COMMENT

Addressing the state, national, and global challenges affecting Colorado State University
SUMMER 2011 • ISSUE 8, VOL. 5

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Information Technology in Higher Education

Colorado State University

Dear Colleagues: Where is information technology headed in higher education, and how is CSU keeping up?

We publish *Comment* periodically as a way to share information on topics of special interest to the academic community of CSU. This issue focuses on technology – what some of our most innovative faculty are doing to incorporate new technologies in their teaching and how we're using technological advances to improve our service to students.

For techies, the newest and latest technology is always a must-have. For the rest of us – including those of us who still believe in the occasional hand-written note and face-to-face conversation – it's always a challenge to know which technologies are worth investing our time and mental energy in adopting and which are likely to fade quickly into obscurity. (Think "MySpace.") Fortunately, the team at Academic Computing and Networking Services does a lot of this analysis for us at CSU, and under the leadership of VP and Dean of Libraries Pat Burns, this group has made some remarkable advances with limited resources at their disposal.

Like our IT team, CSU faculty and staff across campus are engaged at the forefront of their disciplines, pioneering new ideas, approaches, and solutions to complex questions. As we prepare for the fall edition of *Comment*, we want to hear about those ideas that are most intriguing to you right now. *The Chronicle of Higher Education* (in its Chronicle Review section) recently asked scholars across the country to answer this question: "What will be the defining idea of the coming decade, and why?" A few of the intriguing responses they received: "Dizzied By Data," "Fast Evolution," "The End of Human Specialness," "Abandoning Disciplines," "A New Cosmopolitanism."

For our next issue of *Comment*, we want to know how CSU faculty and staff would respond to the same question. What do you think will be the big, defining idea of the next decade? We invite you to submit your responses, up to 500 words, to our editor at Peg.Kowalczyk@colostate.edu, and she'll publish the most interesting and innovative responses in the fall issue.

In the meantime, we hope this technology edition of *Comment* provides some useful information and spurs some ideas as you recharge your own batteries during the summer break.

Sincerely,

Tony Frank
President

Inspired by its land-grant heritage, Colorado State University is committed to excellence, setting the standard for public research universities in teaching, research, service, and extension for the benefit of the citizens of Colorado, the United States, and the world.

EDITOR
Peg Kowalczyk

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COMMENT

Summer 2011 • Issue 8, Vol. 5

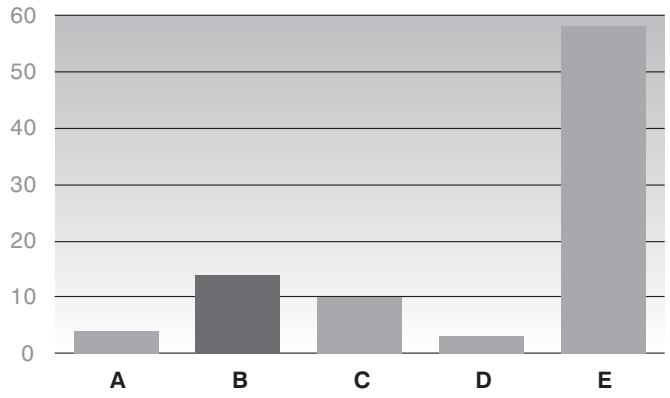
Comment reviews key issues relevant to faculty and staff at Colorado State University.

Teaching with Technology: Clicker @ Colorado State

You're sitting in MIP 300, General Microbiology, and Professor Erica Suchman announces, "Your neighbor's child has been diagnosed with a disease that causes the child to make no IgG antibodies." She then asks, "Which of the following functions would this child still be able to perform at normal levels?"

You don't raise your hand – no one does – but you see the following options on the screen in front of the classroom: A. Stop viruses and toxin from binding to cells; B. Activate CTLs that kill infected cells; C. Increase the activity of phagocytic cells; D. Fix complement; E. The child would not be able to do any of these at normal levels.

You select "E" by clicking a button on the remote in your hand. Within seconds, your response and those of your classmates are fed by a radio-frequency signal to Professor Suchman's computer. Software records, analyzes, and graphs the responses, and the following results are projected on a bar graph in the front of the class:



A. Stop viruses and toxin from binding to cells
B. Activate CTLs that kill infected cells
C. Increase the activity of phagocytic cells
D. Fix complement
E. The child would not be able to do any of these at normal levels.

Your response was incorrect. The answer is B. Why? "A, C, and D require IgG; activating CTLs requires T-helper cells but not IgG," explains Suchman.

In a click, a classroom response system is at work at Colorado State University.

Gone (almost) are the days when students sit passively in a lecture hall, take notes on a legal pad, and fake attentive interest in the lecture. While many students have swapped legal pad for laptop, they also have traded in-class unresponsiveness for an active approach to learning through classroom response.

With a classroom response system, called CRS, the teacher poses a question, and students determine their answers and select the corresponding button on a clicker – a hand-held transmitting device about the size of a television remote control. An infrared or radio-frequency signal beams the responses to a receiver attached to the instructor's computer. Clicker software sorts and collates the signals and produces a graph, which is projected in the front of the room and displays how the students responded.

Clickers encourage participatory learning from students and responsive teaching from instructors by providing immediate feedback about the classroom lesson.

Using clickers

Instructors can use clickers to:

* Engage students. Clickers require action by students, who become engaged anticipating whether their answers are correct.
* Take attendance. Students respond to the question, "Are you here today?" Or, the instructor can track attendance by noting if the student clicks at least once during class.
* Assess real-time learning and comprehension. Students respond to questions throughout the lesson, which provides immediate feedback that they are "getting it." Instructors can modify the lesson accordingly, based on student responses.
* Give quizzes and tests. Instructors can ask multiple-choice and yes/no questions, among other options.
* Poll for opinions or demographic data. Polling can provide information about the composition and collective views of the class.
* Record student participation. While the class doesn't know how individual students respond (histograms represent the collective responses of the group), the instructor can track individual answers.
* Track homework. Students record their answers to homework questions outside of class and submit their answers via the clickers at the start of the next class.

"Lively discussions will likely occur when the histogram showing the percentages of students responding one way or another in a class emerges on an overhead," says Sandy Chapman, associate director of The Institute for Learning and Teaching at CSU, or TILT.

For students engaged in comparing their responses with those of the rest of their classmates, clicker-use elevates active participation over passive observation, says Chapman. "For instructors trying to gauge how well students have grasped concepts, classroom response systems provide immediate, real-time feedback by which misconceptions can be determined and addressed."

In pre-technology days, students knew they were "getting the lesson" only after weeks of attending classes, taking the dreaded mid-term, and receiving their exam grade. CRS, on the other hand, requires students to be active learners during class, rather than passive note takers, and can help gauge comprehension much more quickly (with less after-the-fact damage to students' grades when mid-terms no longer serve as the first comprehension barometer).

"Many students think you can learn biology solely on memorization," says Suchman, one of the first faculty members to incorporate clicker technology at CSU and a master teacher who serves as chair of the national Committee on Technology Enhanced Education for the American Society of Microbiology. "CRS shows students what it means to really understand a concept."

With CRS, passivity is not an option in Suchman's classes, where students receive extra credit for responding and points for class attendance – if they don't miss more than two lectures per semester. Gone are the days of manually taking attendance. If students clicked at least once during class, they were in attendance, notes Suchman.

In classes of more than 100 students, having a teaching assistant to grade homework is ideal, says Suchman. In the absence of TAs, CRS can step in.

Suchman first learned about CRS quite by accident, at a meeting in Britain in 2004. "Shortly after, my book seller said, 'You could partner the text with this clicker.'" Suchman soon clicked on board.

The concept also caught on with several other CSU faculty members, who along with Suchman worked to encourage University standardization so students wouldn't have to purchase different clicker models for various classes. In fact, in 2006 Suchman and colleagues from the Department of Microbiology, Immunology, and Pathology; the School of Education; and the Office of the Provost conducted a study on clicker technology at CSU and published the results in the journal *Microbiology Education* (see story "CSU Professors Test CRS technology in Classroom").

Colorado State University formally adopted CRS in 2007 to increase student engagement in the classroom, and i>clicker technology was selected as the campus standard, says Sally Hibbitt, director of professional development for TILT and the Help Desk for Morgan Library. Hibbitt also coordinates CRS training for faculty.

While CSU students have not formally evaluated the technology, when a subcommittee of the Classroom Review Board assessed various response system options in 2007, a student representative of the University Technology Fee Advisory Board weighed in, says Hibbitt.

How are students responding to the technology? Suchman says in each course she teaches, she asks students for feedback about the clickers. "Universally, students are pretty positive about the technology. It helps them to understand the concepts better, stay engaged, and more quickly know when they are not getting it."

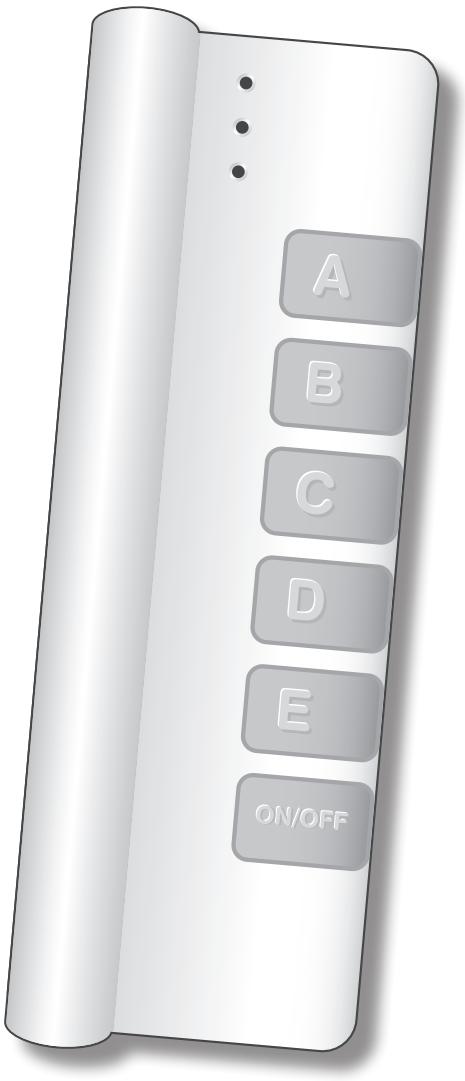
About 30 percent of general assignment classrooms, 49 out of 159, are equipped with i>clicker technology (listed at **http://clicker.colostate.edu/Requirements.aspx**). Additional classrooms can be set up with base stations upon request from instructors, notes Hibbitt.

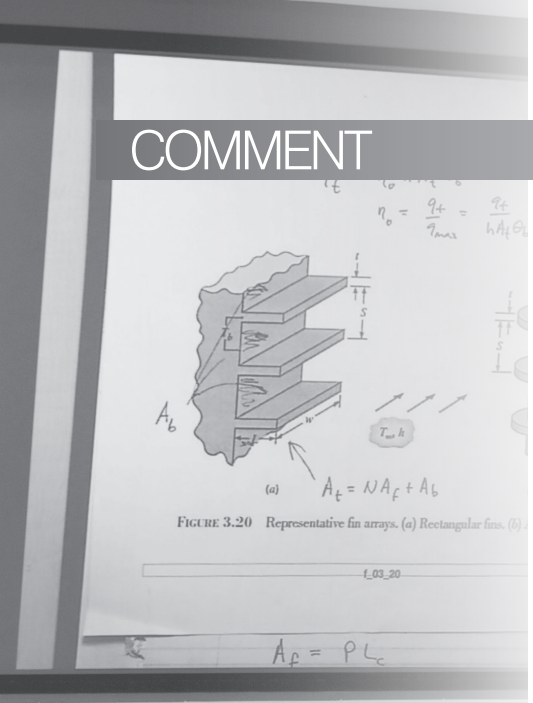
Clickers cost students $40 and are available in the Colorado State University Bookstore. A limited number of used remotes also are available at the beginning of each semester, but they go fast, says Margaret Gearhart, CSU Bookstore associate. An i>clicker remote bought for one class can be used in all classes using the technology. In Spring 2011, clickers were used in 108 courses/sections.

Birth of i>clickers

The technology of i>clickers began with physics – a team of University of Illinois physicists in 2002 began experimenting with ways to facilitate student polling, using such devices as flash cards and their own hand-crafted clickers. The publishing group Macmillan provided funds to support the university innovation. An i>clicker patent was filed in 2004 with the U.S. Patent and Trademark Office, and as early as 2005, several textbook publishers were writing questions designed to be answered by clickers and packaging the devices with their books. Today 1.5 million students at more than 800 institutions in North America use i>clicker.

Sources: i>clicker; *The Associated Press*





Faculty members can learn how to set up i>clicker to begin polling students on the first day of class and exporting grades into RamCT, explains Hibbitt. Training sessions are generally offered before the beginning of fall and spring semesters, and Webinars can be scheduled through http://iClicker.webex.com.

Technology in teaching is changing rapidly, and today's Millennial students are wired with expectations. Some educators are concerned that students are not coming to class, says Suchman, but with clickers, poor attendance has not been her experience.

Clicker words of wisdom? Start small with clickers, such as using one question a class. Tweak, then add questions, suggests Suchman. "The solution is to use technology to create a course that's value added, a reason to come to class." *Comment*

Access **http://clicker.colostate.edu/** for more information.

CSU Professors Test CRS Technology in Classroom

Colorado State University has incorporated a classroom response system, or CRS, since 2007. A year before implementation, several CSU faculty and staff members evaluated the impact of CRS in a microbiology course and published the results in the journal *Microbiology Education*.

Erica Suchman and Ralph Smith from the Department of Microbiology, Immunology, and Pathology; Kay Uchiyama from the School of Education; and Kim Bender from the Office of the Provost compared two classes to determine if augmenting lectures with CRS technology increased student learning, confidence, attendance, and the instructor's ability to respond to students' misconceptions, rather than simply using the CRS as a quizzing tool.

In Section B the instructor used the CRS technology at the beginning of the class period, posing a question on content from the previous class. Students could earn extra credit if they answered the question correctly.

In Section A, the class began with an extra credit CRS question, and CRS questions were integrated into the lecture during the entire class period.

Students in both sections were asked the same questions on examinations. All questions came from common lecture content, some without CRS use, and some questions where Instructor A used both lecture and CRS questions.

The results? Section A students scored significantly better on both types of examination questions.

"Because the students did not perform better only on the questions that were presented both with lecture and CRS questions, these increases in student learning could not be attributed to CRS use," says Suchman. "However, the fact that students who used the CRS technology throughout a class, rather than only at the beginning of class, performed better on all questions suggests that using this technology as more than just a quizzing tool may translate to greater learning of those topics not covered by CRS questions."

This may be due to students participating in activities during class that show them the level of understanding the instructor expects, explains Suchman. "Furthermore, student survey data showed that students in Section A expressed higher confidence levels in their learning and knowledge and indicated that they interacted more with other students than did the students in Section B. In addition, Instructor A recorded more modifications to lecture content when students did not understand the material and recorded more student interaction in the course than did Instructor B." *Comment*

Access the study *Evaluating the Impact of a Classroom Response System in a Microbiology Course* at **http://clicker.colostate.edu/docs/CRSSuchman.pdf**.

21st-Century Classes Tap into Lecture Capture

What teaching technology is emerging on CSU's campus? "Right now, I'm hot on lecture capture – Camtasia," says Erica Suchman, microbiology professor. Capturing a lecture?

Lecture capture circa 1980 meant furiously taking notes in an attempt to record what you should know for the test. (The average professor speaks at 120 words per minute, but students write approximately 20 words, says Isaac Segal, CEO of the class-capture company Tegrity.)

Today, lecture capture refers to technology that allows instructors to record what happens in their classrooms and make it available digitally – delivered to podcasts, mobile devices, or laptops – enabling students to dispense with frenzied note-taking and focus on comprehension, study at their own pace, and review material at a later time.

Not all technology is created equal, though. "You've heard of 'death by PowerPoint'?" Suchman asks, referring to the state of boredom and fatigue induced by information overload during slide-based presentations.

Suchman prefers to breathe life into her lectures, and Camtasia Studio allows her to capture her voice and, concurrently, her clicker questions, diagrams, annotations, and, yes, even her PowerPoint slides, creating a voice-over for her presentation. "Students have an advance outline of what we will be talking about, but in class we create diagrams and illustrate what's in our notes and use clickers to apply this knowledge to questions," she says. The video of the PowerPoint and accompanying clicker questions, diagrams, and audio can then be loaded and viewed on iTunes U.

Capturing lectures

What do students experience as they use lecture capture? Check out Professor Erica Suchman's General Microbiology class, MIP 300 (or other class sessions at Colorado State):

1. Link to iTunes U at Colorado State University at http://itunes.colostate.edu/. (iTunes must be installed on your computer).
2. Enter your eID name and password.
3. Go to the "academics" bar and link to "Microbiology, Immunology, and Pathology" (three classes in the department currently are using the technology).

CAT Got Your Computer?

While you may be competent at navigating Microsoft Word, Excel, and Outlook, many more applications exist to make work life more efficient. Quite simply, you likely don't know what computer skills you may be missing.

CSU's Computer Applications Training, or CAT, offers no-fee workshops for faculty, staff, and graduate students. Hands-on sessions are scheduled five times a year — twice each semester and once in the summer – on such applications as Windows, MSOffice 2010, Photoshop, Dreamweaver, InDesign, Camtasia Studio, and Secure Meeting, says Fran Campana, training manager for computer applications. More than 2,000 CSU faculty members, staff members, and graduate students receive training each year.

In addition to training, CAT staff members consult on various University-standard software applications, customized classes, and software upgrades. "We also see a lot of undergraduate students who need help with graphing and Web design," says Campana.

Increasingly, graduate students are taking advantage of CAT's services. Beginning Jan. 1, 2011, Colorado State University required the electronic submission of master's theses and Ph.D. dissertations.

"Graduate students are requesting training to properly format and submit their work electronically to ProQuest/UMI, the University's digital dissertations and theses database," Campana says. Electronic theses and dissertations are formatted traditionally (with pagination, tables, figures, references, etc.), but are saved as PDF files and submitted electronically. (The work is later archived and stored in the CSU Digital Repository, an open-access showcase of CSU research, scholarship, and creative endeavors.)

What's on the CAT horizon? "We're adding an online video library of topic-specific tutorials, building the library over the summer," says Campana.

"Customization is key," notes Campana. As technology changes, needs change. CAT aims to meet those needs. *Comment*

Access CAT workshops at http://lib.colostate.edu/cat/, or contact Fran Campana at 491-7976. CAT training is typically held on the first floor of Morgan Library, Classroom 1.

Stop, Rewind, Replay – CSU Tests Online Training

Photoshop, Flash, Dreamweaver, Logic, Illustrator, Office. Do you (really) know how to use your software? Colorado State University students, faculty, and staff have 24/7 access to more than 60,000 lynda.com video-based tutorials – through June 30, when CSU's yearlong test license expires.

The online training, funded by an initiative of the University Technology Fee Advisory Board and the Office of the Vice President for Information Technology, makes available the entire library of the lynda.com tutorials, which includes the product suites of Adobe, Apple, Microsoft, Google Apps, Drupal, video editing, audio editing, and operating systems. Tutorials contain up to eight hours of instruction per subject area, broken down into five- to 15-minute segments.

During the academic year, faculty members incorporated the modules into their classes – Professors Lauren Kalash in AGRI 320 (Computer Applications in Agriculture), Rosa Martey in JTC 211 (Computer-Mediated Visual Communication), Candace Ryder in BUS 150 (Business Computing Concepts and Applications), Pete Seel in JTC 335 (Digital Photojournalism), among others – and students accessed the tutorials independent of coursework, says Don Zimmerman, professor of technical journalism.

Zimmerman and Pete Seel, also a professor in the Department of Journalism and Technical Communication, were instrumental in bringing the lynda.com trial tutorials to Colorado State. In addition to providing students with learn-at-your-own-pace primers, the license gave faculty and staff access to the training, says Zimmerman.

While the University has opted not to review the license because of a substantial price increase, the trial year provided some insights, says Zimmerman. Most notably, the out-of-class training sessions closed the competency gap, bringing some students up to software-savvy speed without holding back the advanced students, an educational approach that allows professors to focus on more complex concepts in class.

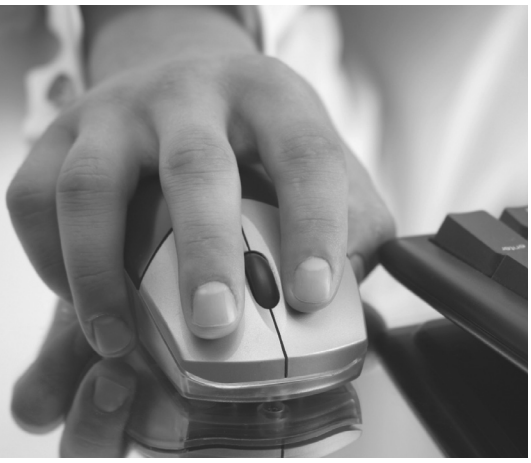
"Lynda.com also provides a training approach that models the lifelong-learning format students will experience when they step into in the world of work," says Zimmerman. Today, corporations aren't as readily funding hands-on training workshops at off-site locations – training that often requires pricy registration fees, travel reimbursement, and employee time away from the office.

What happens when lynda.com disconnects on July 1? "My sense is that our department and other departments on campus will explore similar training alternatives," says Zimmerman. "The lynda.com modules have been particularly helpful to our students."

Check out lynda.com. Access the tutorials at http://lynda.colostate.edu/, enter your eID e-name and password, and search for topics of interest to hone your skills – at least through June 30.

Who is Lynda in lynda.com?

The computer-training-module's namesake is Lynda Weinman, co-founder and publisher of training software books, who started producing videos to support the texts. Lynda.com is among the fastest-growing U.S. businesses, according to *Inc.* magazine, ranking 12 in the publication's 5000 Top Education Companies category.



Lynda.com counts

The following statistics document the Lynda.com online software-training at Colorado State University for an eight-month period, from August 2010 to March 2011.

30,408	Number of site visits
6,515	Number of users
19,858 or 65.3%	Visits by students
5,385 or 17.7%	Number of visits by staff
1,863 or 6.1%	Number of visits by faculty
3,301 or 10.8%	Number of visits by "other"

Source: *Lynda.com Usage Report*, **http://wsnetdev.colostate.edu/cwis24/LyndaReports/**.

What did you access?

Top 5 lynda.com modules the CSU community accessed, through Nov. 30, 2010.

Title	Views
Access 2010 Essential Training	2,702
Photoshop CS5 Essential Training	2,157
Photoshop CS5 for Photographers	1,716
Dreamweaver CS5 Essential Training	1,621
XHTML and HTML Essential Training	1,293

▶TALKING POINTS

Computers Challenge Human Intelligence

Sci-fi or future technological reality?

IBM supercomputer Watson made national news in February in a man-against-machine match-up on the quiz show *Jeopardy!* Watson was victorious. Later that month, Watson was pitted against five members of the U.S. House of Representatives in an exhibition contest and again emerged as the overall winner (although Rush D. Holt, Jr., D-NJ, and former *Jeopardy!* contestant, led in the only round he played).

Despite the theatrical software victory, machine still needs man as teacher – at least at Colorado State. The University News Service in January reported that CSU professor and computer scientist Bruce Draper and his research team will teach computers to "learn," with a $625,000 grant from the U.S. Department of Defense.

The goal, says Draper, is to help computers deliver critical, real-time information without human involvement. The process is complex – the team will work two years on the project – and the researchers will teach the computers to understand the images they process, a skill that eventually could help the U.S. military with remote surveillance.

Similar CPU tutorage is occurring at universities across the county.

While machines have not yet trumped humans as thinkers, the technology may not be too far off, according to recent media headlines. Computer technology is now progressing more each hour than it did in its entire first 90 years, reports *TIME* columnist Lev Grossman in the magazine's Feb. 21 cover story "2045: The Year Man Becomes Immortal," which details the futurist prediction that technological progress will become so rapid and complicated that our ability to foresee its consequences will diminish completely, and those who don't keep pace will find civilization to have become completely incomprehensible. (That *TIME* story includes the cautionary footnote: "If you believe humans and machines will become one.")

While this concept for many is still the stuff of sci-fi, such well-known futurists as Raymond Kurzweil and Vernor Vinge say the phenomenon could occur as early as 2045. This beyond-human-intelligence theory, coined the Singularity, will occur when technology accelerates beyond the ability of humans to understand, futurists contend.

The concept of accelerated technological progress has been reinforced for years, notably after Intel co-founder Gordon E. Moore wrote in 1965 that the rate of technological development and advances in the semiconductor industry and the complexity of integrated circuits doubles every 18 months.

Computer champ processes flubs

In the *Jeopardy!* man-against-machine match-up of wits, computer Watson (named for IBM's first president, Thomas J. Watson) had access to 200 million pages of content consuming four terabytes of disk storage, according to *PC World*, including the full text of Wikipedia (a reference site Colorado State doesn't necessarily encourage students to source). "Watson searches for matches and then uses about six million logic rules to determine the best answers," writes Joab Jackson, of IDG News, in "IBM Watson Vanquishes Human Jeopardy Foes." Software-wise, among other systems for analyzing unstructured data, Watson uses a natural language processing program called DeepQA that can understand a human sentence – a program that differentiates Watson from a typical search engine. In addition to methodically analyzing the various components of questions – names, dates, locations – the software also examines the phrase structure and the grammar of the question. "While Watson performed flawlessly in many cases, it was also capable of flubs even casual *Jeopardy!* watchers could laugh at," writes Jackson. Watson missed a question asking for the name of a well-known grammar reference book, *The Elements of Style*. "To this question, Watson had inscrutably and confidently answered 'Dorothy Parker.'"

Computing king

"I for one welcome our new computer overlords."

– Ken Jennings III, computer scientist and quiz-show champion, writing on his answer board in the final *Jeopardy!* round against the IBM computer Watson, referring to a line from *The Simpsons* episode "Deep Space Homer"

This trend, which also was a theme in the popular 1970 book *Future Shock*, by Alvin Toffler, has occurred for more than half a century and is expected to continue, possibly until 2020.

Former professor of mathematics at San Diego State University, computer scientist, and author Vernor Vinge re-introduced Singularity in 1993 as a science-fiction subject, writing: "Within thirty years, we will have the technological means to create superhuman intelligence. Shortly thereafter, the human era will be ended." Since then, other futurist writings have kept the concept alive.

Exponential growth in computing power? Technological change that will transcend our ability to comprehend? Superhuman intelligence? "(E)ven if they're dead wrong about the future, they're right about the present," Grossman writes.

Such speculation continues to fuel the futuristic fires. *Comment*

Top 6 Technologies to Watch in Higher Education

Where is CSU on the tech continuum?

Mobile devices and electronic books are one year away from transforming education, according to the *2011 Horizon Report*, which identifies emerging technologies that will have an impact worldwide in the next five years.

The report, a research venture of New Media Consortium and EDUCAUSE Learning Initiative, identifies six technology trends that will affect higher education – innovations that can change what it means to work, learn, and earn a college degree.

Weighing in on this watchful technology for Colorado State University is Patrick Burns, vice president for information technology, who oversees administrative computing, academic computing and networking services, instructional technology infrastructure, and institutional research on the CSU campus. Burns also serves as dean of University Libraries.

1. Electronic books, popular in the consumer sector, are moving closer to mainstream adoption within educational institutions. While electronic books support note-taking and research activities, the technology had slowed in higher education due to limited availability, restrictive publishing models, and rights issues, according to the *Horizon Report*. E-books are moving away from the basic, digital reproduction of printed materials and incorporating interfaces to enhance the intellectual experience, transforming the way users interact with reading materials of all kinds. In addition to dedicated electronic readers, multifunction devices such as the Apple iPad and the Samsung Galaxy merge the utility of e-book readers with Web browsing and audiovisual, interactive, and social applications, augmenting the informational content of books and magazines. Adoption nationwide is likely in one year or less.

The technology at CSU?

IPad touch is taking over the solitary e-book reader, says Burns. The iPad tablet or slate is a real computer with a long battery life, Wi-Fi, and a big form factor. "What we are hearing is that students don't like the Kindle and e-textbooks – it's hard to open e-books to the proper chapter and page, it's cumbersome to highlight material in text, and it's even more cumbersome to do annotations." And, there is no real economic advantage, he says. "The designers will fix these problems over time, and people will then change their reading behaviors." Burns see a "Star Trek future" for such readers – we will talk to a computer and it will answer us – but he hesitates to predict how far and how fast e-devices and e-readers will trend in that direction and notes that such decisions are financial. "Publishers know how to make money and will control the reading-materials

landscape – not higher education – and eventually will elect to stop printing," says Burns. Delivery, storage, and disposing of hard-copy books are issues for publishers.

2. Mobile devices increasingly are a user's first choice for Internet access and will outnumber computers within the next year. Today, with easy mobile access, networked information and applications accompany users wherever they go. In fact, by 2015, 80 percent of people accessing the Internet will be doing so from mobile devices, according to mobile broadband manufacturer Ericsson. Resistance to the use of mobiles in the classroom had slowed adoption in many schools, according to the report, but institutions are finding ways to incorporate the technology that nearly all students and campus personnel use. The Internet no longer anchors users to a physical location via a cable within a wall but is pervasive and ever-present, accessible wherever there is a cell signal. Adoption nationwide is likely in one year or less.

The technology at CSU?

Burns says that Internet life at Colorado State is remote, 24/7, 365-days-per-year access in which people expect to work, learn, and study whenever and wherever they want. It has been reported that one-third of the global labor force will work from multiple locations in the next two years. At CSU, that trend is evident in the number of laptops and the Wi-Fi in use, says Burns. "We already are on the electronic leash." The next step is to ensure better wireless connectivity. Courses are increasingly online and hybrid (some online, some face-to-face), he says. The traditional concept of a college class is evolving. "We likely will see two days of lecture coupled with online content," contends Burns.

3. Augmented reality, the layering of virtual information over a 3-D space, supplements information delivered via computers, mobile devices, videos, and printed materials. Sometimes called blended reality (blending information and the real work in an experiential environment), the technology refers to the addition of a computer-assisted contextual layer of information over the real world, enhancing what exists. Some examples: Augmented reality is used in a tour of a city, in which GPS positioning and geo-tagging allow users to view information and 3-D historical images overlaid on contemporary buildings. Or, 3-D characters emerge from the pages of augmented reality books. Adoption nationwide is likely two to three years.

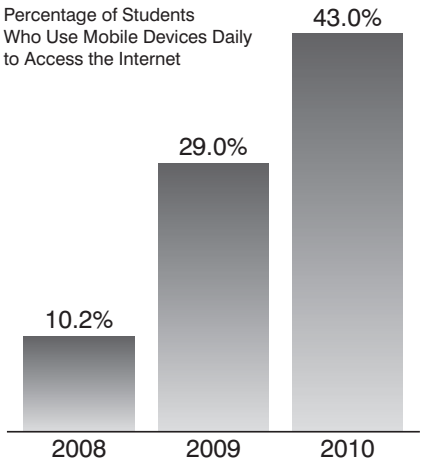
The technology at CSU?

Augmented reality is a reality at Colorado State, says Burns, on a small, test scale. The CSU Information and Science Technology Center, or ISTeC – directed by H.J. Siegel, Abell Endowed Chair and professor of electrical and computer engineering and computer science – promotes and facilitates innovative research and application of computer, communication, and information systems. While augmented-reality usage, growth, and innovation are limited at CSU, the University did make changes in its network to pass that traffic, says Burns.

4. Game-based learning gained traction in education when research linked game play and cognitive development. Games can connect learners in ways other tools and approaches cannot, enabling students to actively experiment with leadership, collaboration, problem-solving, and procedural thinking, according to the *Horizon Report*. Being dynamically engaged with issues, rather than simply reading about them, can lend new perspectives and personal involvement to subject matter. Alternate Reality Games, or ARGs, enable players to find clues and solve puzzles in experiences that blur the boundary between the game and real life. Some ARGs: The game *World Without Oil* requires players to process the first 32 weeks of a global oil crisis. Another, *Superstruct*, requires players to imagine themselves in a future world of daunting environmental, political, and health challenges. *Virtual Forensics Lab* instructs students to conduct forensics at a crime scene. *Melody Mixer* teaches students how to read and compose music and experiment with sound and composition. Adoption nationwide is likely in two to three years.

The technology at CSU?

Game-based learning is not a priority at CSU right now, says Burns. We don't see gains in upper-level science and engineering, for example, with this learning technology. We do see a use for 3-D



Source: EDUCAUSE Center for Applied Research

Colleges should go mobile

More than 40 percent of all college students used mobile devices to access the Internet last year, according to the educational-technology company EDUCAUSE, but colleges and universities are slow to integrate the technology into their operations. It is important to recognize the mobility of mobile devices and not treat them as if they were small desktop computer, reports *The Chronicle of Higher Education*. "Among colleges, even the leading mobile applications and Web sites still function like add-ons; students and others can get much the same information on a personal computer, although perhaps not as quickly." But that will change within a few years, contend many college administrators. Access the story "As the Web Goes Mobile, Colleges Fail to Keep Up" at http://chronicle.com/article/Colleges-Search-for-Their/126016/.

and LCD television, however. "Remember chemistry molecules with straws and balls? At CSU, we have a 3-D TV that displays these molecules and their interactions from a variety of vantage points," he explains. The technology eventually could make inroads in our educational environment. For example, Morgan Library houses large-format, 2-D map cases, about 3 feet by 4 feet. "How do we look at that on a 20-inch monitor?" says Burns. "High-res 2-D and 3-D video walls would allow us to look at entire maps or structures."

5. Gesture-based computing moves the control of computers from mouse and keyboard to the motions of the body through input devices. Today's students are accustomed to touching, tapping, swiping, jumping, and moving as a means of engaging with information (Nintendo Wii, Apple iPhone, iPad), and the proliferation of devices that incorporate gestural interactions will bring new user interface designs that move beyond the keyboard and mouse. The full potential of gesture-based computing remains several years away, especially in education, but 3-D visualizations can be used in simulation and training, such as for practicing surgical techniques or for providing fine-touch feedback for people with visual impairments, states the *Horizon Report*. The EyeMusic project at the University of Oregon, for example, uses eye-tracking sensors to compose multimedia productions. Adoption nationwide is likely in four to five years.

The technology at CSU?

"Gesture-based computing could be huge if it becomes real, but it is still highly experimental," says Burns. The technology could make good progress, Burns adds. "Will it permeate the laptop? It may."

6. Learning analytics is using data to track student progress, with the goal to revise curricula, teaching, and assessment in real time. A wide range of data produced by students is collected, interpreted, and used to assess academic progress, predict future performance, and spot potential problems. Student assignments, exams, online social interactions, extracurricular activities, posts on discussion forums, and other activities typically not assessed as part of the student's educational progress collectively help teachers tailor educational opportunities to each student's needs and abilities. Still very early in development, the *Horizon Report* notes, learning analytics faces challenges, such as integrating data from disparate sources and different formats, ensuring student privacy, and avoiding profiling. Adoption nationwide is likely in four to five years.

The technology at CSU?

"Like gesture-based computing, learning analytics will be huge, too," says Burns. The demand for accountability in higher education requires data and analytics, notes Burns, and access to data is key. "At CSU, we are ramping up our longitudinal data collection, moving past only storing a couple of years of data. This technology can help us do that." *Comment*

Access the complete *2011 Horizon Report* at **http://net.educause.edu/ir/library/pdf/HR2011.pdf**.

Report Identifies Key Technology Trends

The *2011 Horizon Report* advisory board projects four trends that will affect teaching, learning, and creative inquiry for educational institutions over the next five years, through 2015.

1. **Electronic education.** The profusion and accessibility of resources via the Internet increasingly challenge educators to revise how they can best teach and engage students. The use of online resources as open content, access to the Internet from mobile devices, and e-textbooks are changing the way educators interact with students.
2. **Remote, 24-7 access.** Today, people expect to work, learn, and study whenever and wherever they want. Mobile devices increase availability to the Internet, which feeds expectations for access.
3. **Collaboration.** The world of work is increasingly collaborative, a trend driven by global business and Internet technologies. Isolated desk jobs are disappearing. One billion people are considered mobile employees, and one-third of the global workforce – 1.2 billon workers – will work from multiple locations by 2013, according to market intelligence firm IDC.

4. **Cloud computing.** Technologies are increasingly cloud-based (provided over the Internet, or "cloud"), and IT support is becoming decentralized. This trend is influencing adoption at educational institutions. Mobile apps and the demand for immediate access are dethroning the desktop computer, moving data and services into the cloud. Privacy and control are issues.

Experts List Critical Tech Challenges

Technology adoption in higher education must consider constraints and challenges, none more central than individual organizational constraints. The *2011 Horizon Report* advisory board details current challenges institutions face in adopting new technology.

1. **Digital media literacy.** Such literacy, first noted as a challenge in 2008, is an important skill in every discipline and profession. What constitutes digital media competency, however, is not well-defined or universally taught. Digital technologies morph at a rate that often outpaces curriculum development, adding to the problem.
2. **Evaluation metrics.** Appropriate metrics for evaluation lag behind the emergence of new scholarly forms of authoring, publishing, and researching. E-books, blogs, multimedia pieces, networked presentations, and other academic work is not easily evaluated and classified according to traditional metrics.
3. **Traditional university models.** Economic pressures and new approaches to education are challenging traditional university models. The need to provide high-quality services while controlling costs impels institutions to seek creative solutions. Innovative institutions are developing new models to serve students – such as streaming survey courses over the network so students can attend from their dorm or other locations to free up classroom space.
4. **New developments in technology.** Keeping pace with the rapid proliferation of information, software tools, and devices can be overwhelming for institutions and users and requires sifting through a mountain of information on a regular basis. Incorporating the technology is time-demanding and cost-intensive.

Avoiding 'bleeding-edge' IT

Behind the scenes, Colorado State University's IT professionals continuously address technology requirements, minimize outages and redundancy, and back up multiple systems. While CSU is a leader nationally in adopting the Kuali Financial System (see story "CSU Boasts IT Financial First"), it can be dangerous to push some technology too soon, says Patrick Burns, vice president for information technology. "The leading edge is the bleeding edge," he says, about moving too fast to adopt first-wave technology. "At Colorado State, we carefully assess risk and value. We are being appropriately progressive. We have the right structures in place."

▸PLANS AND STRATEGIES

Governing IT at Colorado State

Campus paper-pushing has long been replaced with electronic storage and integration of information. (Simply thinking about paper today elicits the prompt: "Go green – think before you print.") That integration of information – the acquisition, processing, storage, and dissemination by microelectronics-based computing and telecommunications – was coined "information technology," decades ago. (The authors of a 1958 *Harvard Business Review* article poetically wrote: "The new technology does not yet have a single established name. We shall call it information technology.")

Information technology is not optional. Today, IT permeates nearly every facet of campus life. Even federal and state laws have seeped into the information-technology arena, mandating digital-system overhauls at universities to secure student data, for example. (House Bill 03-1175, enacted by the Colorado General Assembly in 2003, required each postsecondary institution in the state to take "reasonable and prudent steps to ensure the privacy of a student's social security number." Colorado State was fully compliant by 2007.)

Despite such importance and reach, IT is largely a behind-the-scenes phenomenon. The cyber-work required to keep Colorado State's information train on track appears seamless, ethereal. Internet access is 24/7. We work anytime, anywhere. We rely on cloud-based technology to do our jobs – processing class registrations, paying University bills, accessing student data, capturing digital lectures, checking degree-audit information, accessing our e-mail, scheduling meetings (even our paystubs must now be downloaded).

ACNS rolls up its service sleeves

Information-technology governance and oversight at Colorado State involves many professionals and advisors, but where does Academic Computing and Networking Services fit?

ACNS, the hands-on technology arm at CSU, rolls up its service sleeves to support the University's central computing requirements, providing e-mail (accounts, spam and virus protection, WebMail interface, and Microsoft Exchange), Web hosting (create a website), electronic calendar and scheduling, and contact and directory information, says Scott Bailey, ACNS interim director.

ACNS also manages CSU eID (your electronic identity, which provides secure authentication and authorization across multiple University electronic systems), Google Apps (e-mail, word processing, spreadsheets, calendaring, chat, template-based website service), RamCT (online learning-management system Blackboard, which students and instructors use for course materials, online class interaction, assignments, exams, and grades), RamPoint (the CSU portal), RamWeb (online access to class registration, financial information, personal records, University services), RAMtech (retail store in Lory Student Center, which sells computers, accessories, and software at educational discounts), telecommunications, classroom technology, and University Housing computing.

The ACNS reach is wide, adds Bailey. "Indeed, ACNS services, such as access to the Internet and the research and education networks (Internet2 and National Lambda Rail), are used daily by every student, faculty, staff, and researcher on campus."

As a CSU faculty or staff member, you may never interact directly with CSU's IT governance committees (see story "Governing IT at Colorado State"), but you are doing business each day with ACNS.

Information technology at Colorado State connects a chain of professionals who ensure that operations are efficient and effective, beginning with Provost Rick Miranda, chair of the Information Technology Executive Committee, or ITEC. ITEC oversees the IT environment and policy and is advised by the ITEC Advisory Council, or IAC, which is chaired by Vice President for Information Technology Patrick Burns. IAC reviews IT policy, operations, and management, referring policy issues up to ITEC for consideration and possible action.

Ultimately, ITEC provides oversight for computing (servers, desktop computers, applications), communications (voice, video, data), instructional technology, information services, information storage, back-up, archival and preservation, and information technology infrastructure. ITEC also addresses technology change as it affects instructional methods, research, outreach, and administrative processes, and develops the overall IT vision for CSU, which is integrated with the University's strategic planning and budgeting process.

Information-technology governance at CSU doesn't stop with Provost Miranda, Vice President for Information Technology Burns, ITEC, or IAC but encompasses other advisors, consultants, and students, including:

- **Campus IT Security Technical Advisory Committee –** investigates IT security technologies, periodically evaluates current practices and policies, disseminates information to campus.
- **Classroom Review Board, or CRB –** manages general assignment classrooms, including instructional technology, computer projection equipment, and Internet access.
- **College IT Administrators Council, or CITAC –** representatives from each college provide technical guidance to IAC and the deans to promote consistent application of technology across campus.
- **Communications Infrastructure Committee, or CIC –** manages upgrades to the University's communications infrastructure.
- **Windows Security Committee –** develops best practices for securing MS Windows workstations and servers.
- **University Charges for Technology Committee, or UCFT** – coordinates charges for technology in the eight academic colleges, including maintaining policies, compiling annual reports, and managing charges and proposed increases.
- **University Technology Fee Advisory Board, or UTFAB –** under the auspices of the Associated Students of Colorado State University, the board provides guidance and advice for the implementation of technology, reviews all University technology fee allocation requests, and ensures all allocations will benefit as many students as possible.
- **Subnet managers –** IT professionals coordinate and communicate IT matters across campus, including aggregated purchasing and site licensing, networking, and security.
- **Faculty Council Committee on Teaching and Learning –** oversees academic issues associated with technology in the teaching and learning environment, and advises ITEC on aspects of technology affecting faculty.
- **Ad hoc committees –** committees for specific applications are formed as needed.

IT checks and balances are in place. "This structure has developed over more than 20 years," says Burns, "and has proven very effective in operating and managing CSU's IT environment." *Comment*

University's Strategic Plan Incorporates IT

Shortly after Tony Frank became Colorado State University's 14th president in 2009, he announced he would focus on fundamental excellence in teaching, research, and outreach. The blueprint to achieve those fundamentals – and to measure successes, identify emerging concerns, and prepare for new initiatives – is CSU's strategic plan, says Frank.

Strategic Directions: Colorado State University Strategic Plan 2006-2015 details the University's objectives for teaching and learning, research and discovery, outreach and engagement, resources and support, and diversity. A three-year planning cycle assures the plan is dynamic – soliciting broad campus input and integrating regular updates to reflect new priorities, opportunities, and ideas.

Because this issue of *Comment* focuses on changing technology in higher education, we've outlined the information-technology goals for Colorado State through the lens of the University's strategic plan.

Colorado State's informational technology plan is a part of the bigger institutional picture and is incorporated into the overall strategic plan for the University, says Patrick Burns, vice president for information technology.

Among CSU's IT goals:

Create an IT environment required for student-focused learning, faculty research, service and outreach, and effective management. Colorado State will continue to invest in its technology infrastructure. These investments also will support improvements in financial and human resource management, student enrollment and academic record management, research data management, and internal and external communication.

Strategies: Continue with Kuali Financial System enhancements and Kuali Research System implementation as planned and support project budget; continue with efforts to upgrade the University's backbone IT network and enhance IT security and privacy.

Related metrics: Deploy initial Kuali Research System modules by FY11; initiate IT security events; progress in upgrading backbone, including upgrading capacity in LAN, upgrading off-campus connectivity, preparing infrastructure for new telephone technology.

Improve and increase learning facilities. Faculty and students will have access to state-of-the-art learning opportunities enabled by continuous assessment and improvement of classroom and laboratory media, facilities, and environments. CSU Libraries will be enhanced to meet the needs of the 21st-century land-grant university and be ranked highly among peer institutions based on access to information; training of students, faculty, and staff; and service to the University community.

Strategies: Enhance classrooms and laboratories with multimedia upgrades; assess the impact of classroom renovation on student perceptions; incorporate task-force report recommendations into CSU Libraries strategic plan; continually assess seating and high-density storage capability; increase investments in the Libraries through central funding and endowments.

Related metrics: Library ranking among peers in ARL assessments; number of classrooms equipped with instructional technology; usage rates and feedback by and from students with diverse abilities.

Construct and equip new laboratories and other research and library facilities and services to serve the needs of a growing research institution. New laboratories and central, core research facilities are essential both to assure research productivity and to attract world-class research professionals. We also must develop services and IT support services at levels appropriate for each discipline in which graduate-level education and research are conducted.

Strategies: Develop portfolio of research resources (handbooks, operating procedures, Web resources, technical updates); fully implement Kuali-Coeus Research management system; provide administrative/IT support commensurate with a world-class research program; implement base funding for Laboratory Animal Resources and core facilities; ensure new laboratory facilities or renovated existing facilities are aligned with campus physical development plan, including additional offices and lab spaces for net new-faculty hires.

Related metrics: Completed portfolio of research resources; successful implementation of Kuali-Coeus within established timeframe; changes in administrative/IT support numbers; implementation of base funding for LAR; completion of new or renovated research facilities.

Access the full report *Strategic Directions: Colorado State University Strategic Plan 2006-2015* at **http://www.president.colostate.edu/pdf/csu-strategic-plan-update-2006-2015.pdf**

information technology

(noun); abbreviation, IT: the development, implementation, and maintenance of computer hardware and software systems systems to organize and communicate information electronically. *(dictionary.com)*

▸FINANCES

CSU Boasts IT Financial First

Colorado State University was the first university worldwide to go live with the Kuali Financial System, or KFS, a comprehensive suite of financial software developed by higher-education institutions and partners to address the unique operating needs colleges and universities.

The KFS open-source system (which allows users to freely access, install, run, and modify original software) was designed to meet the needs of Carnegie Class institutions, which are required to keep detailed financial records subject to review by state and federal agencies.

In 2009, CSU took the lead nationally to implement KFS. At that time, the cost of a commercial financial network was more than $6 million, which didn't provide the full functionality that CSU needed. Colorado State's pioneering technological approach saved the University millions of dollars, provided the necessary system customization, integrated financial- and research-management functionality, and attracted national attention in the process.

CSU's innovative approach to maximize resources, its partnership in the development and launch of Kuali, and two years of prep-work to implement the new system brought the project in on time and at a fraction of the cost of our peers, says Patrick Burns, CSU vice president for information technology.

The new system is Web-based, allowing all authorized users easy, online access. (More than 400 CSU employees have been trained to use the system.) Documents in the system can be routed electronically for approvals and then electronically stored.

KFS tools and resources provide secure, effective, and efficient management of CSU's finances and resources. The old system only recorded financial transactions. "Kuali allows us to manage our finances," says Burns. "It's software designed by higher education for higher education." *Comment*

▸NUMBERS

Behind the (Academic) Record: Creating a Paper Trail in the Digital Age

They're the academic workhorses: student records, course registration, transcript processing, degree certification, enrollment verification. They're not the typical subjects of captivating water-cooler conversation; rather, these behind-the-scenes activities confirm a student's academic existence. No record? No proof the student has earned her bachelor's degree.

In the Colorado State Registrar's Office, these official University tasks demand the daily attention of more than a few information-technology and registrar professionals.

Senior Associate Registrar Chris Seng, who has clocked 18 years at Colorado State, talks with Comment about CSU's Student Information System and technological advances within the Registrar's Office. (Before working at Colorado State, Seng was a Peace Corps volunteer in the West African country of Guinea. Working with technology? "No, mostly boiling water," Seng responds with a laugh.)

CSU's life-force of electronic records, the Student Information System, or SIS, processes and stores critical student-course-registration data (see story "SIS and Next-Generation Networking at CSU"). When *Comment* came across the number of people in SIS – 719,204 – we were surprised. With about 26,500 current CSU students, who are the other 692,000 people in the system?

"SIS includes student records that date before 1950," says Seng. That's more than 60 years of records that have been meticulously maintained and transferred from paper to the current electronic system. "In addition to current students and applicants to Colorado State, SIS is the foundation system for CSUID and electronic identity, which includes all faculty and staff," adds Seng.

Managing such comprehensive – and historic – data brings us to the role of technology, which is at the heart of official academic record-keeping today.

What are the next tech developments likely to emerge in the Registrar's Office? "At some point we would like to deliver some of these services to mobile devices," says Seng. (We report in this issue that mobile devices are one year away from transforming education.)

Some CSU students are accessing RAMweb from their mobile phones, says Seng. "Today, we send a student a text message that a seat is open on a class wait list, but to respond, the student must go to a computer to log in to RAMweb." What would be ideal? "The student would simply text a message to accept or decline. If the student declines, we would then go to student number two on the wait list."

Stop the (physical) paper trail. "Another advance would be to never touch paper," says Seng. "We're building workflow processes to stop the physical routing of paper documents." Replacing the time-consuming practice with a more efficient electronic path would streamline the process. Currently, grade changes and updating GPAs are labor intensive, requiring physically sending paper documents from faculty member to department head to the Registrar's Office, explains Seng. "We could do this electronically."

But SIS offers a workflow that currently is electronically effective, and Seng and his colleagues ensure that the 2,700 faculty and staff users are properly trained. Technology requires maintenance, and system upgrades are necessary each year. "We don't want to create more work for our users," says Seng. "Our goal is to make the system seamless." *Comment*

SIS and Next-Generation Networking at CSU

At a recent Colorado State University Technology Fee Advisory Board, or UTFAB, meeting, more than a dozen committee members discussed the Student Information System, or SIS at CSU – its use, online wait-list registration, enforced prerequisites and in-progress courses, and such future projects as the collection of local addresses, implementation of lawful presence driver's license verification, implementation of electronic grade changes for instructors, addition of last-day attendance for failed or dropped classes, enhanced security for maintaining employee demographic data, integration with RamCT replacement, document imaging, parental access to RAMweb, digital transcripts, and transfer equivalency – a constantly evolving list of electronic issues. And that was just one meeting.

Colorado State's Student Information System, known as ARIES, processes and stores information related to students, courses, and registration – including the University catalog, class schedule, admissions, billing, financial aid, student term records, and academic history. Each academic department at CSU is supported by SIS, as well as Admissions, Business and Financial Services Accounts Receivable, CASA, Catalog and Curriculum Administration, Division of Continuing Education, Graduate School, Institutional Research, Registrar's Office, Student Financial Services, and Summer Session Office.

Colorado State's Bob Engmark, director of information systems; Christopher Seng, senior associate registrar; and Rusty Scott, associate director of ACNS, provided the following data about the SIS system.

Who uses SIS?

719,204	Number of people in system (includes student records dating from before 1950, current students, applicants to CSU, current faculty and staff, former students, and former faculty and staff with records)
28,329	Number of students in system, Spring 2011 census
2,700	Number of faculty and staff members with SIS access
54,384	Number of RAMrecord accounts (alumni with self-service access to transcripts, address updates, and other student-record information)
36,454	Applicants for admissions to CSU in 2010
3,894,939	Number of RAMweb logins for 2010 (to access class registration, financial information, personal records, University services)
833,831	ARIESweb logins (to access class lists, application information, advisee lists, degree audits, etc.), Academic Year 2009-2010
128,000	Approximate number of grades entered by faculty (includes all individual course-section enrollments), Fall 2010
7,101	Class course sections, Fall 2010
14,074	Academic major and minor changes processed, Fall 2010
$235,000,000	Approximate financial aid disbursed, Fiscal Year 2010
36,010	Official academic transcripts produced, Academic Year 2009-2010
189,662	Degree audits run on RAMweb/ARIESweb (this self-service degree-audit report tracks progress toward degree completion, including major, minor, core curriculum, interdisciplinary study, NCAA academic requirements, etc.), Academic Year 2009-2010
1,706,010	Documents imaged (131 different documents are used by Admissions, Registrar's Office, and Student Financial Services, including change-of-major forms, high school transcripts, transcripts from other institutions, admissions application materials, graduation contracts, grade-change forms, letters of recommendation, marriage and birth certificates, etc.)
2-plus	Years it took to scan the above 1,706,010 documents (each document is given an index number that correlates to each student's record)

▸CSU QUOTABLE

Star power

"As a land-grant university, providing anyone with the talent and motivation to make a difference in our world must always remain our North Star."

– Tony Frank, Colorado State University president, about the importance of access to a college education and the bill President Obama signed in March overhauling the nation's student loan program
(*The Fort Collins Coloradoan*, "Obama signs bill to change student loan program, increase Pell Grants")

Rings of history

"Humans have burned, suppressed fire, harvested, planted, and marked trees for centuries."

– Laurie Huckaby, ecologist with the U.S. Forest Service Rocky Mountain Research Station, about the documentation of trees in human land-use records, information that can help us manage landscapes to be resilient to changes in the future
(GreeleyTribune.com, "History museum to present importance of trees in human record")

Genetic wild side

"If the test results come back showing they are 100 percent pure, then it is a valuable herd, definitely worth keeping."

– Temple Grandin, professor of animal science, about Denver's municipal herd of bison
(STLtoday.com, "Bison once more walking on the genetically wild side")

Ag action

"This is a call to action. Agriculture must be central to problem-solving."

– Craig Beyrouty, dean of the College of Agriculture, about seeking new ways to advance the state's thriving agricultural industry while revitalizing rural communities, in light of the statewide urban population growth of 17 percent – almost double the nationwide growth rate – and the population decline in rural communities
(*The Fence Post*, "Governor's ag forum provided a look at future of industry")

Fueling a 3-D future

"It's going to take a new generation of batteries to do so, and we hope our 3-D battery is poised to be at the forefront."

– Amy Prieto, chemistry professor and founder of Prieto Battery, about her prototype that uses copper nanowires to store twice as many lithium ions as conventional lithium-ion batteries, which could be the ideal battery for an electric car
(Wired.com, "Future of batteries may be 3-D")

Maximizing technology

"Some faculty have found innovative ways to use their HP tablets to grade student homework papers, then resubmit the documents back to students electronically."

– Jon Schroth, information technology director for the College of Business, about how flexible-technology solutions enable faculty to effectively interact with students
(KXO Radio, Los Angeles, Calif., "Increasing graduation rates through technology")

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CSU QUOTABLE

Food failure

"There can be hot spots far away from an accident and places in between that are fine."

– F. Ward Whicker, professor emeritus of environmental and radiological health sciences, responding to the abnormal levels of radiation in foods following the earthquake and tsunami that crippled a nuclear plant in Japan
(The New York Times, "Radiation, once free, can follow tricky path")

Wishing back water

"Once you move water out, it ain't coming back to the land."

– Jim Valliant, irrigation specialist for the Colorado State Extension station in Rocky Ford, about towns that sell water rights to satisfy urban demands along Colorado's Front Range
(Denver Post, "In Crowley, 'plug's already out of the tub'")

Bear sink

"Aspen should be a source, because it has such good habitat, but it may be a sink because of the euthanizations – because of conflicts."

– David Lewis, CSU graduate student in fish, wildlife, and conservation biology, who is tracking bears for the Roaring Fork Urban Bear Ecology Study, to determine if the area's bear population is increasing or decreasing
(Glenwood Springs Post Independent, "Is Aspen a 'sink' or source for bears?")

Aging drinkers

"Not good enough."

– Lindsay Sharp, CSU doctoral candidate in counseling and psychology, about the limited screening of older patients for alcohol and drug use – which can exacerbate heart damage, depression, and arthritis pain and interfere with medications older people often take, citing that physicians don't look for alcohol problems because they believe older people can't or won't stop drinking anyway
(*The New York Times*, "The aging drinker")