least a licensed Sport Pilot (a pilot certificated by the FAA as eligible to fly light sport aircraft, having passed applicable examinations) to fly the drone and must also obtain a COA, which is essentially an approval to operate a drone at a specific time and place. The FAA automatically grants a "blanket COA" for flights at or below 200 feet above ground level to any drone operator holding a valid Section 333 Exemption, as long as the aircraft weighs less than 55 pounds (considered a small UAS, or sUAS) and certain weather conditions exist. Entities wishing to operate outside of those parameters must obtain a specific COA for each operation.

Commercial drones in particular are somewhat in a regulatory limbo. The February 2015 NPRM discussed above sets out the framework needed to integrate small (less than 55 pounds) commercial drones into the national airspace. This proposed framework would establish a new Unmanned Aircraft Operator certificate and generally lower barriers for commercial drone flight. Some operations, such as promotional advertising and videography, land surveying, agricultural applications, industrial inspections, insurance claims review, and construction, mesh well with the proposed rules, while others, such as package delivery, may face a more challenging path.

To date several colleges and universities, including state universities in Iowa, Idaho, Wyoming, Oregon, Florida, Nebraska, Alabama, and South Dakota, along with the University of Southern California, Miami Dade College, Virginia Computer Institute, Duke, Cochise College, Franklin W. Olin College of

Figure 1. Number of Approved Exemptions Covering Type of Use*

*Estimated as of October 1, 2015



Engineering, and Sinclair College, have applied for Section 333 Exemptions for their planned operations. These operations span an array of activities, from research, training, and demonstrations to marketing and supporting student recreational and sport activities. As of October 1, 2015, Duke, Cochise College, Auburn University, Franklin W. Olin College of Engineering, and Sinclair College have received their Section 333 Exemptions.

Process for Obtaining FAA's Authorization to Fly UASs for Noncommercial Reasons

- State Agencies/Entities

State agencies or entities seeking to use drones for official, noncommercial business have chosen to use the Public Certificate of Waiver or Authorization (Public COA) process to get airborne. This process appears to be somewhat less favored now that the Section 333 Exemption process has become more efficient and less arduous. The Public COA involves a lengthy application and consultative process to develop conditions and limitations for drone operations, but the resulting Public COA often permits operations beyond the parameters of Section 333 Exemptions (e.g., flights at greater than 400 feet). While many entities using the Public COA have been law enforcement and other state agencies, academic institutions such as Georgia Tech, Virginia Tech, Virginia Commonwealth University, and major state universities in Alaska, Arizona, California, Colorado, Indiana, Michigan, North Dakota, and Wisconsin have also opted for this route. These Public COA uses primarily focus on research and development of aircraft or related technologies.

- Hobbyists

On the other hand, recreational drone users need only follow the guidance of Advisory Circular (AC) 91-57A, which replaces previous FAA guidance that did not mesh well with the 2012 Act. The AC lays out the particular guidelines and best practices for recreational flight (i.e., adhering to community-based safety guidelines, flying more than five miles from airports, and flying below 400 feet).

Developing a Drone Policy

In order to ensure drones are safely and appropriately integrated into any college or university, all drone operators must follow federal, state, and local laws regarding the use of drones. Institutions will have to consider whether they will allow staff or students to pilot/operate individually owned or institution-owned drones, or permit any third party to do so for the institution's benefit. Generally speaking, the more control and ownership a higher-education institution exercises with respect to drone operation and equipment, the more it should be prepared to take responsibility for the results and liabilities of those flights. Whatever the choice, it remains prudent to insist the operators (and associated individuals) fully comply with all applicable laws.

Figure 2. A drone is ready to capture the action on a football field.

It's difficult to generate a "one-size-fits-all" approach to a college or university drone policy, but below are some general principles:

- Set usage goals/limits. Consider the purpose for allowing drone use on your campus. Is it for research, student projects, promotional material, or athletic department use? Something else entirely? Will the institution provide the drones, or is it merely providing a space or forum for deployment? Answers to these questions will affect what provisions the policy must contain.

Also consider developing a drone policy that addresses drone use by students, faculty, staff, or outside parties. If applying for a commercial exemption, the institution must decide who will operate the UAS and whether it is more advantageous for the institution to apply for a Section 333 Exemption or contract with a third party who already possesses one.

- Evaluate safety. How, where, and when will the drones be used? Drones have been known to malfunction or fly away unexpectedly. Institutions and any third-party operators should therefore take steps to ensure the safety of other people and property on the ground and aircraft in the air. Appropriate measures include employing safety officers, netting, signage, and other safety devices (e.g., lost link–automatic landing and/or return to starting position technology) to protect nearby people where required by the FAA.

Additionally, campus police and staff should be briefed on which drones are authorized and which are not. Employ safety precautions and seek waivers where appropriate. Also, institutions wishing to use UASs should post conspicuous notices at the entrances to their grounds or facilities where drones will regularly operate to alert people about drone/video operation and potential risks.

- Carry insurance. Carry appropriate insurance that covers the risks and liabilities associated with drone operations. Liabilities associated with personal injury, invasion of privacy, and property damage are especially important. Several providers exist in the drone insurance space to offer coverage tailored to a particular use. The FAA will assess insurance coverage when evaluating a Section 333 Exemption and determining if it's warranted. It is also imperative to find an operator (i.e., at least a certified Sport Pilot) who is properly trained and experienced, regardless of whether they will be flying an organization-owned device or one that is owned by a third party.
- Understand the airspace. Any drone policy will need to account for the operating location's proximity to airports and helipads as indicated in FAA regulations and guidance. Drone use is more limited within five miles of airports and other restricted areas, such as large football stadiums (including some NCAA events). There are also proximity restrictions for certain heliports. Each institution will need to review all facilities and their proximity to these restricted areas before proceeding with a Section 333 application or any other drone use.

Additionally, remember that the FAA does not regulate the use of drones indoors. Institutions choosing to use UAS indoors only, therefore, will not have to apply for a Section 333 Exemption. Nevertheless, colleges and universities should still have a policy on such use and consider the safety of all participants and observers because indoor usage may pose additional or different safety issues for the institution.

- Know the law. Apply for FAA exemptions or permission where necessary and take efforts to understand how the FAA regulates drones. A good policy will indicate an understanding of what the rules are and where the FAA is most likely to enforce its rules. Don't have a policy that permits operating beyond the limit of FAA parameters. Rules are also different depending on the size of the drone and the purpose and location of the use. Any applicants or operators that do not comply with federal rules and regulations are subject to a variety of FAA actions and steep civil penalties (potentially tens of thousands of dollars per day), in addition to other forms of civil liability, federal criminal charges, as well as the negative publicity that is associated with a UAS incident and/or violation of law.

In addition, many states have proposed and/or passed legislation regarding the use of drones, especially if they carry cameras or other recording devices on board. Cities and counties have passed local ordinances governing drone use as well. Each higher-education institution must review the state and local requirements applicable to facilities where UAS operations are contemplated.

Conclusion

This is a constantly changing environment, and any policy should also account for anticipated future changes to the law and regulations, such as the expected departure from the Section 333 Exemption process in a year or two. Today, the requirements for commercial use of UASs are fairly stringent; however, once the small UAS regulations become final, several of the more stringent requirements should be lessened. Because we are in this interim period between Section 333 Exemption application and final UAS regulations, any institution's UAS use should account for potential regulatory changes. Careful planning and implementation can make drone use a soaring success on campus.

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Technology Supports Learning at the University of Illinois

CTIL provides a resource and support for all instructors

Cynthia Yewdall Thackeray

The University of Illinois at Urbana-Champaign is a public university with a focus on research. It was established as a land-grant institution in 1867. Originally a single location, the university has expanded, and the Urbana campus is now the flagship campus of the University of Illinois system. This system is ranked by *U.S. News and World Report* as the number 11 public university in the nation. There are over 44,000 students and over 425,000 alumni.

Illinois is most often recognized for its engineering and hard sciences programs; however, the most successful outcomes have come from the integration of these disciplines beyond a purely scientific application. These efforts have led to PLATO, the first computer-assisted instruction system; the National Center for Supercomputing Applications; a research park for collaboration with industry partners; and many others.

There are always individuals who are able to look at something—a piece of technology, for instance—and imagine it as something more. The world of education is no different. We could still conduct classes with an instructor lecturing at the front of a large room and students taking notes with number two pencils on paper. We *could* still conduct classes that way, but we would be missing out on numerous advances that allow us to provide more engaging, interactive classes. Done properly, these classes create learning environments that allow our students a more enriching experience.

The university is working not only to develop new educational technologies and methods, but also to make sure that these advances are cultivated and spread. To this end, we created a center of excellence, the Center for Innovation in Teaching and Learning (CITL). The CITL acts as a hub to encourage high-quality instruction that strives to advance what is possible in education through technology, but maintains a core focus on pedagogy and technology as a *supporter* of learning.

The University of Illinois has seen many important innovations in educational technology through the work of its faculty and staff. Not all instructors have this ability to look at a new piece of technology, or even a new field of technology, and figure out what it could offer their students and how to integrate it into their courses. CTIL provides a resource and support for all instructors to learn about new developments, see what others are doing, and offer general assistance on improving their courses.

History of Classroom Innovation at UIUC

Following World War II, enrollment at most colleges and universities in the United States grew significantly. All of a sudden, higher-education institutions were struggling to keep up with the growing demand, and traditional classroom education methods were insufficient. Following the 1957 launch of the Sputnik satellite by the Soviet Union, the U.S. government was looking for new ways to improve education in science and engineering. Computer instruction was discussed, and several interested parties—including higher-education institutions and computer manufacturers such as IBM—began conducting studies.

In 1952, the University of Illinois built the first computer owned entirely by a U.S. educational institution: the Illinois Automatic Computer, or ILLIAC I. While computer instruction wasn't one of the goals of ILLIAC originally, in 1960, the first computer-based education system was designed. PLATO, or Programmed Logic for Automatic Teaching Operations, ran on ILLIAC. At first, PLATO could support only one user at a time. PLATO II debuted in 1961 and supported up to two users at once! During the 1960s PLATO was refined and redesigned. By 1969, remote terminals could connect to the system (the first one was at a high school in Springfield, Illinois), and a new programming language for writing content allowed instructors with little to no background in computer science to create, share, and use instructional material. PLATO was heavily used until the last production system was shut down in 2006.

In 1997, the physics department began a major reform of its introductory class sequence. A key component in the redesign was the instructor posing conceptual questions to all of the students, and using the combined feedback to adjust the pace. A group of physics professors began working on a technology (now called I<Clicker) where each student has a wireless, handheld device he or she can use to answer these questions. The results, which are anonymous, are shown in the front of the class as a histogram. If most students get the answer right, the instructor can reinforce why the answer was correct, and continue to more advanced content. If the answers seem to indicate confusion among the students, they can break up into groups and discuss the material, or the instructor can provide a review. These devices have

spread to other departments, and other institutions as well, where many professors report a marked increase in student engagement and participation.

Distance Learning

While improving student engagement in the classroom has proven to be very effective, distance learning is another area that's seen significant advances recently. In 2012, the University of Illinois began a partnership with Coursera to offer free online courses to anyone with an Internet connection. Today, this partnership has expanded and includes an iMBA program. Half of the classes are Coursera specializations, and are supplemented with enhanced online courses from the College of Business at the University of Illinois. The end result is an MBA from one of the top programs, at a fraction of the cost. The involvement of the University of Illinois in these massive open online courses (MOOCs) is a continuation of the tradition begun with PLATO.

In addition to expanding access to university courses to students who would not otherwise be able to participate in an Illinois education, the university itself also benefits from offering these courses. Illinois is able to gather data as students participate in courses and study how students interact with the material. Thus we are able to improve various aspects, including course length and participation patterns.

Perhaps the most innovative of recent classroom technologies are those that have expanded our idea of what a classroom is. Many innovations being rolled out now are focused on making learning more inclusive and more engaging for students. Flipped classrooms with recorded lectures that students watch outside of scheduled instruction time allow instructors to use that for more hands-on collaborative instruction. More instructors are incorporating tablets and other wireless technology into lectures to engage students, even posing questions to students in class and having them tweet their answers.

When technology is integrated well into a classroom, it advances what is possible, but does not take center stage. Successful technology extends and supports instruction in and out of the classroom and can draw students in and engage them in ways they would not have imagined. The best classroom technology can even expand the established concept and confines of the classroom.

Where Does This Leave Us?

CITL works with departments and individuals throughout the campus to help with educational technology needs. That does not mean building a class around the newest, hottest gadget. Before technology comes into play the first step is to evaluate the desired outcome of a course and then determine what are appropriate means and methods to reach it. There is no one-size-fits-all solution—many factors come into play when deciding when and how to integrate technology into a course. Discipline, size, and whether it is a lecture, lab, or studio course make different approaches necessary.

As technology is increasingly integrated into more aspects of our lives, we see the same in education. This hasn't always been the case, and education is still an area that in many places is not a technology-rich environment. PLATO was revolutionary because no one thought to use computers in the classroom. Today the university has 100 percent wireless Internet access coverage in its classrooms—and no one would be happy if it were any other way.

As the University of Illinois continues to develop and integrate technology, it is not using it in isolation. For instance, many materials developed for MOOCs are used in on-campus or hybrid courses as well. The information learned from data collected in MOOCs is applied to courses regardless of format. Technology in isolation, as anything else, is not as valuable as when it is combined. Each advance in classroom technology—educational technology—is an achievement. Bringing these together propels these achievements even further.

The Illini Union on the UI Quad

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App Development as a Learning Tool

Students participate for a win-win learning opportunity

by Kyle Parker

When classes began this fall, colleges and universities welcomed students born in or around 1997. While these students were learning how to walk, Larry Page and Sergey Brin were developing Google in a California Bay Area garage. As the students approached second grade, Facebook began amassing its 1.5 billion users worldwide. When they were in fourth grade, the first tweet was sent, and a few years later, the first vintage-filtered square image was posted on Instagram. In between the launches of these social media platforms, the first iPhone hit the market, starting the mass adoption of today's smartphone. These are only a few of the technological wonders that were conceived as current college students were growing up and learning about the world around them. The term "digital natives" has been used to describe today's students, but even that was coined in 2001, when they were four years old.

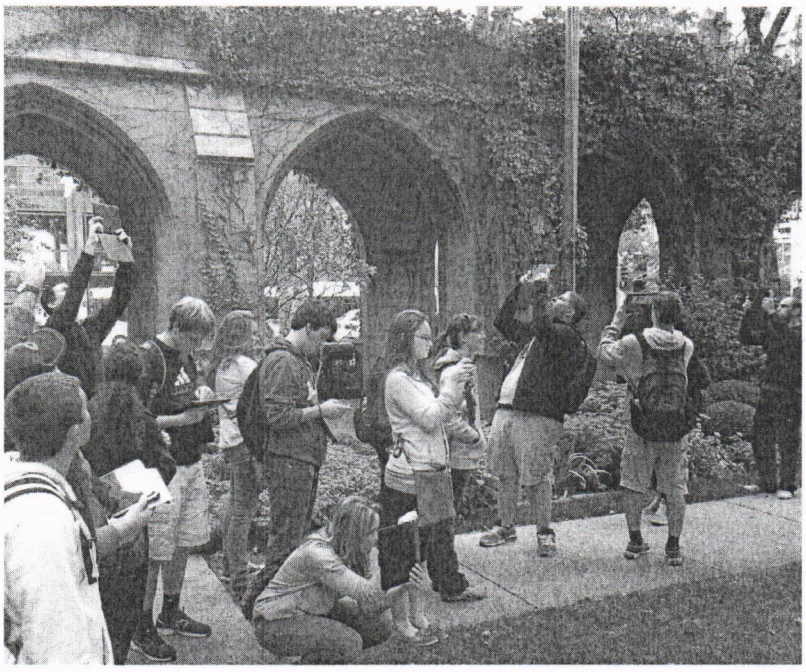
As the culture of technology expands, and the collaboration and social interconnectedness of all things continues to evolve, the tendency of educational technologists is to take a new device or service, spring-load it with content, and then push it out into the classroom for use. To start and complete a project quickly, with little inclusion from faculty or students, is normal and driven by time limitations of a semester, a summer break, or the standard school year.

Within the Office of Information Technology (IT) at Ball State University, there is a small group of designers and developers responsible for collaborating with faculty and students to imagine, create, and develop apps, deploying and integrating emerging technologies and assisting with providing students with new learning opportunities both inside and outside of the classroom. Through these efforts, we develop prototype and proof-of-concept projects, apps, and services for our faculty and students. This pursuit follows the goal of IT to "serve as the catalyst to the campus community using technology in creative, innovative and immersive directions to advance and support the mission and goals of the university."

Throughout the development of three tablet or smartphone apps—the David Owsley Museum of Art (DOMA) App, The Traveler, and Campus Hub—we have embraced the input of students as part of the development process. By stepping back from our typical development path to slow the process and become more inclusive, we have merged our IT goals with the educational goals of existing courses and organizations on campus. As a result, the functionality of each app is improved and students become immersed in not only the content being taught within their class, but through their research in related subjects from other disciplines. Learning the subject matter is no longer merely a prescriptive task for students to check off a list; it becomes intentional, involved, and owned by the student.

Learning becomes an investigative process. Students uncover more details about the subject matter by choosing their own paths of discovery based both on their established intellectual pursuits and new-found interests that have surfaced as a result of their research. This shift empowers students to take ownership of the app's content, the project, and its use by others. While innovation in technology is a core component of the IT office's mission, the implementation of new technology is not done simply for its own sake. Rather, we have collaborated with faculty and students who also see a tangible educational benefit to engaging in the creative and development process together.

Figure 1. Art students use apps to enhance their experience



The following three mobile apps are real-world examples of these guiding principles.

David Owsley Museum of Art

Ball State University has a first-class art museum. A large art and art history program annually visits the museum's galleries. Their experiences on these visits have tended toward the typical silent sketching trips and hushed tours led by docents and professors. Using a course on museum studies filled with 13 advanced undergraduates as the content curators and the museum as a laboratory, we developed a new app through which students and museum visitors of all ages could engage with the collection in interactive ways. Students created virtual tours centered on themes such as politics, religion, imagination, and feminism, which lead visitors through the museum's geographically and temporally organized collection, creating cross-cultural comparisons that fit with the learning goals of art history as a discipline and university education in the 21st century. The tours include additional media content—photographs, drawings, and videos—and longer texts that expand upon the brief information offered in traditional museum labels, reaching into such interdisciplinary areas as geology, gender studies, and military history to connect with visitors on a variety of levels.

Developing this content required students to use the skills of research and writing that they had learned in class and also to think deeply about the app-users' curiosities and interests. The app capitalizes on location beacons that can help the user find him- or herself in the museum and suggest nearby works. It also allows us to feature works that are in the museum's collection, but not currently (or often) installed in the galleries. This broadens the museum's reach and keeps return visitors interested in learning more about the vast collection.

Throughout the creation of this app, students played a key role in defining the user experience, suggesting alternate display and layout designs, and testing the app within the museum environment. As a result, the interface became more efficient by eliminating duplication and streamlining access to information. Their feedback helped us reduce the number of finger taps it takes to get from one portal of information to the next; helped to ensure that media content, such as photographs, appear large on the screen; and taught us a lot about what today's college students expect from this type of resource.

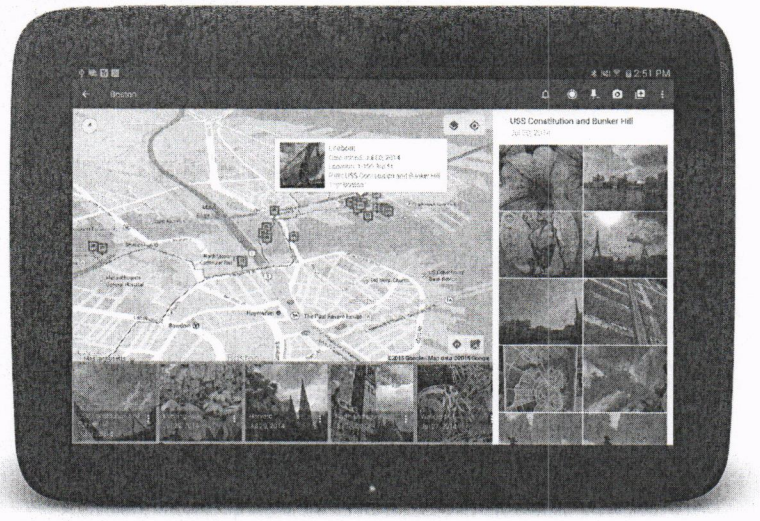


Figure 2. The Traveler captures experiences for students

Students' reflections confirmed our expectations for the educational merits of this type of project. Regan Kelly explained, "Working on the app gave us the opportunity to work closely with people who had different skill sets and backgrounds within the School of Art, which made the content for the application engaging and varying. When someone uses the app in the future, she or he will be able to sense these differing opinions and points of view of each of the writers. I am delighted by what we all created, and I would love to see the finished product in use by visitors of the David Owsley Museum of Art."

Katie Norman echoed her sentiments, writing "Contributing to a project blending technology and education, a topic that is current with the museums around the world, is invaluable. This app provides students and staff 24/7 accessibility to the museum and will promote education about the arts."

The next phase of interactivity in this app will ask a new group of students to develop puzzles or games, including scavenger hunts and trivia questions, which create opportunities for educational play and inject whimsy into this otherwise predictable and solemn cultural space.

The Traveler

Created for students and faculty participating in field studies and study-abroad programs, The Traveler is a comprehensive digital journal capturing their experiences in the field and abroad. (See Figure 2.) Using a tablet or smartphone, students have the ability to record and visualize the path traveled and pin and geolocate captured photos, audio notes, short video clips, documents, and stylus-drawn sketches. Using The Traveler, students can collaborate with their classmates and instructors and share the experience in near real-time with family and friends at home. When students return to the classroom, the recordings and media provide a wealth of information and opportunities for reflection, rekindling the memories and learning directives inherent in the coursework.

Launched in 2012, The Traveler's first in-field test was a four-day trip with a group of 17 freshmen from the College of Architecture and Planning (CAP) as they toured Chicago. With a focus on design and studio-based curriculum, the app was a useful tool to document and record examples of the built environment, along with trends and issues in architecture, landscape architecture, and urban planning.

Since that first trip to the Windy City, the project branched out from CAP to include a myriad of disciplines, including fashion and culinary arts from family and consumer sciences (Italy, Greece, and Ecuador); journalism (Hungary and the 2014 Olympics in Russia); geology (Australia, New Zealand, and Antarctica); humanities and foreign languages (Italy and Germany); and a creative inquiry focused on the Civil Rights Movement (Midwest and East Coast). The most extensive trip followed 20 CAP students on an 80-day trip around the world, and a repeat tour will begin in January 2016.

From the app's inception, students and faculty have had a direct impact in shaping the features, functionality, and design. From identifying critical bugs in the sketching feature to adding time-saving quick actions and audio notes, The Traveler is an accurate reflection of a user-built app.

As illustrated in the DOMA app, encouraging and fostering this collaborative and shared approach has resulted in a much more refined and polished app that serves to benefit others that follow in their footsteps. It also provides a sense of ownership and continued use because the students are able to point to key features and know they were responsible for their implementation.

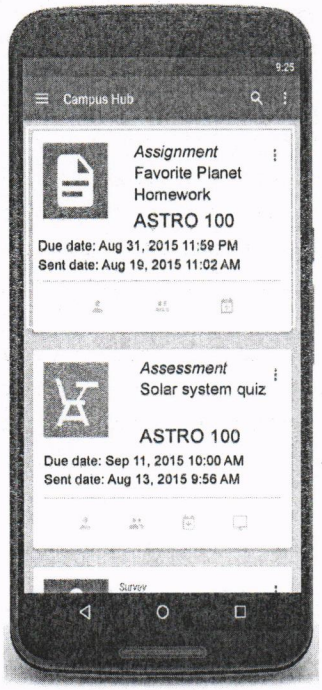


Figure 3. Update on Campus Hub

Campus Hub

The most recent app developed by IT focuses on delivering timely and relevant interactions to students through a mashup of location, campus tools (learning management system and enterprise data), and daily activities (schedule and tasks). Glancing at their mobile device or smartwatch, students have immediate access to assignments and quizzes, grades and announcements, schedules and academic life, and much more, all connected through time and place. Here's just one example of an interaction: a student needs to take a Blackboard quiz in one of our testing labs. As the student walks by the lab, the app checks for seat availability and whether the student's schedule is free, and then sends a nudge to encourage him or her to stop by.

In the early stages of the app development process, we engaged a group of students known as the Digital Corps. Comprising undergraduate and graduate students with aspirations to work in creative and innovative fields, the Corps provided feedback and ideas through several brainstorming and prototyping sessions. Their daily pain points and issues with academic and campus resources spurred the inspiration and became the catalyst for shaping the features included in the first release of Campus Hub. As the project continues to evolve, additional student cohorts will serve as content and design consultants to provide use scenarios, feedback, and continued direction for the developers.

Wrapping Up

Inclusion, interactivity, and ownership feed our fundamental needs to create, to be part of a group, and to leave our mark on something. Exposing students to the development process not only exposes them to new fields of inquiry; it allows them to engage in the production process, to witness the evolution of their work becoming a real product, and experience entrepreneurial spirit. When developers and designers work with students and faculty, the dynamics of the project do change for the better. The data become meaningful content, the context in which the content is used becomes intentional, and new perspectives are learned from how students use and experience the app.

Kyle Parker is senior software engineer for developing technologies at Ball State University.

Denise Jones is director of enterprise user relations and Lara Kuykendall is assistant professor of art history at Ball State University.

Death by Popcorn

Case study: How two colleges manage BYOD

by Curt Harler

Dealing with the bring-your-own-device trend is like being stoned to death with popcorn. Each student's BYOD presents just a tiny instance of required connectivity and authentication. Taken together, however, the overall effect is suffocating. No matter how tech-savvy a college's IT department may be, they don't know everything about all platforms from PC desktops to tablets to iPads and Chromebooks. How does an IT department, especially one at a community college or smaller college, get ahead of trends like these?

"BYOD is part of our customer service model. But we call it BYOE—bring your own everything," quips Christopher Waters, assistant vice president for technology and chief information officer at Elon University, Elon, North Carolina. "The challenge is that the number of devices on our network was growing exponentially each year. It behooves us to be ready for that."

Faculty members frequently are not as early adopters as incoming students, who typically feel that "everyone" is connected to the latest and greatest platforms and hardware. Assuming faculty will allow BYOD in the classroom is tricky. "If the faculty chooses to allow BYOD, we have to provide the resources so it works so students can connect with the software required for their course," Waters says.

"Students are bringing iPhones, iPads, laptops, Androids," says Vicki Sells, EdD, associate provost for library and information technology services at Sewanee: The University of the South, Sewanee, Tennessee. While there are many devices, Sells says iOS devices are, far and away, the majority.

A few years ago, Sewanee completely re-did their wireless network. "We are all 802.11n or .11ac (5G Wi-Fi) right now," Sells says. "As part of that we also put in SSID (service set identifier) for the Sewanee secure network." That secure network has both more bandwidth and stricter security than the guest network—which is a bit more open but has much lower bandwidth. The SSID requires all wireless devices on a WLAN to employ the same SSID in order to communicate with one another. Students use their Sewanee sign-in, connected to other school accounts, to access the network with whatever device they have.

Students and faculty would not use the guest network since the guest version has much lower bandwidth. Sewanee does capture who logs into the guest network—whether visitors, regents, or trustees. However, it is the regular users who command the most attention. "The right solutions will let these kids bring their computers, access the network, and make it seamless for them," says Pam Takahama, VMware's director of vertical solutions. She oversees the education market for the Horizon Air and Air Watch lines. And, while IT's concerns are important, she notes that customer service—with student as customer—is vital.

"Computing is a differentiator, not just for the on-site students but how you reach beyond that and serve less-privileged students and remote areas," Takahama says. For colleges, BYOD support is paramount. "There is no other market where it makes more sense to support BYOD," she says.

Unlike corporate environments—where it is possible to "lock down" the components allowed in the office—the education market accommodates faculty, staff, and students by welcoming all sorts of computing devices. Elon has established virtual networks in both the mathematics and the computer science departments. IT seeded the idea with faculty that students would be somewhat ahead of the curve with computing and that they would likely want to bring devices to the classroom other than the ones provided for them by the school.

There are many ways to meet BYOD demands. "We are seeing a strong interest in cloud computing solutions," Takahama says. She points to one college where they recently contracted for a 60,000-seat document solution as a result of strong interest in going to the cloud. "The primary reason they did that is to support their BYOD initiative and to build out their online university market and re-differentiate themselves in the market." The college's move, she says, was both visionary and strategic.

Help Desk

While Apple and Android are the primary platforms at Elon, they offer walk-up help desk for any platform with tech staff at the library. The staff is quite knowledgeable about a range of devices. However, their default service offering is to help students as much as possible and then to show them how to access the self-help section of the college's wiki.

"We are not necessarily diving to the individual-device level with every student," Waters says. "We have a highly skilled and trained group of student

technology staff who work for us (IT). If somebody has questions, they will help as much as possible."

Takahama says virtualization is one good way to provide required service. "But virtualization is not the only way," she says. "It is not just the IT. Virtualization offers one layer. But the question is how you actually manage each of those devices."

Virtualization helps a university provide one-to-one service. "While you might not be able to provide a piece of hardware to each student, you certainly can provide access to a desktop through virtualization," Takahama says. One of the schools she works with has been able to provide virtual lab sessions remotely, helping to alleviate a space crunch in its laboratories. Engineering programs appreciate the ability of virtualization to handle the huge, data-consuming applications students want to use as they do design work.

At Sewanee, the help desk is a central hub that serves students, faculty, and staff. Sells finds students still need some assistance with laptops and computing. But other devices are more worry free. "There are not huge numbers of students bringing in iPhones or iPads," she finds. Rather, when problems arise, the students tend to deal directly with Apple.

A change in cell phone policy at Sewanee also lightened the load at the help desk (see sidebar on page 21).

Takahama notes that virtualization will make the data more secure. It also will make IT easier since management of devices is centralized and eases the management of devices outside the virtualization layer. That is why VMware chose to focus on government, healthcare, and education as its core markets.

Seeking Security

"Security is much more an issue for everyone," Sells states. She points to several instances where colleges have lost their entire networks for hours or even a full day. When that happens, students, staff, and faculty really start to stone the IT department—and not with popcorn.

Sewanee's network sits behind a firewall. They use Proofpoint for email security. The service keeps malware, spam, and targeted attacks such as phishing out of users' mailboxes and social media accounts. Proofpoint protects users no matter where they access their accounts—within or outside campus—and whether they use a BYOD desktop, laptop, or mobile device.

Sewanee's association with Net TN helps. Net TN serves the state's governmental entities, from the local level through all three branches of state government, as well as the state's educational institutions, from kindergarten through postgraduate. Net TN provides Sewanee an additional layer of security for spam filtering and denial-of-service attacks.

"We are constantly monitoring for those things," Sells says.

"Security certainly is a challenge," agrees Waters. Originally, Elon had a restrictive model on network access that allowed only authenticated devices to get on the network.

Wireless printers changed Elon's security model. A consumer is hard pressed today to find any printer but a wireless one. Students bring their printer to college and have no intention to hook it up with wires. "Those printers really throw problems," Waters says. "They are their own wireless device."

For example, students were able to "see" and access a neighboring unsecured printer that was within wireless signal range. "That's a good example of where the consumer market got out ahead of sophisticated university networks," Waters feels. IT departments faced a conundrum: Either ban such devices from the network or force them to be wired up. Neither was palatable or a good long-term solution. IT simply could not tell a student with a new printer that their device would not work on campus. And printers are not the only devices that pushed colleges to reexamine their technology base. Waters notes that the same situation existed a few years ago when students brought HDTVs onto campus and found the residence halls only provided standard cable.

"As the proliferation of other devices came along, we created another individual wireless network specifically for our gadgets," Waters says. "When students bring something outside the initial level of laptops and phones, they can put them on the second network by registering them." Elon purchased a commercial package from ISE, Coralville, Iowa, that helped them resolve the issue.

While security on the second network is somewhat less rigorous than on the primary, the IT department knows it is still their traffic and their network. The unsecured traffic is separated. "It allows us to provide some level of security because we now know who they are," Waters says.

"A lot of the same security rules still apply. It does not allow unsecured devices to travel on the same network path as secured devices," he explains. "It separates that traffic and reduces the rogue device occurrence. Now we at least know who it belongs to and what type of device it is because you have to register it to get it on."

It also provides a handy source of metrics to keep abreast of what new BYOD gizmo people are using on the school's network. Takahama says that strict security, such as that seen in compliance-driven markets like healthcare, is not as important to colleges as providing access to a diverse client base. "How do you give them access to the right level of information and make it a dynamic experience for them?" she asks.

Take, for example, a student enrolled in multiple community colleges or at a community college as well as at a university. "How do you make that student's experience seamless for both schools?"

she asks. The answer, Takahama says, is in a product from VMware that is not too far down the road.

"You will have one dynamic session that renders the right level of information on curriculum and class information to the student despite the number of community colleges where they are enrolled," she explains.

Waters says Elon might have been a bit late to the party since other schools either had internal mandates or were working under federal guidelines. "We were able to sell the concept as a part of the whole security platform for us," he says. "Allowing students to bring the devices they wanted to bring was part of our customer service model. With that tool, we were providing a more secure environment for everyone's devices."

Today, Elon's IT department makes every effort to stay ahead of the coming campus BYOD technology wave. "You have to collect good data from your students," Waters says. To that end, they conduct a considerable number of regular student surveys to help IT understand students' needs and expectations. They have a regular meeting with a student focus group advisory service. "It's just to get a pulse," he says. "There is no question what the students are bringing. But we want to make sure, before we make a technological innovation, that we are meeting the needs of our residential population."

Budgeting Background

Like other schools, Sewanee does an annual budget. However, they also build a three-to-five-year projection to define and prioritize what they need.

"Network infrastructure is always going to be at the top of the list," Sells says. A few years ago, as part of their association with Net TN, they upgraded their 750 Meg to 1 Gig connectivity. That was partly in reaction to student and faculty demands for more bandwidth as more devices came to campus. IT got a one-time budget infusion to fulfil that project.

"We know we will have to go to 10 Gig network at some point. That means we'll have to replace all of our 1 Gig switches," Sells says.

There is a balancing act between the demands of the BYOD community and the network's capabilities. The 1 Gig will be good for a few more years, Sells expects. But the upgrade looms.

Providing bandwidth is important as a student service, as an attraction to enrollment, and as a way to do business. "You have to get a plan. It is not a hard sell. Everyone understands how important it is," Sells says.

Communicating with the administration is important. However, Sells emphasizes the need for continued communication with students, faculty, and staff as changes happen. She also sees a possible silver lining to the BYOD trend.

"I think we did a good job with our wireless rollout," Sells says, referring to the upgrade that won an ACUTA award a couple of years ago.

At the time, Sewanee calculated that they would need enough bandwidth to handle four devices per student on the network. "Given the way things are going, maybe we should have said even more," she muses. "What you have access to is the most important thing. The network is critical. Quickly the network became how we do business." For that reason, communicating with the university community — before, during, and after a rollout—is vital to success. "Being deliberate about communications is important," she emphasizes.

Down the road, Sells says the trend might flatten or even reverse. "I do see a bit of convergence back to one device," she says. She personally purchased an iPhone 6S+. Not only does it give her 12 MB photos and 4K video but it has a bigger screen making it easier to type and read and respond to e-mail. That takes her closer to having one device for both computing and communications.

"As devices come together, that will not lessen the amount of bandwidth you need but it is a coming trend," she says.

And that would be like having your popcorn nicely buttered, one piece at a time.

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Offloading BYOD Help

A couple of years ago, Sewanee: The University of the South changed its cell phone policy. The result, says Vicki Sells, is less help desk traffic.

For years, the university paid for cell phones used by faculty and staff as part of their jobs. "Recently, we've gone to a different model where, if you need to have a cell phone for your job, there is a stipend," she says. "We are out of the business of owning those devices."

Keeping in mind that most cell phones are used both for conversation and for computing, the move to personal devices helped move the help desk function back to one's personal level rather than being a school-owned tool and thus a school-owned problem.

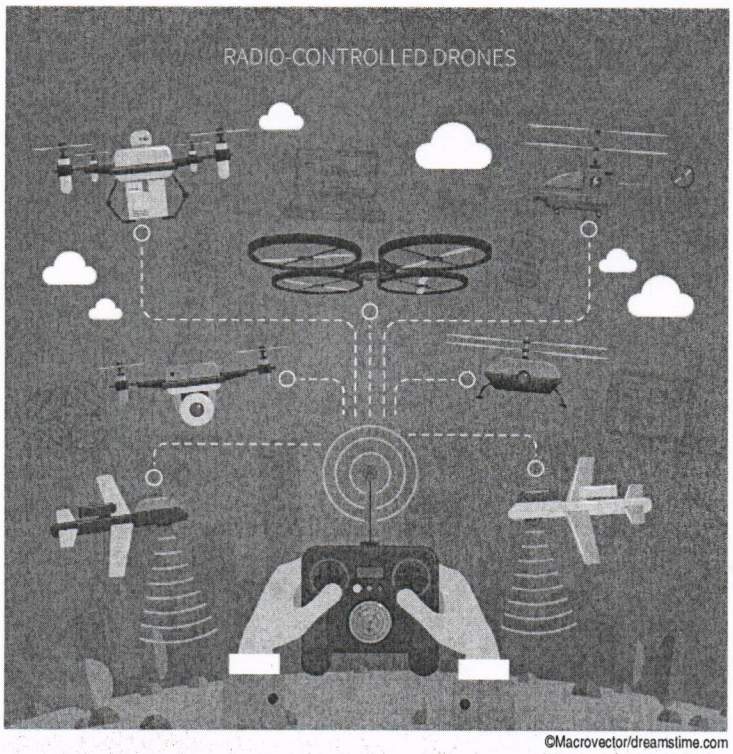
While it affected her, Sells adds, "I think it is the right thing to do. I very much consider my cell phone my personal device."

It's a Bird...It's a Plane...It's a Drone

A primer on the issues and challenges in the new era of unmanned aircraft

y Martha Buyer

When leaves are off the trees and flurries chill the air here in the Northeast, Buffalo hosts the oldest Turkey Trot in the country, a five-mile race on Thanksgiving morning down Buffalo's main drag. For the last two years, as I've prepared to start in my annual sprint downtown, I've noticed a drone hovering over the start. "That's cool," I thought as I battled my way to the finish.



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Since Thanksgiving, I've seen bits and pieces of news and notices about drone use from a variety of sources for a variety of reasons. While I'm hardly an expert in this field (for someone who is, look up Joe Hanna at Goldberg Segalla, jhanna@goldbergsegalla.com), it seems timely and certainly relevant to provide a high-level overview of the topic as these devices—and the technology they rely upon—become increasingly present for recreational, public safety, and commercial use. Particularly because enterprises from the neighborhood realtor to large corporate and governmental entities are using drones to gather information in what's perceived to be a cost-effective and efficient way, it's critical that those who are deploying drones have at least a primer on what the law requires. It's not simply a question of buying a drone from Amazon and promptly putting it to work.

Definitions and Regulations

The Federal Aviation Administration is the primary regulator of drones, whose more formal name could be an unmanned aircraft system (UAS), unmanned aerial vehicle (UAV), or just UA. For purposes of clarification, this piece has nothing to do with the devices that are used for military activities. Definitions are important. Under 49 U.S.C. 40102(a)(6), an "aircraft" is defined as "any contrivance invented, used, or designed to navigate or fly in the air," and an "unmanned aircraft" is defined as an "aircraft that is operated without the possibility of direct human intervention from within or on the aircraft" (P.L. 112-95, Section 331(8)). Finally, one more bit of boilerplate from14 C.F.R. Section 91.13(a): "No person may operate an aircraft in a careless or reckless manner so as to endanger the life or property of another."

The FAA has identified three primary classifications for UASs, or drones: model, public, and civil. The FAA does not regulate aircraft in the "model" category so long as (1) each device is flown for hobby or recreational purposes (this is important!); (2) each device is operated in accordance with community-based safety guidelines; (3) each weighs no more than 55 pounds; (4) each yields to manned aircraft; and (5) notice is provided, in advance of launch, to local air traffic control officials. The important distinction in item 1 is that if a device is flown for any commercial purpose, the FAA has—and takes—authority to regulate such operations. That's *any* commercial purpose.

There are two other important items to consider when using a drone for non-commercial purposes. First, the operator must maintain visual line of sight with the device from a fixed location (the back of a car is unacceptable, and, not kidding, there has not yet been a ruling about whether an operator sitting on a

horse is acceptable for maintaining line of sight from the FAA's perspective, but the question has been raised). Second, federal law requires that a model device cannot go more than 400 feet above the ground. The height restriction is simply based on the FAA's rulings. Municipalities may enforce lower flight limits. For more information on rules for flying model aircraft, see https://www.modelaircraft.org/files/105.pdf.

The non-aeronautical issues that the presence of drones create may be more cocktail party–worthy, but certainly no less—if not more—important than the aeronautical ones. Included in these issues are privacy rights, data collection, property rights, law enforcement uses, and public safety.

Privacy and Data Collection

As Edward Snowden (remember him?) made painfully clear to most Americans, the federal government has been keeping tabs on many citizens, much to the dismay of civil libertarians and others who are concerned that our privacy as individuals has been severely—and potentially permanently—compromised. The presence of drones in our daily lives (not to mention our backyards) certainly creates legal and personal challenges. As a side note, while your neighbor's drone may violate your airspace and be generally annoying, it is a federal crime to shoot down a drone. Remember, it is an aircraft, and for all sorts of good reasons, shooting down any aircraft is a bad move any way you look at it.

Drones and Interference

While the issues of property rights and nuisance caused by low-flying drones are complex and important, in the interest of space, those will be left to the experts. I'm not ignoring them. However, what is critical is at least a mention of the issues of both law enforcement drone usage and the potential for interference with law enforcement operations by well-meaning (let's hope) but ill-informed drone operators.

Recently, there have been several publicized incidents where drones have either interfered with or almost interfered with helicopters that were transporting critically ill or injured patients for immediate medical care. Within the past few weeks, a drone in California recently got in the way of a firefighting helicopter. Disaster was averted, but not by much. Because in both cases (and many others, no doubt) the drones were operating beyond the allowable altitude, and because they may or may not have been operated by someone complying with existing rules, let alone good judgment, public safety was threatened.

The issue is drone operators, regardless of how enamored with the technology they are and what beneficial information can be retrieved using one to capture information, must know how the devices should—and should not—be used. During this year's U.S. Open tennis tournament, one crashed in what had been a crowded stadium. No one was hurt, but it's not hard to imagine how the outcome could have been much worse. It also seems clear that the operator had let the drone fly out of his or her line of sight, creating potential legal challenges if its owner was even identifiable.

Final Thoughts

Recreational users who have no interest in financial gain or commercial advantage are obligated to meet a lower standard to comply with existing rules and good practice than do those who are using the devices for anything that could even remotely be argued is for commercial gain. But if your school is even considering using them, even for all sorts of good reasons, it's important to know and understand how the specific rules apply to the circumstances. Drones offer access to an incredible array of information. But like any other new and exciting technol-

Beating the Cell Capacity Crunch

Coverage enhancement systems enable universities to shift cellular capacity to where it is needed

att Thompson

An increased desire for cellular connectivity brought about by widespread 4G LTE has forced campus managers to look to coverage-improvement systems to ensure staff and students have access to high-bandwidth services without the need to spend huge amounts of money on equipment and avoiding increased energy expenditure. Wireless data usage on college campuses is booming, with students and staff alike looking to use high-bandwidth services throughout the day. In addition to the regular use of smartphones, tablets, and laptops for accessing online content, the advent of a rich range of cloud-based teaching aids and the desire to be "desk phone free" has meant there is a real educational need for the adoption of sturdy cellular and Wi-Fi connectivity.

Although Wi-Fi can provide much of this supporting data capability, it is limited in its scope due to its severe limitations outside of the buildings where the access points are located, and the difficulty of provisioning reliable voice services through the technology. This is why many campus managers make the decision to opt for a cellular-based enhanced-coverage service or one that combines the power and efficiency of LTE alongside the indoor data power of Wi-Fi.

While Wi-Fi struggles outdoors, cellular struggles indoors as many older buildings that are made of stone and marble are prone to blocking signals from cell towers. Modern construction materials fare just as badly, with reflective external surfaces such as glass and plastics deflecting signal away from newer buildings. These coverage inhibitors prevent reliable four-bar coverage and significantly hamper the availability of high-grade services, including access to video services, indoors. In some cases, where there are other environmental factors also in play, the signal may not even be strong enough to make a voice call. Today's smartphone users consider cellular to be a utility in the same way as electricity and water. Failing to provide adequate coverage around the campus can lead to complaints from both staff and students, affecting the reputation of the institution—especially if part of its offering is in the technology sector or reliant on mobile communications for teaching.

This is why many campus managers have turned to distributed antenna systems (DASs). DASs have an excellent history of providing universities and colleges with the strong cellular coverage needed to ensure campuses are provisioned with sufficient voice and data coverage to keep students and staff connected, particularly in challenging or remote environments. However, with the changing nature of mobile broadband comes a new challenge of not just providing a cell signal to users, but giving them access to one that is strong enough to enable high-quality mobile Internet sessions when they are needed.

Even when a strong signal is available, if many users are all trying to access high-bandwidth services simultaneously, in facilities such as the library or sports arena during a big football game, what little coverage capacity is available is likely to be consumed very quickly, causing the service to fail completely.

Shifting with the Times

The traditional DAS, though, has its problems. Unlike modern systems, in order to ensure reliable coverage across a large site, campus managers must plan for the worst-case scenario by hardwiring coverage into each building and facility within the complex. In addition to the high capital expenditure of the equipment, these technical limitations have led to facilities being provisioned with high-grade cellular coverage even when the site isn't being used. This operations expediture (OPEX) is then increased when the venue has very high capacity demands at sporadic intervals, as managers have to account for the worst-case scenario at all times.

Facilities managers who have already installed DASs and are looking to reduce these costs, or those with sites that have been expanded outside the range of the current systems, are now considering new solutions that enable them to reduce OPEX while continuing to support the complete range of communications and cloud business services.

The development of the intelligent fiber DAS adds another layer to the abilities of DAS technology, increasing the level of control for managers and enabling cellular coverage only when required, saving money and improving their ability to service network users.

By using these solutions, campus and IT managers are able to divert unused cellular capacity to other facilities in the

area for the first time. This can be either done on an ad hoc basis or by using preprogrammed capacity switching, based on perceived requirements around known events or seasonality.

For campuses with extensive and busy recreation and sports facilities in addition to student accommodation and education facilities, this enables the dynamic movement of cellular coverage to serve each location in accordance with the demand for voice, SMS, and data services.

For example, during classtime, the majority of the provision can be used in the educational facilities with only a small amount of coverage channeled to the residential and sports areas, as those areas will be largely empty. When the sports facilities are due to be used, cell signals can be dynamically moved to provide spectators and coaches with four-bar coverage during game time and training sessions.

In the evening, when most educational facilities are closed, this coverage can be moved to the student accommodations, providing high-bandwidth 3G or LTE coverage for the residential facilities. By shifting coverage around, there are significant cost savings to be made while providing the maximum level of service to staff and students as and when it is needed.

For campus sites in inner-city areas, a capacity-shifting DAS opens up the possibility of sharing the cost and ongoing price of deployment with nearby venues such as local shopping centers, sports hubs, or office spaces that have complementary coverage needs. This is a business model we have already seen implemented in a number of high-profile developments around the world.

Staff Benefits

Outside of OPEX savings and connectivity benefits for students, there are many business advantages for institutions, with technologically advanced commercial applications now requiring access to mobile data services to operate effectively and efficiently. This encompasses the enterprise cloud and hybrid cloud and their associated rich range of applications used for administration purposes across organizations. Business-critical information needs to be accessible at any given time, so there's a real need for low-latency, highly resilient coverage, both inside and around the university site.

With such a dynamic and varied workplace, employees are rarely tied to a desk and require all the efficiency of a desk phone and a desktop computer terminal with them wherever they are. With the development of cloud file access and other virtual tools, this information is fully accessible wherever a strong signal is available.

When provisioning for campus connectivity, cellular coverage systems need to be considered as early as possible in the development process to ensure maximum efficiency. Although retro-fitted solutions are available for older buildings, when coverage systems are installed at the point of construction, these can be placed in optimum locations and incorporated into other technological facilities, including Wi-Fi infrastructure.

DAS technology has continued to grow in sophistication and is now a vital part of network planning, supporting every major wireless technology, including GSM, WCDMA, and LTE. It is now also capable of providing IP backhaul infrastructure serving, for example, small cells and devices such as surveillance cameras. It can be used alongside small cells and Wi-Fi to provide a complete coverage footprint both indoors and outdoors.

Modern systems also enable different capacity requirements to be served in specific areas—for example, where 2G and 3G need to be provisioned into the whole site and LTE is needed in priority areas only, operators can configure the system to ensure coverage is available throughout the building while premium resources are delivered to selected customers or areas (hotspots) as required.

This technique can also be utilized in multioperator systems, as capacity resources can be dynamically allocated to areas where each operator requires it to best serve its customers. This is especially important in deployments where the system has been commissioned by either a conglomerate of operators or by the building owner/managers to serve the needs of multiple parties.

Safety First

The need for coverage goes further than consumer and commercial applications with the benefits of using 4G in the public-safety communications sector being intensely discussed at a federal level. Here, availability of high-speed mobile data enables a range of rich applications that can enhance the abilities and reaction speed of emergency services. The use of LTE for public-safety communications is already beginning, with FirstNet deployments under trial in some regions in the United States.

An additional benefit of more intelligent digital DASs—such as Cobham Wireless's idDAS—is the ability to incorporate location-finding devices into the system to use the routing capabilities of the DAS to scan the building in order to identify an E911 caller. This capability is inherent in the architecture of the modern DAS and can be operated with the additional cooperation of geolocation partners.

Many alternative E911 solutions on the market are expensive, stand-alone pieces of equipment requiring multiple installations in each zone of the building or campus. By installing this equipment as part of the DAS, this cost is drastically reduced.

Looking to the Future

When making these significant investments in cellular infrastructure, it is important to go beyond simply enabling 3G and 4G mobile Internet services. Installed infrastructure must continue to support legacy services but also be completely future-proofed in order to deal with the technological requirements and rapid

increase in data usage expected as cellular operators begin to introduce advances including LTE-A and 5G. With further advances in wireless technology, a greater number of objects will be developed featuring technology that connects them to the Internet and other connected items.

The success of incoming technology is completely reliant on strong and reliable coverage both indoors and outdoors. By selecting a coverage enhancement solution that can fully support future technologies, colleges and universities can ensure they remain at the center of innovation and are among the first adopters. With increased reliance on mobile technology, provision of cellular coverage is no longer an optional extra in commercial or leisure premises. With many facilities already offering and marketing these abilities, those who don't offer enhancements will be left behind.

Matt Thompson is vice president Americas at Cobham Wireless, a newcomer to our family of corporate affiliates. Reach Matt at matthew.thompson@cobham.com.

Snapshot

Flipping Classrooms to Change College STEM Teaching

The University of California (UC) Davis is one of a handful of American universities pioneering efforts to "flip" large classrooms from traditional chalk-and-talk lectures to interactive, discussion- and problem-based learning. The new approach aims to engage students and go beyond memorization and regurgitation of information to interpretation and application, says assistant vice provost Marco Molinaro, who heads the UC Davis Center for Educational Effectiveness - CEE Hub (the merger of iAMSTEM Hub and Center for Excellence in Teaching and Learning - CETL).

Molinaro's team, in close collaboration with faculty and educational staff, focuses on large STEM classes (science, technology, engineering, and mathematics) and beyond (psychology and economics). They are working, for example, with teachers leading Introductory Biology 2A, the first class UC Davis undergraduates take in biological sciences. Other projects include classes in introductory chemistry, math, engineering, and psychology.

"We've been able to raise expectations of student performance and dramatically increase the level of interpretation in tests, all while maintaining grades," Molinaro said.

The goals of the CEE are to better prepare students to succeed in the workplace or graduate school, and to address the "achievement gap" for minority students, Molinaro said.

"With these new approaches, students learn more and can do more. Students with different learning styles are helped to succeed," he said.

Making such major changes to teaching programs is not necessarily quick or easy, but Molinaro said he's very optimistic they can change how teaching is delivered at UC Davis. Collecting data on how students are performing and the faculty pedagogical approach is crucial. "My job is to make our teaching more effective through best practices and promotion of a culture of data," he said.

The iAMSTEM Hub was established at UC Davis in 2012 to promote evidence-based improvements in teaching in STEM fields, with a special goal of improving retention of students from underrepresented minorities. In 2013, UC Davis was one of eight universities selected by the American Association of Universities to receive grants in an effort to improve STEM education, underwritten by The Leona M. and Harry B. Helmsley Charitable Trust. In July 2015 the iAMSTEM and CETL merged to create the Center for Educational Effectiveness.

For additional information, contact Marco Molinaro, Center for Educational Effectiveness, mmolinaro@ucdavis.edu.

Flipping the Classroom

New teaching approach has implications for academics and networks

by Paul Korzeniowski

Universities are constantly trying to enhance the learning experience, and flipped classrooms are the latest iteration on that theme. "In the past few years, interest in flipped classrooms has really popped," noted Jamie Jensen, a professor of biology and discipline-based educational researcher at Brigham Young University. "Flipping" presents information to students in an atypical manner. They watch materials, such as lectures, before coming to class and then conduct various exercises while in class, with guidance from the professor and participation by other students. The technique is catching on because some educators think it breaks down traditional barriers to learning and is more effective than traditional pedagogy.

As the flipped classroom gains traction, implications from the change are rippling throughout the campus. Faculty must learn new ways of interacting with students, and pupils need to prepare for school differently. The model is in an early stage of development, so best practices are still being fine-tuned. The flipped classroom's ultimate role is unclear because not everyone is convinced that it automatically improves learning (see sidebar on page 29).

Regardless of the flipped classroom's ultimate success or failure, the movement is affecting communications managers right now. This new learning style is video intensive, so schools must make sure that they have sufficient network, storage, and server processing power to support the new teaching model.

Flipped Means What Exactly?

Like many concepts, flipped classrooms lack a precise definition, and several different implementations have arisen. Its most obvious difference is that students spend less time in the classroom listening to lectures. Instead, before arriving in class, pupils are expected to consume course content via instructional videos, recorded lectures, and other remotely accessed instructional items. In class, students spend their time learning interactively: taking tests, experimenting, dabbling in the laboratory, and discussing concepts in groups large and small.

This change occurs with the help of several technologies, with video playing a cornerstone role. Instructors upload lectures that students watch at their convenience. In addition, faculty provide ancillary materials (links to websites, quizzes, and lists of definitions) designed to reinforce the course's main points.

Many benefits are possible. The first plus is a better, more dynamic learning environment for students. Large lecture courses have functioned in much the same way for centuries. Some educators have come to view lecturing as one-sided and ineffective because students tune out rather than absorb the professor's key points. In the flipped model, the students passively absorb materials then reinforce the concepts and information with a more engaged learning style.

Reaching the YouTube Generation

With flipped classrooms, presentations become immersive. These systems rely heavily on video, which is popular and familiar with the current generation that has grown up watching YouTube and playing video games. Students can slow or replay the video if they do not understand a point or two in the presentation.

Class time becomes more effective. With lecture time eliminated, more classroom interactions are possible. Faculty can spend the first few minutes of class clarifying any confusing concepts and move on to interactive exchanges. More feedback channels are possible. When students arrive, their knowledge can be tested to determine which ideas they understood. For instance, a teacher develops post-lecture quizzes probing what areas that the students have already seen and how much they retained.

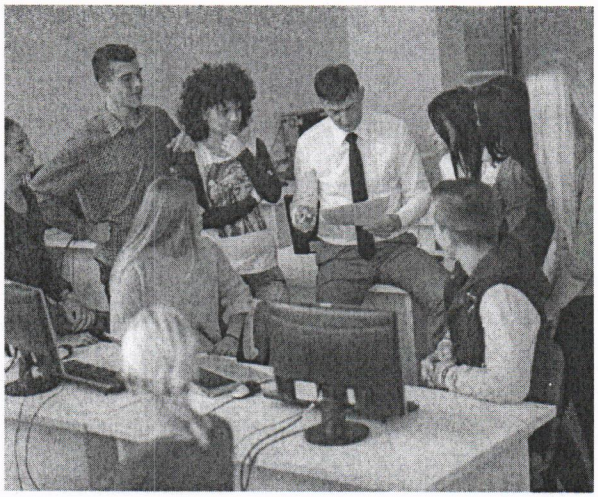


Figure 1. The flipped classroom encourages collaboration

Faculty have the ability to adjust instruction styles on a per-student basis, according to a survey completed by the

Center for Digital Education (CDE), a national research and advisory institute specializing in K–12 and higher-education technology trends, and Sonic Foundry Inc., a video-service supplier. Clickers can be used for interactive polling that tests pupils' understanding of the material, and complementary content can be designed to interact with students possessing varying levels of comprehension.

Another plus is "more classroom activity/discussion/collaboration," according to the CDE/Sonic Foundry Survey. Students work in groups to discuss the concepts. Ideally, pupils engage in peer-to-peer learning and start to think about what they know and what they don't know.

Making a Neat Fit

Learners gain practical skills. In the past, faculty emphasized learning and remembering facts. Today, remembering facts seems less important. Instead of memorization, many teachers focus more on how to conduct quality searches and find facts and answers to key questions. This approach fits with pupils' learning styles. Increasingly in K–12 schools, they are trained to actively self-learn rather than passively absorb.

Theoretically, the end result is better student performance/grades. Although formal research in this area is just beginning, those participating in the initial trials have reported positive results: 57 percent of faculty agree that their flipped classroom is "extremely successful" or "successful," according to the CDE/Sonic Foundry survey. Improved mastery of information (81 percent) and improved retention of information (80 percent) topped the list of benefits.

Because of the potential improvements, the approach has been growing in popularity. "Flipped classrooms have become a key driver for interest in our systems," said Sean Brown, senior vice president at Sonic Foundry. Indeed, half of the universities surveyed are employing the flipped classroom model or have plans to implement it within the next 12 months, according to the CDE/Sonic Foundry survey.

An Ad Hoc Movement Emerges

The movement has been taking root in an ad hoc manner. In many cases, curious faculty dabble with the approach. "New faculty are very open to new methods of teaching," stated Raul Burriel, an IT consultant at Oregon State University. In the fall of 2013, Burriel noticed a number of short videos being uploaded by faculty at the start of the term. After a quick examination, he determined that these teachers had latched onto the flipped classroom model. Less than five percent of faculty appear to be using the flipped classroom at the moment, but the number deploying it has been steadily growing, according to Burriel.

In select cases, the demand comes from the top down. University presidents, provosts, and deans are currently encouraging faculty to give the flipped model a try.

Making an Uneven Transition

However, this emerging modality is not a panacea. In fact, this technique presents several potential hurdles to universities. The transition from class lecture to class activities is not an easy one for many faculty members because it moves them out of their comfort zone. Consequently, there is a need for professional development to support teachers as they make the switch, according to the CDE/Sonic Foundry survey.

Even with some prodding, faculty members may resist. They are familiar with one teaching model and are reluctant to trade it in for another. Another factor is the flipped approach represents more work: 75 percent of faculty indicated that preparing for a flipped classroom takes more time than a traditional class, according to the survey.

The work starts with designing the course materials. More than half (51 percent) of faculty record their own video content for their flipped classes. They also need to fill in the face-to-face class time. The question—What am I going to do in the class if I do not lecture?—is a daunting one for some teachers.

Riding the Roller Coaster

Because the classroom becomes more dynamic, faculty must prepare for the unexpected and be ready to make adjustments on the fly. Activities they expect to take very little time sometimes will take much more and vice versa—especially on the first go-round. In essence, teachers give up control of the even flow that comes with set lectures and have to be prepared intellectually and emotionally for dynamic, sometimes random classroom interactions.

Students can have problems adjusting as well. Some struggle with the new model because it puts the onus of accessing the materials squarely on their shoulders. They need to stay on top of their homework, but in some cases, their time-management skills are mediocre at best.

Pupils may feel overwhelmed by the workload, which may increase. Faculty have to be cognizant of students' time constraints. Teachers cannot ask pupils to watch the video outside class, participate in class projects, and then do other homework. Consequently, professors may have to narrow their focus and take some content out of the course.

Technical Issues

For the communications manager, the change to flipped classes raises new technical issues. The groundswell requires upgrades in network, storage, and server systems. "The biggest technology item is storage because of the large amounts that video needs," stated Sonic Foundry's Brown.

Security is also a major concern, and schools must have a strong authentication system in place. "IT needs to be able to restrict access to course materials to only those students enrolled in the class," explained Oregon State University's Burriel.

New support issues arise. Students must be able to access the coursework, whether they rely on university-supplied or student -purchased systems. So, the underlying infrastructure needs to be flexible.

Pupils need to be able to navigate the classroom. Since getting to class in the virtual world requires more than just strolling across campus, universities may be required to beef up their technical support teams. Students may lack the knowledge needed to use the system. "We think today's pupils are so tech-savvy, but their expertise is often limited, and there are plenty of tools they may not be comfortable using," said BYU's Jensen.

Final Thoughts

The flipped classroom is a fairly recent concept that turns the educational paradigm on its head. The flipped model is being deployed on a growing number of campuses, and some pundits view it as the future of university teaching. To reach that point, faculty, students, and communication managers need to clear some hurdles and become more comfortable with this pedagogy.

Paul Korzeniowski is a freelance writer who specializes in communications issues. He has been writing about technology for more than two decades, is based in Sudbury, MA, and can be reached at paulkorzen@aol.com.

The Key to Student Success: Active Learning or Flipped Classrooms?

Putting the cart before the horse may be an accurate description of the impact of flipped classrooms on university learning. The flipped movement started sweeping the nation a few years ago with conventional thinking based more on assumptions than empirical data. In fact, researchers at Brigham Young University (BYU) have taken a closer look and found no difference between a flipped and a conventional classroom. "Active learning rather than a flipped classroom seems to be key to improved student performance in the classroom," stated Jamie Jensen, a professor of biology and discipline-based educational researcher at BYU.

To test the impact of the flipped classroom, BYU researchers created two freshman biology classes, one that used the flipped model and one that didn't. Otherwise, the classes were nearly identical. They had the same instructor, lectures, assignments, and activities. There were 55 students in one class and 53 in the other. They were taught one after another at the same time of day. They used the same level of active learning in and out of the classroom. At the end of the semester, the exam results of both groups of students were equivalent. Consequently, the researchers concluded that the flipped classroom does not automatically produce higher student-learning outcomes.

Instead, improvements seemingly come from a change from traditional lecture-based learning to active learning. Active learning alters student interactions from being passive recipients of information to active participants in the search for knowledge. Rather than listen to someone highlight important concepts, students engage in various in-class exercises and discussions where they play key roles in information dissemination.

Active Learning, a Proven Pedagogy

Active learning has been proven to be a more effective means of instruction than the traditional, didactic approach. In an influential 1998 study of more than 6,000 physics students across multiple high schools and universities, Richard Hake found that students taught by active strategies comprehended twice as much as those taught by traditional methods.

A reason why the flipped model may be gaining unearned accolades is faculty often change their approach from passive to active for their flipped classes. They also develop new materials, use new technology, and rely on more supplemental items, so comparisons between the old and the new are not apples-to-apples.

In sum, BYU's research demonstrated that if a professor is not using an active-learning model already, then the flipped classroom is certainly a viable way to move to that modality. If they have already traveled down the active-learning path, the tangible benefits of changing to a flipped classroom seem to be negligible.

Saving College Dropouts

Institutions collaborate technologically—with remarkable results

by Joe Dysart

More than 50 institutions are pooling their data, research smarts, and analytics to more quickly identify—and save—students who might otherwise drop out of the higher-education system. Dubbed the PAR (Predictive Analytics Reporting) Framework (www.parframework.org), the ongoing, collaborative effort, based in Chapel Hill, North Carolina, is reportedly saving colleges and universities millions of dollars in lost tuition.

Moreover, given that the PAR Framework is a not-for-profit venture, those same institutions are also saving millions of dollars that might otherwise end up in the pockets of commercial software programmers.

"PAR has already helped us transform the targeted delivery of interventions for students identified as 'at risk' through its predictive models," says Dr. Joshua Riedy, vice provost, University of North Dakota.

Dr. Karen Vignare, vice provost at University of Maryland University College, who works closely with the PAR Framework, adds: "Clearly, improving transfer-student success depends on our ability to exchange records and transcripts with other institutions."

What Is Par Doing?

Initially funded by the Gates Foundation in 2011 and helped along by Amazon Web Services—which supplies free computing power to process the records and other data associated with the project—PAR has been continually working with colleges and universities to gather and analyze key indicators of college failures.

In addition, the organization goes on to study, analyze, and inform on dropout intervention solutions that have proved most successful across a wide spectrum of institutions. "We designed PAR as a national resource that is uniquely poised to 'crack the code' on what matters for student success," said Beth Davis, CEO, PAR.

J.M. Lowendahl, an analyst at Gartner (www.gartner.com), agrees. "The PAR Framework project—combining data from big traditional universities, community colleges, and for-profit organizations—is an interesting example that keeps growing."

One of the reasons the system works so well is the sheer volume of data it processes—currently 25 million records drawn from 2.5 million students attending more than 50 institutions, according to Davis.

It also gets very granular. Student demographics, pass/fails on specific courses, student academic progress, student financial info, and the success/failure rate of intervention strategies, as well as dozens of other data inputs, are all analyzed.

Plus, the data stream coming into PAR is funneled from a wide spectrum of colleges and universities, including for-profit and public institutions, two-year and four-year institutions, traditional and progressive institutions, institutions offering courses online, and institutions that hire both part-time and full-time instructors.

Moreover, the system takes a truly collaborative, open-source approach, which encourages all institutions to work together to solve the problem of student dropouts by freely sharing data, analytics, and brainstorming.

Benefits

At the individual institution level, IT personnel at colleges and universities benefit from the project by being able to share a common language when using computers to assess, describe, and analyze key factors behind student dropouts.

PAR, for example, has openly published, under a Creative Commons License, the commonly agreed upon data definitions that all of its participating institutions use to describe key factors behind student dropouts. Those data definitions were published in 2013 in the *Data Cookbook*, a kind of collaborative data dictionary of terms. By using this common language, IT personnel can use their own computers to study the dropout behavior of their own students, and then compare the analysis with what's going on at other universities to get deeper insights into their own problems with dropouts.

This approach was used recently by the University of Hawaii, which compared its analysis of what causes transfer community college students to drop-out at its campus with similar analysis that was done at the University of Maryland. Essentially, IT personnel at the University of Hawaii would not have been able to easily implement such a comparative study without sharing that common language developed by PAR to assess, describe, and analyze those key factors.

"We are pleased that our PAR participation helps us benefit from the results and associated findings about how community college behaviors can inform student success in the university," said Dr. Hae Okimoto, director of academic technologies at the University of Hawaii. "We now have even more validated evidence we can use to help our students be more successful."

Moreover, IT personnel at individual institutions are also able to individually benefit from PAR by integrating other

data and analysis from PAR into the commercial software they may also be using at their locations to prevent more students from dropping out.

The University of North Dakota, for example, recently integrated PAR's data and analysis with Starfish Retention Solutions, a commercial package designed to help rescue students who are teetering on the edge of dropping out.

"Working with PAR and leveraging the Starfish platform will further enhance the efforts of counselors, coaches, and advisers who are actively using Starfish at the University of North Dakota," says Riedy.

Par CEO Davis adds: "Using predictive analytics to drive student interventions represents the first phase of this integration. We are now poised to measure how this tight, data-driven approach in student services moves the needle for retention and completion within the University of North Dakota."

Moving ahead, PAR is also seeking to expand its *cookbook* of data definitions to include terms unique to transfer students and adult learners.

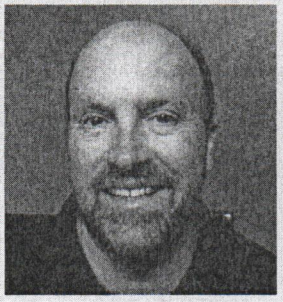
Helping with that effort is the American Institutes for Research (AIR), as well as more than 15 U.S. post-secondary institutions. "We are excited that AIR is exploring relevant metrics for today's post-secondary reality and are especially pleased the data experts at AIR have chosen to work with the PAR team to accelerate their efforts," says Davis, PAR Framework CEO.

Adds Dr. Thomas Weko, a managing researcher at AIR: "PAR's data experience, existing relationships with key partners, and its skill in working with multi-institutional data to draw meaningful, national comparisons made it an ideal partner in this work."

Institutions interested in investigating PAR for their own needs are welcome, according to Davis. PAR membership is open to all accredited institutions of post-secondary education in the United States that are interested in learning—and sharing—how to best rescue would-be college dropouts.

Joe Dysart is an Internet speaker and business consultant based in Manhattan. Reach him at joe@joedysart.com.

Snapshot



Cellular Savvy

Rod Perry

Project Fi—the Wi-Fi–First Cell Phone

As a cellular consultant who works with universities, I am constantly looking for ways to leverage the significant investment schools have made in Wi-Fi. There has been a lot of talk about cellular/Wi-Fi convergence, but few products have actually made it to the street. Let me introduce you to Google Project Fi, the first step, I believe, in a world where Wi-Fi and cellular are seamless and equal alternatives for smartphone users.

I was lucky enough to get one of the first Project Fi handsets. The Fi phone is a Motorola Nexus 6 that has some proprietary software on it, but is otherwise a standard Android smartphone. Google's approach is unique in that the phone will look first for Wi-Fi coverage, and if none is available, it will then roam to either the Sprint or T-Mobile cellular networks. While I do not have an insider's view of how the Fi phone works, it would make sense that the handset has software based on the Hotspot 2.0 standard that makes the authentication on Wi-Fi networks as easy as possible. In order for Wi-Fi to be a seamless cellular alternative, the user cannot be required to go through the hassle of logging onto every Wi-Fi network they can access. In addition, I would assume that Google has network equipment that facilitates handoffs between Wi-Fi networks and the cellular network of choice.

I tested my Fi phone in three different Wi-Fi environments: my home, a Starbucks, and the University of Utah campus. My testing consisted of placing a call while on the Wi-Fi network, then walking out of the building until the handset dropped the Wi-Fi and acquired the cellular network. I would then make a new call on the cellular network and reverse the process. In all of my tests, neither I nor the person on the other end of the phone call could detect any issues with the handover. In other words, there was no evidence that the call was being transferred between networks.

While it is a little early to declare victory, my results with the Fi phone were encouraging. I believe we are on the cusp of having Wi-Fi networks serve as the primary access networks for voice calls in a campus environment. Keep in mind that cellular networks are owned and controlled from end to end by the cellular operator. The quality of service on these networks is paramount, and today we are all used to a high-quality environment for voice calls. Placing calls on a Wi-Fi network means that you are subject to any issues of throughput or latency that exist on that network, and each network will probably have a different level of performance. In environments where the Wi-Fi network is heavily used, you may experience clicks or dropouts as the voice packets contend with the data packets from other users. If you are interested is testing the Wi-Fi calling experience on your campus, apply to Google for a Fi phone or purchase a handset from Republic Wireless, which has a similar service.

Hybrid IT—The New Campus Landscape

New technology increases risk as well as productivity

by Jim Romeo and Kevin Sapp

The University of North Texas (UNT), based in Denton, has some 41,000 students across three campuses, taught by 5,000 different faculty members. The university recently moved from a patchwork of IT silos, mobile devices, and university legacy databases to a streamlined hybrid cloud. The move is expected to enable them to not only streamline their multiple IT silos for efficiency, but also afford better control for a more secure IT enterprise.

Like UNT, many institutions of higher learning around the world are expected to join in the emerging hybrid IT revolution.

Hybrid IT: The New Game Changer?

Hybrid IT has arrived. We are living in a new business environment where mobile devices connect to cloud computing and legacy IT infrastructure. Hybrid IT, an important infrastructure to enable efficiency in today's global IT environment, includes the use of cloud-based applications and data with organic applications and databases found in-house.

Cloud computing offers useful software-as-a-service (SaaS) applications and cloud data and services. When cloud computing is combined with mobile assets and organic corporate databases and applications, workers enjoy great productivity; the enterprise flourishes.

Nearly every college student on about every campus has a mobile phone now. Phones are utilized, intentionally and unintentionally, inside the classroom as well. A 2014 study by Baylor University asserted that students were "addicted" to their cell phones.

But cell phones are not a token of evil that lead to trouble. For students as well as university staff, the mobile phone can be a useful tool. In fact, many campuses promote them as a means of ensuring greater campus safety. In addition, students use a multitude of apps on their mobile phones to do everything from looking up a word to converting Fahrenheit to Centigrade. There is even more mileage that educational institutions can harvest from mobile phones when used in combination with cloud-based software and legacy databases.

With hybrid IT, workloads move between internal and external IT infrastructures. This complementary relationship allows workers to be nimble and flexible with regard to where they work, what data they use, and when and how they access that data to perform a task. Hybrid IT allows them to do things they couldn't do just a few years ago.

In spite of all of that, hybrid IT has its challenges. Security risks from a distributed workforce and student body, coupled with a growing population of mobile devices and apps, present concerns for today's chief information security officers (CISOs).

How an organization rises to meet demands and challenges of hybrid IT is crucial. Hybrid IT, when managed appropriately, can positively transform enterprise IT. "Hybrid IT is the new IT and is here to stay," says Chris Howard, vice president and chief of research at Gartner. "While the cloud market matures, IT organizations must adopt a hybrid IT strategy that not only builds internal clouds to house critical IT services and compete with public CSPs [cloud solution providers], but also utilizes the external cloud to house non-critical IT services and data, augment internal capacity, and increase IT agility. Hybrid IT creates symmetry between internal and external IT services that will force an IT and business paradigm shift for years to come."

IT leaders must monitor this business paradigm shift in the years ahead and embrace the change in order to harness its full potential.

Security: The Challenge to a Fully Functional Hybrid IT Environment

Major IT security breaches dot the landscape of today's engaged knowledge worker. Hardly a day goes by without another major breach making international news. Think about Sony, Target, Home Depot, and others.

In September 2015, California State University campuses and networks were breached, touching hundreds of thousands of records. In 2014, millions of records were breached over many campuses including the University of Maryland and North Dakota University.

Every IT leader knows the consequences when hackers find a chink in the IT supply chain somewhere. Damage from a security breach can be devastating. This threat raises concern for security risk in a hybrid IT environment as data is accessed from anywhere, at any time. Operating in a hybrid IT model sends a signal to CIOs and CISOs: Proceed with caution.

The prevalence of multiple points of entry poses additional security risk. Mobile device access and asset management pose risk and must be controlled. The apps they use are also a source of breach. While CISOs have worked hard to build security to bolster against such risk and intrusion, the pathways followed in a

The New 3-Legged Stool of Today's (and Tomorrow's) Knowledge Worker

Mobile devices proliferate. So do applications. Cloud computing is robust and growing. Organic databases and applications residing at the IT datacenter have been and will likely always be accessed and utilized. All these venues make up a hybrid IT platform —or "three-legged stool" for today's knowledge worker to rest and rely on for improved productivity.

The first leg of the stool is the mobile device. Knowledge workers rely on smartphones and tablets to access sensitive data that may be in the cloud or datacenter.

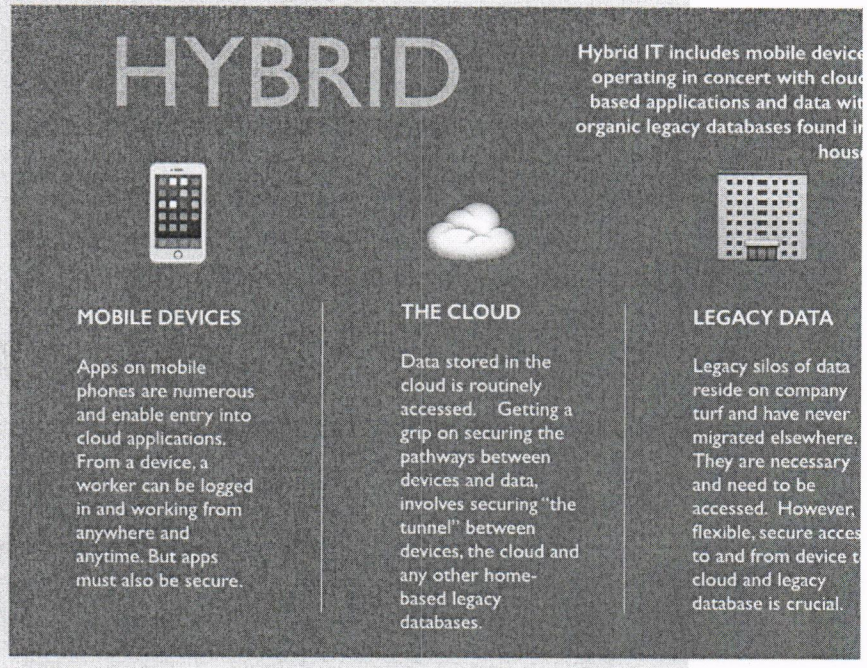
Mobile users now surpass desktop users, and over 80 percent of their usage is via applications. Applications are growing and improving to enable cloud access of all types .

The second leg of the stool is the cloud. Cloud computing is expected to grow at 44 percent over the next five years. Companies are spending about $13 billion per year on it, according to a 2014 market research report by In-Stat. Over 80 percent of companies say they are saving money by moving operations to the cloud, and over half of company workloads are now conducted in the cloud (NSK, Inc. , *7 Statistics You Didn't Know About Cloud Computing*).

The third leg is the existing silos of data, information, and applications that are home-based in the traditional IT enterprise; they reside on company turf and have never migrated elsewhere. The cloud, in conjunction with devices, is used with legacy databases and home-based IT infrastructure to perform many business functions. This entire model has already been widely adopted and is likely to continue in popularity and utility in the years to come.

"IT organizations are taking an 'adopt and go' strategy to satisfy internal customer IT consumerization and democratization requirements," according to Chris Howard, vice president and chief of research at Gartner. "Many IT organizations are adopting public cloud computing for non-critical IT services such as development and test applications, or for turnkey software-as-a-service (SaaS) applications such as Web analytics and CRM that can holistically replace internal applications and enable access for a mobile workforce."

The success of hybrid IT relies on a new robust security perimeter with policy at its core; it makes the three-legged stool strong and secure. This includes compliance, authentication, and a secure gateway to and from dispersed endpoints. With the right tools and technology, the knowledge worker of today and tomorrow will be most productive with all the information that abounds in the public and private cloud as well as their corporate network.



hybrid IT environment demand more. As the popularity of hybrid IT grows, its adoption and success depends on the management of security risk to enable its success.

Mobile device access is essential for productivity, but security must continue to be a priority. There are about 7.22 billion mobile devices in the world; there are about 7.19 billion people on the planet. Research from GSMA intelligence, who tracks data on mobile devices, notes that their prevalence is growing about five times faster than the population. About half the world's population subscribes to a mobile service of some kind.

This is because mobile devices are useful for everyday life. Through a myriad of available apps, they allow quick access to information and utilization of different software applications—all in the cloud. Workers now want the same utility from their employers, letting them access their corporate email and applications with their personal mobile devices via bring your own device (BYOD) practices. Workers can find customer data, create a document, and access financial informa-

tion with the same agility they have in their personal lives.

But it is important that enterprise information be managed as secure mobile devices containers that allow, through appropriate software and applications, a separation of personal business data. Mobile devices must be compliant with existing security policies. Risk is inherent with personal devices—Gartner found that one in four business users surveyed admitted to having a security issue on their private device in 2013.

In addition, numerous apps on mobile phones enable entry into cloud applications and must be secure. From a device, a worker can be logged in and working from anywhere at any time. The same convenience of access that mobile phones afford is also a source of intrusion. According to Pulse Secure's 2014 Mobile Threat Report that researched some 2.5 million mobile applications, there were 931,620 unique malicious applications—a 391 percent increase from 2013 alone.

Traceability and control of devices further challenge CISOs in maintaining a secure perimeter. Identity and access management (IAM), given the popularity and utilization of mobile devices, has become the new IT perimeter.

Securing this perimeter in real time as utilization grows is the challenge of CISOs. Melding the effective control of user identity and device identity with device compliance is the new objective for CISOs in a hybrid IT environment.

"Authenticating users on a variety of endpoints should provide the right balance of user experience, security, and workforce productivity," according to Gartner's research report *Refresh Authentication Choices to Improve Mobile Workforce Remote Access* (28 January 2015, by Gartner Analysts Anmol Singh and John Girard). CISOs and IAM leaders need to keep pace with new methods of remote access for the mobile workforce in a constantly changing work environment.

Challenging the Security of Hybrid IT

When mobile workers utilize BYOD to access sensitive corporate data, there is a risk of non-compliance and exposure of sensitive data to unwanted parties. SaaS is very useful for today's business entity. However, such platforms pose security risk. Fifty-three percent of respondents in KPGM's 2014 Cloud Survey Report cited "data loss and privacy risk" as the greatest concern when adopting the cloud.

Sensitive corporate information will reside in the cloud through SaaS vendors such as Dropbox, Office 365, Salesforce, and Concur. This data may become a target for artful hackers to use their tricks and methods to exfiltrate data. Users rely on a safe gateway or tunnel to and through the cloud.

Secure the Tunnel to the Cloud and the Datacenter

Getting a grip on securing the pathways between devices and data involves securing the tunnel between them. The clincher for IT leadership is to allow secure access and ensure the tunnel is protected and controlled.

How does this happen? Principally, by implementing authorization-access control services for employees and other users—from any device, anywhere, at any time it happens. This means using existing Secure Sockets Layer virtual private network (SSL VPN) gateways to access the datacenter while also relying on a cloud access security broker (CASB) to ensure a secure pathway between users and the cloud provider. Enforcing device compliance is key in both cases to protect the integrity of enterprise data. Such tools ensure the tunnel of hybrid IT use is not only accessible but secure.

Secure the Data, Not the Device

Building a gateway is part of meeting the security challenge of hybrid IT because workers take advantage of the BYOD approach, and managing the access and authentication of their device must be a critical component of any security strategy.

This requires the use of a device container, so workers can utilize BYOD securely and peacefully coexist with personal and corporate applications on their device. The container eliminates the enterprise need to manage the entire device and protects worker privacy.

Securing the tunnel using identity management tools and technology, and ultimately securing the device container, affords today's competitive knowledge workers the freedom to collaborate and work together globally in a secure environment—with any device accessing information in the datacenter or in the cloud, whenever and wherever they choose.

Personal Productivity: The Payoff

Location, location, location—it really doesn't matter anymore; users work anywhere, at any time, and are much more productive. Thanks to advances in technology, this productivity gain is possible, even though evolving security risk continuously challenges it.

Secure the tunnels to the datacenter and the cloud, enable workers to use any secured device—be it their own or not, and you have the ingredients for a very productive and secure work environment. Ensuring remote and mobile security should encompass multilayered access that is easy on the user without sacrificing security. With the right solutions and tools, expediting access will also aid in making hybrid IT an even more productive platform than it is.

Today's workers are able to do things they could not do before simply because secure access technology allows them to do it. And they can produce not just from their cubicle, office, or desk, but from anywhere and any time zone in the world—a true payoff for personal productivity.

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Jim Romeo (www.JimRomeo.net) is a technology journalist based in Chesapeake, Virginia, and a frequent contributor to the ACUTA Journal.

The George Washington University Introduces CAAREN

Advanced research network infrastructure enables research in the D.C. area

by Donald DuRousseau

The Capital Area Advanced Research and Education Network (CAAREN) was developed by the George Washington University (GW) division of information technology (IT) in partnership with the D.C. office of the chief technology officer's program, DC-Net, D.C.'s citywide communications network. CAAREN was developed out of a need for advanced research infrastructure for the D.C. area, and a need for collaboration among D.C. area universities.

CAAREN's objective is to provide an advanced research network infrastructure, as well as outreach and services for K-12 schools, museums, libraries, and similar organizations within the D.C. metro region. CAAREN has worked with DC-Net to bring research network infrastructure services to its own network and make it available to these organizations and institutions within the D.C. region.

CAAREN was launched in December 2013 and contracted with Internet2 to become a Community Anchor Institute (CAI). CAAREN provides GW and other institutions with access to Internet2 resources, which run at 100GB per second. The network is available to GW students and researchers, as well as other higher education institutions, K-12 schools, charter schools, libraries, hospitals, museums, and other organizations within the D.C. metro region.

There was an extensive agreement throughout the division of IT at GW with support from researchers requesting the need for an infrastructure such as CAAREN. The network fits the strategic vision of the university to support research and become a high-quality research institution. The division of IT hired staff and brought on people to build and focus the effort, in addition to providing money and resources. Business cases were developed and presented across the university. Needs were identified, and CAAREN's value was proven through what it brings to the region in terms of research, competitiveness, and sustainability of operations. Business cases were presented to executives at GW, as well as to the D.C. chief technology officer through DC-Net.

CAAREN Reaches Out

The George Washington University has leveraged its campus geographies in Ashburn, VA; Rockville, MD; and Foggy Bottom, Washington, D.C., to provide regional advances in research network services.

Within GW, this environment compliments the other investments made in support of research through collaborations with the office of the vice president for research, schools, colleges, and institutes. One example of this includes partnering with the Columbian College of Arts and Sciences to develop Colonial One, a high-performance computing cluster that gives researchers the computational power and storage they needed to conduct research and move data outside the university. In this environment, CAAREN extends the capabilities of that infrastructure by providing an onramp to the expansive services of Internet2 and the greater national and international research and education community.

Since its inception, CAAREN has collaborated with DC-Net to establish connections with the schools across D.C. Two initiatives, CAARENensemble and ECOSTEM, have been developed to promote community outreach and benefits to the D.C. public schools. Both initiatives are currently in the incubation period, and will become live services in the near future.

CAARENensemble uses CAAREN to provide K-20 schools in the Washington D.C. metro region with the network, video technology, and Internet infrastructure needed to access and participate in connected performances across the region in real-time. Through a planned partnership with Amadeus Concerts, local K-20 music and arts programs, and professional organizations supporting arts-in-the-schools initiatives, CAARENensemble provides access to professional instruction and real-time student participation in concerts performed at multiple locations simultaneously. With the help of low-latency (LOLA) audio-visual technology, CAARENensemble allows students and professionals to play together, even though each group is performing at several different locations. LOLA audio-visual technology will run on CAAREN to remove the delay, allowing for seamless participation in distributed performances.

The initiative will help support and enhance the music and performance arts programs in school systems throughout the area. Students will have access to well-known conductors and local performers, and professional development opportunities will be available for teachers and professionals. CAARENen-

semble provides the advanced technology necessary for students to play alongside professional musicians without leaving their own school auditorium.

In addition, students and teachers will have the opportunity to enhance digital literacy skills, and for teachers to learn how to use the LOLA system. CAAREN-ensemble will coordinate a distributed performance at Wolf Trap Foundation for the Performing Arts with several K-20 regional schools.

GW ECOSTEM is an initiative working with innovative uses of research and education technology to provide a community of education, industry, technology, and government partners, as well as a high-bandwidth infrastructure to connect D.C. schools, libraries, and museums to Internet2 network resources. CAAREN will connect ECOSTEM members to regional and international education and training centers, as well as leading research institutes. The GW Sustainability Institute will provide oversight and guidance in the development of the comprehensive online education and training program. The Institute will ensure that up-to-date content is online and will collaborate with university

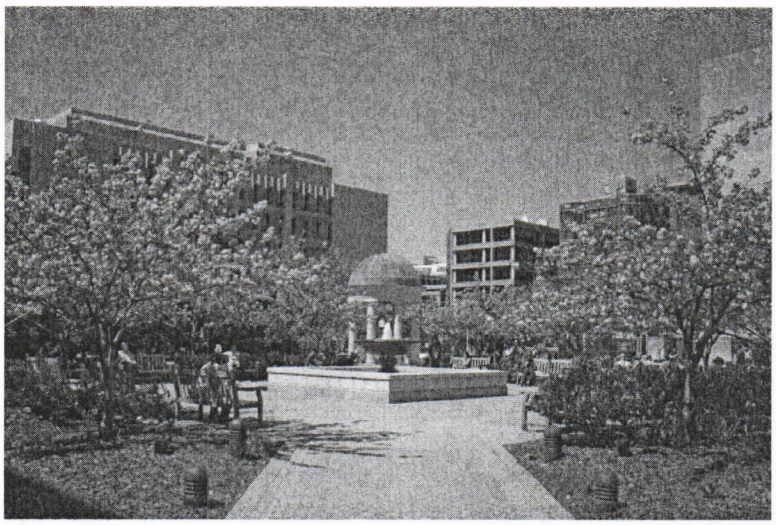

Figure 1. Kogan Plaza at the George Washington University

schools-to-jobs (S2J) program focused on solar energy. The initiative will develop science-, technology-, engineering-, and mathematics- (STEM) related internships and jobs for Washington, D.C. K-20 youth. It will also create professional development opportunities for D.C. Public School (DCPS) teachers, develop a learn-by-seeing and learn-by-doing curriculum, and provide access to big data research in ECOSTEM fields. This initiative will help transform districts into green communities to provide the foundation for a sustainable jobs program.

CAAREN will help facilitate this initiative by providing an established faculty and DCPS teachers to develop an age- and skills-appropriate curriculum.

Partnering for Success

These services and others are provided to the schools through membership in CAAREN. CAAREN's partnerships have spanned from internal collaborations on advance research technology support within GW to external collaborations with government institutions, city organizations, and other research and education establishments, such as a recent partnership with Georgetown University to enhance the research collaboration within the D.C. metro area.

In 2015, President Obama announced a newly created MetroLab Network as a part of a $160 million Smart Cities initiative to help communities tackle local challenges and improve city services. The Smart Cities Initiative will invest in federal research and leverage more than 25 new technology collaborations to help local communities tackle key challenges such as reducing traffic congestion, fighting crime, fostering economic growth, managing the effects of a changing climate, and improving the delivery of city services.

The MetroLab Network will strengthen and create partnerships between metro areas and their respective universities to research, develop, and deploy innovative technologies to address challenges facing the nation's urban areas. The District of Columbia, Georgetown University, the George Washington University, and Howard University have partnered to join the network, which will provide the opportunity to share successes, address challenges, and build shared platforms for experimentation and data between cities and universities necessary to increase the tangible results of new innovations. GW's contribution to the MetroLab Network also includes leveraging the power of CAAREN to help connect the city, engage the community, and foster innovation. As a partner in the MetroLab Network, CAAREN strengthens the regional collaborations between the District and local universities and allows for greater engagement around solving shared challenges nationally.

Additional partnerships include one with Indiana University's Global Research Network Operations Center (GlobalNOC) to provide CAAREN with services, support, and tools. GlobalNOC is used for layered networking support to large and small networks around the world. Specifically, it provides CAAREN with tier 1 service-desk support and tools, including a 24/7 call center, network monitoring, incident triage, trouble ticket management, support coordination, and workflow support. In addition, work has

started on a National Science Foundation grant with Georgetown, GW, and the Computational Biology Institute to build out and expand CAAREN to include more infrastructure and capabilities.

Funding CAAREN

Funding for CAAREN initially came from the division of IT. This included not only funds for the project, but also a commitment through hiring skilled people to run the network and develop it further. Past and future grant support from agencies, such as the National Science Foundation funding research into the development of a software-defined network exchange supporting large data transfers, have and will be integrated into CAAREN where there is a synergy with delivered services.

Planning for CAAREN took about a year and a half, and the implementation phase took six months. Organizationally, a new office was formed within the division of IT to focus on research and technology services, with key engineering competencies and a mindset targeted at integrating technology within a research lifecycle. A culture change occurred within the university as the division of IT transformed how technology integrates with research and how it enables and supports it. The university has challenged the leadership within the division of IT to enhance the support for research, primarily through its support of initiatives like CAAREN and by bringing in new staff with research-support experience.

The financial risks are ongoing as CAAREN develops. These risks include not attracting enough key partners to sustain CAAREN as well as complexities in the public and private partnerships and corporate engagement. There is always the risk that some services will fail to meet the desired objectives.

CAAREN's business plan involves socializing through constant engagement internally and externally. It includes frequent in-person communications, collateral that articulates the benefits, and continuous updates, and it requires communication with a target audience through press releases, web presence, and branding. As an enhancement to existing infrastructure to the university and within the region, CAAREN is one of the select few networks of its kind from across the country that has implemented the 100GB infrastructure. More of these networks are appearing throughout the U.S., but CAAREN was among the first to implement.

Growing Recognition

This year, CAAREN was highlighted by Internet2 for its partnership with the National Institute of Health in developing genomics research. Raja Mazumder, an associate professor of biochemistry and molecular medicine at the GW School of Medicine and Health Sciences, co-developed the High-Performance Integrated Virtual Environment (HIVE), a genomics analysis platform. HIVE was featured at the 2013 Supercomputing Conference as a novel approach to computation that greatly speeds up the analysis of genomic data. The 100GB network of Internet2 allows HIVE to realize its full potential, and GW connects to Internet2 through CAAREN.

CAAREN continues to target new research and grant opportunities to enhance the ability to support research. An example of this is a recent effort that builds on a GW partnership with the National Institute of Health in Lima, Peru, to provide GW students with research and education opportunities and help strengthen Peru's healthcare system, particularly in the area of cancer research. Peru has a very diverse population, and the National Institute of Health has collected millions of tissue samples from the population. However, the Institute has limited capability to process the information from the tissue samples.

CAAREN is working on concepts behind an open exchange with Peru, in addition to providing training in advanced networking. The focus of this is to work with scientists on next-generation technologies and methodologies for the handling of large and complex data as well as challenges with the handling of physical aspects of research, such as tissue samples, by integrating technology into their workflow and overcoming geographic limitations. If successful with these joint research efforts, CAAREN will help to develop the network in Peru to assist with research, infrastructure, and teach new technology.

Let the Research Begin

CAAREN began in December 2013, essentially as a start-up. The IT services at GW are extremely advanced and established, but CAAREN itself as an entity is new, bringing state-of-the-art capabilities to the university. With the introduction of the high-performance computing cluster, Colonial One, GW was already well on its way to becoming a leading institution for researchers. By creating CAAREN to allow researchers to better leverage the high-performance computing power of Colonial One, GW gained the resources it needed to attract top-quality researchers and educators, in addition to creating a network that can be utilized through partnerships throughout the D.C. metro area. CAAREN gives researchers the ability to pursue grants for which they otherwise would not have been able to apply without the use of the 100GB connection from Internet2.

With this connection, CAAREN provides an extra layer of funding possibilities for researchers not only at GW, but at partner institutions as well. CAAREN supports those who have grants who need to move large data sets, allowing them to complete work they were previously challenged to do within a short time frame or in less complex ways. Without CAAREN, it can take researchers longer to move data and conduct the research necessary for progress.

CAAREN also provides researchers with extra resources. For example, if Colonial One does not have enough com-

Applying University Themes

From the university's perspective, CAAREN directly applies to its themes within Vision 2021: A Strategic Plan for the Third Century of the George Washington University. Overall, the strategic plan is focused on enhancing research and education through four different themes, and CAAREN's cutting-edge technology will allow the university to be on the forefront of developing new research and education opportunities for the GW community.

The first theme, ***innovation through cross-disciplinary collaboration***, is modeled through CAAREN's partnerships across the several disciplines of research and schools within GW, as well as through its partnerships outside of the institution and throughout the D.C. area. From genomics, to music and arts, to sustainable STEM jobs, CAAREN provides the opportunity for innovation in a variety of subjects.

The second theme, ***globalization of educational and research programs*** is met most prominently through GW's partnership with Peru's National Institute of Health to elevate health research. CAAREN has the potential to make a difference on an international scale in several different ways; and through CAARENensemble, ECOSTEM, and other initiatives it will make a difference locally to a variety of institutions and organizations.

Expansion of programs that focus on governance and policy in the public and private sectors constitutes the third theme of Vision 2021, and CAAREN helps meet the theme goals through its initiative to create a schools-to-job program in sustainability, as well as its work within the healthcare arena. CAAREN allows researchers to tackle major problems within our healthcare system and is working to create a sustainable infrastructure to better inform policies to change the world.

The final theme, ***emphasis on infusing the ideas of citizenship and leadership into everything we do,*** is another important aspect of CAAREN. The network is looking to lead the region in cutting-edge research and education, and is ready to take the lead in a collaborative effort to benefit institutions and organizations across the region. CAAREN hopes to develop STEM education within D.C. schools, helping to create leaders for the future.

putational power, researchers can use CAAREN to access other supercomputing centers across the country through the Extreme Science and Engineering Discovery Environment (XSEDE). XSEDE is a single virtual system that scientists can use to interactively share computing resources, data, and expertise. CAAREN is integral to the research process as it works together with computing, networking, and storage. CAAREN's staff has conducted personal outreach and met with researchers across campus to understand their needs to help them do their job better. CAAREN staff also work closely with researchers in the various GW institutes and schools in order to get their data across the network if necessary.

In addition to the clear benefits researchers receive from CAAREN, another value is the opportunity for the George Washington University to host events to bring in innovators and others on the bleeding-edge of technology to campus. This year, the Global Environment for Network Innovations (GENI) Conference will be hosted by the George Washington University and will utilize CAAREN for high-speed networking. GENI provides a virtual laboratory for networking and distributed systems research and education. It will allow for new applications and new areas of research to be developed at the conference, in addition to networking opportunities and technology demonstrations. A GW student competition will be held prior to the conference, with resources provided by CAAREN. Cisco has agreed to be the corporate sponsor for the competition to provide students with scholarships, and several other corporate sponsors will support the overall conference. In addition, CAAREN provided the network infrastructure for the Internet2 Global Summit held in Washington, D.C. in 2015.

Although other networks exist nationally and internationally, CAAREN is focused on the D.C. metro region and on growing the local community along with fostering national and international collaborative opportunities. CAAREN is part of GW, but services customers both within and external to GW. The membership costs related to CAAREN are for continued operations and service enhancements established collaboratively with members. Additional funding from grants with particular research focus which can be integrated into CAAREN services longer terms are target opportunities. CAAREN is an extensive effort, and it is important that it be available to anyone, anywhere in the university who needs to work off the high-speed network.

As IT services evolve in a dynamic research environment, technology groups are working to position themselves as key enablers of business and research outcomes and align agilely with changing demand. From the university's perspective, its core research infrastructure is necessary to support complex data research and the dissemination of that research, foster collaboration nationally and internationally, build closer partner-

ships between academic and research organizations in the D.C. metro region and support engagement with international partners. In trying to put forward multi-institutional research initiatives, including public and private research partnerships, CAAREN's infrastructure provides not just interconnectivity, but the opportunity for community.

Customer Satisfaction

Tools exist to measure how fast the network runs, and tests are run on the various data sets run through the network. Tools also exist for looking at network productivity, including perfSONAR, and staff are currently working to better integrate such tools into the operational performance management and monitoring.

CAAREN's uptime is 99.99 percent. Overall performance targets include 24/7 uptime for customers. GlobalNOC monitors CAAREN to ensure everything is performing correctly. Data generated from genomics, bioinformatics, satellites, super colliders, and other sources all require resources for transfer and processing globally. Researchers and other users define expectations collaboratively with CAAREN staff to ensure successful service delivery and performance.

Evaluations include the types and volume of research grants supported by infrastructure; the number, size, and success of initiatives; measuring performance across the infrastructure; and evaluating the sustainability of the initiative. These evaluations advise on future investment and membership in the infrastructure with partner organizations and will result in collaborative changes in forward direction. Currently, measures are compiled into an annual report.

CAAREN is currently in the start-up phase, and the reporting focuses on new partners and financial status. The measures are currently evolving, but the first metrics include viability of the infrastructure on a 5-year return on investment plan. CAAREN is currently in its first year of that plan. Staff fully expect measures to change as they learn what has been successful.

CAAREN includes membership agreements, and an investment from the university and the division of IT. The division of IT was revamped to allow for hiring of expert staff to support and build CAAREN, placing the focus of the division on research technology. Direct costs for CAAREN include the maintenance and upkeep of equipment to keep the network running.

Key user involvement in CAAREN comes from a collaborative team made up of key technical and research members at GW, DC-Net's engineering and operation team, and close collaboration with outreach and communication offices on the launch and communication of the initiative. Thus far, customers have been very satisfied with CAAREN's services. However, measuring customer satisfaction has been limited to informal surveys as CAAREN staff move toward developing a more structured annual report, with better ways to capture and report on those metrics. Once CAARENensemble and ECOSTEM go live, CAAREN staff will be working across campus and the D.C. area to develop and promote the initiatives to best serve the region.

CAAREN staff are also continuing to build collaborative partnerships that support and enhance the value of CAAREN. Challenges include how best to grow CAAREN moving forward and how to attract membership to CAAREN. The newly developed initiatives will help to tackle those problems. The ECOSTEM initiative is beginning with solar energy, but can easily be expanded into other areas around sustainability. The schools-to-job platform can also offer other types of sustainable planning.

Challenges exist around explaining the benefits of the network infrastructure without key use cases, and these are being met through leveraged examples such as CAARENensemble, high-performance data transfers with NIH (as exampled with the HIVE project), and the ECOSTEM initiatives to articulate the value of the infrastructure. There are high levels of interest as value is communicated. Other challenges included technical complexities at implementation (since resolved), organizational communication challenges between organizations, internal politics, and collaboration with external organizations within partner groups working on various timelines. Frequent planned committee meetings, clear actions and next steps, and constant open dialogue on priority and timelines helped to overcome many of the communication challenges faced. Technical limitations were resolved through the engagement of additional engineers. Additional challenges include recruitment and establishment of staff, bringing in funded partnerships and dealing with timing issues, readiness, funding abilities, willingness to commit and a need to communicate value.

For the Future

CAAREN is actively pursuing new initiatives, and currently has two grant proposals submitted with additional opportunities being explored. Ideally, CAAREN staff would like to support the needs of and enable establishing regional centers of excellence around key initiatives. In addition, there is a need for a growth in outreach to K-12 schools, museums, hospitals, libraries and other organizations to bring advanced technology into the classroom for the next generation of scholars and into the workplace to increase national and international collaboration.

The contact person for CAAREN is Donald DuRousseau, director, research technology services, office of planning and strategic initiatives at the George Washington University division of information technology. He can be reached at ddurousseau@gwu.edu.

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