The purpose of higher education is to equip students for success in life—in their workplaces, in their communities, and in their personal lives. Yet though this purpose has remained constant for centuries, colleges and universities themselves are undergoing major change. The campus, the library, the refereed journal article, the classroom, and the traditional-age student—common features of higher education today—may be inadequate in describing higher education tomorrow.
Consider a few changes already evident:

- Formal, traditional boundaries are becoming more permeable and porous. Interdisciplinary fields (e.g., nanotechnology, bioethics) are increasing. Leading faculty are being recruited worldwide. The physical constraints on when and where students participate in education are being removed through open and online education and competency- or experience-based credentialing.

- The classroom is no longer limited to a three-dimensional space for the dissemination of knowledge. Students have virtually limitless access to information, faculty, tutors, and each other. Digital libraries and repositories make materials instantly accessible. And learning is increasingly facilitated by exploration, interaction, and problem-solving. Thanks to large datasets and collections, students at small or remote campuses have access to large-scale resources.

- The library is not defined as a building for books. Many disciplines rely almost exclusively on online resources—whether books, journals, data, or artifacts. Students may consider the library more as a social place than a site for the reference desk or physical books. In addition, the size of library collections becomes less critical in an era when Google and other large-scale digitization projects make it possible for any institution to have access to millions of books.

- The digital environment is a “place” for social interaction and community exchange. Although the value of the campus as a physical place continues, an increasing number of interactions for students, faculty, and staff happen online, including the emergence of virtual, multinational research organizations.

- Scholarship and research are becoming more “conversational.” There is less reliance on communication through formal publications as an increasing number of exchanges occur through e-mail, preprints, and monitored blogs. The journal article may continue to serve as a means of credentialing authors for the purposes of promotion and tenure, but scholars’ contributions to a field are likely to be posted elsewhere.

- Digital technology and the unprecedented scale of data, as well as the nearly limitless ability to reconstitute the data, have altered the conduct of traditional research and scholarship. Theory and experimentation have been augmented with computation involving modeling, simulations, and visualization.

- The more traditional model of a university or college providing most of its services physically on (or near) a campus is changing. More and more services and programs originate offsite and are shared, distributed, or aggregated by other colleges and universities or outsourced agencies.

To address these changes, the Council of Australian University Directors of Information Technology (CAUDIT, http://www.caudit.edu.au/), the U.S.-based EDUCAUSE (http://www.educause.edu/), the United Kingdom’s Joint Information Systems Committee (JISC, http://www.jisc.ac.uk/), and the Netherlands’ SURFfoundation (http://www.surf foundation.nl/en/) undertook a collaborative visioning of the future of higher education. Although information technology is the focus of all four of these associations, the resulting white paper (from which this article is drawn) explores higher education overall, not just information technology. The value of information technology lies in the activities it supports, which span virtually every college and university system—for managing finances, learning, research, security, sustainability, and more. IT professionals thus need to understand the larger issues faced by their institutions: the drivers of change and the enablers, themes, and questions for the future.

Drivers of Change

A complex and adaptive system, higher education is influenced by trends in the larger society. Although Australia, the United States, the United Kingdom, and the Netherlands differ in many ways, similar forces are driving change in higher education in all four countries.

An Expanding Market

The number of students pursuing higher education has skyrocketed worldwide, growing from 28.6 million in 1970 to 152.5 million in 2007. And the demand for postsecondary education continues to rise, due to government policies, growing populations, and/or increasing affluence. For example, whereas the current higher education system in the Netherlands was designed in the 1950s for a participation rate of about 5 percent, that rate is now 47 percent. Across the United Kingdom, undergraduate enrollments in higher education institutions have increased by 25 percent overall from 1998–99 to 2007–8. In the same period, non–European Union (EU) international student enrollments in the United Kingdom have also increased by 25 percent (with China being the largest provider). Perhaps most important, the demand for postsecondary education will grow because more jobs and careers will require education. In the United Kingdom, the number of skilled jobs still outnumbers the supply of students with higher education qualifications, so the government is committed to increasing participation. Rapid changes in jobs, fields, and companies will result in more career transitions during a person’s lifetime, also necessitating additional education. Some national goals illustrate the demand for postsecondary education:

- By 2025, 40 percent of Australians 25 to 34 years old should have degree
qualification. By 2020, 20 percent of undergraduate enrollments should be from low socioeconomic status groups.9

- By 2025, 60 percent of the U.S. population should hold “high-quality college degrees or credentials.”10
- By 2020, 50 percent of the Dutch labor force between the ages of 25 and 44 should hold a higher education degree.11
- By 2010, close to 50 percent of those in the 18-to-30 age group in the United Kingdom should be participating in higher education.12

**Financial Support**

A global economic downturn began in late 2008, and most educators and economists do not expect funds for higher education to return to previous levels. Although economies may improve, competing funding demands from health care and retirement will continue to squeeze higher education funding.

**Cost of Education**

In most countries, the cost of higher education has risen due to infrastructure, labor, and service costs. When those costs are passed on to students and their families through tuition and fees, affordability can become a challenge. Although free tuition may not lead to increased student success, costs (for tuition, fees, books, and housing) can put education beyond the reach of qualified students.

**Efficiency and Productivity**

Institutions are looking for ways to reduce costs and increase efficiency, particularly in non-differentiating tasks found in areas such as finance, human resources, and information technology.11 Although “home-grown” was associated with “uniqueness” in the earlier days of information technology, the emergence of viable commercial services is leading colleges and universities to determine which core services must be resourced on campus and which services are more efficiently supplied through contractual relationships (whether with corporations or other institutions).14 As Jamie P. Merisotis, president of the Lumina Foundation for Education, has noted: “Higher education must become more productive so that it can increase capacity and serve more students.”15

**Sustainability**

Sustainability is an increasing focus of higher education—for research, education, and operations. Although information technology contributes to environmental challenges (e.g., generating greenhouse gases, disposing electronic equipment and the hazardous materials it contains), information technology also offers opportunities to solve those challenges (e.g., redesigned data centers, server virtualization, cloud computing). Information technology may enable other approaches to carbon reduction through telecommuting, virtual meetings, or “smart” grids that reduce electricity usage.

**Alliances**

Multi-institutional systems already share infrastructure or leverage scale for greater procurement power. And many colleges and universities are establishing alliances to gain access to expertise, degrees, and international experiences. In the United States, community colleges and state universities have established articulation agreements ensuring that students can transfer from one institution to another—for example, ASSIST in California (http://www.assist.org/web-assist/welcome.html) or North Carolina’s guaranteed transfer program between community colleges and universities (http://www.northcarolina.edu/aa/articulation/index.htm). In the United Kingdom, government-funded Lifelong Learning Networks aim to improve the coherence, clarity, and certainty of vocational learners’ progression opportunities into and through higher education. Universities and colleges have formal partnerships with indirect funding arrangements to facilitate “higher education in further education,” with a focus on employer engagement, skills, and the needs of local and regional communities. Managing Information Across Partners (MIAP, http://www.ucisa.ac.uk/members/activities/miap.aspx) is a program of services that will enable data sharing across the entire education sector in the United Kingdom. In addition, alliances are increasingly common between higher education institutions and corporations. The goal is to spread out the fixed costs for research, education, infrastructure, and services.16

Finally, multinational agreements, such as the Bologna Accord, establish even larger alliances intended to facilitate the exchange of students and scholars.

**Student Engagement and Achievement**

Decades of educational research support the importance of student engagement to educational achievement. For example, although Dutch higher education students are sufficiently motivated when they enroll (4.2 on a scale of 1 to 5), their motivation drops (to 3.8) due to a number of factors, including lack of good administrative support and uninspiring teaching staff. Of the students in Dutch higher education, 20 percent indicate that they do not find their education challenging enough.17 Challenging and engaging these students goes well beyond content (which is in almost unlimited supply) to interaction, problem-solving, and reflection.

**Diversity of Suppliers**

For-profit colleges, community colleges, open universities, corporate universities, and “new institutions” contribute to the growing number of international suppliers for educational episodes, classes, courses, certificates, and degrees. Although the required time, delivery mechanism, pedagogy, and cost vary greatly among these suppliers, their “customers”—the buyers of these educational experiences—have the opportunity to make informed trade-offs.18 In the United Kingdom, for example, a significant review of higher education by the government may prompt a greater diversity of educational providers. Consumer choice will be further enhanced by the open educational resources (OER) movement, which will offer learners more opportunities for seeing the quality of
Accountability

Cost, productivity, and competing demands for funds have increased calls for higher education accountability. As education and degree completion become more critical to economic vitality, calls for measurable outcomes and return on investment become more common. Data on costs, as well as on student preparation and performance, is being scrutinized.

Enablers of the Future

These drivers are catalyzing changes such as those mentioned at the beginning of this article. These changes, in turn, are being enabled by developments in information technology. In fact, information technology could be considered a game-changer for higher education, since it is providing options never before possible. Now that virtually everything and everyone is connected, the “network” underlies emerging educational models that supersede place—whether that place is a classroom, a building, or a campus. The network provides an architecture for participation and collaboration—irrespective of time, place, age, or position. And because materials are digital, they can be accessed and used over and over again, with access becoming more important than ownership. In addition, information technology has provided new platforms for knowledge creation: Wikipedia, Facebook, and other social-media tools enable collective intelligence, often involving millions of contributors. Of course, the attitudes and experiences of college and university students and faculty also enable the future, in ways that are both powerful and subtle. The majority of today's traditional-age college students have grown up with technology, using it as a natural extender of their activities, whether for communication, entertainment, friendship, learning, or work.

New IT tools and capabilities are providing higher education with a unique set of options for addressing its future challenges. As college and university leaders anticipate the future, they should pay attention to three essential areas that will serve as enablers of the future:

- New structures and new business models
- Expanded options for the educational experience
- Innovation and economic vitality

New Structures and New Business Models

The future shape of higher education will be influenced by new structures and new business models. Information technology can disintermediate—or break apart—traditional structures. For example, a course can be offered by an entity other than the university, and a textbook can be released without the involvement
of a traditional publisher. Another instance is the “above campus” or “cloud computing” service model, which uses a metaphor that can be applied to sourcing, services, expertise, or even students and scholars. A common example is the use of Gmail, rather than a campus-based e-mail system, by students.

Openness and sharing are emerging as key features of developing structures and sustainability models. The fundamental value that higher education places in sharing, added to the ability of the Internet to make information almost universally available, has led to the growth of opportunities for meaningful local, regional, and international collaboration around the creation of a variety of resources. Open-access publication, open educational resources, and open-source software are all examples. Such resources are freely available for improvement, modification, and/or localization. It is important to note, however, that sharing and openness are not models in themselves but are approaches to or features of sustainability or business models. A number of organizations generate revenue based on providing services that support open-source software, for example.

Although the Internet makes the exchange of services and information more open, it is not necessarily trustworthy. Tools such as identity and access management are designed to ensure that those who access resources (e.g., data centers, databases, remote instruments, learning resources) are “trusted.” The ability to share resources beyond the limitations of the physical campus hinges on trust, identity, and access management.

Finally, new educational models are emerging as well. Western Governors University (http://www.wgu.edu) is based on a competence model rather than credits. The Open University (http://www.open.ac.uk), the first U.K. university to offer distance learning to entrants with no prior qualifications, is the country’s largest university, with approximately 180,000 students; it routinely tops the national student satisfaction survey. For-profit institutions—for example, the University of Phoenix (http://www phoenix.edu/) and Capella University (http://www.capella.edu)—are growing in number and size. Nontraditional institutions are also emerging: Peer 2 Peer University describes itself as “an online community of open study groups for short university-level courses” (http://p2pu.org/); the University of the People is “the world’s first tuition-free, online academic institution dedicated to the global advancement and democratization of higher education” (http://www.uopeople.org/). Common characteristics of these models include an emphasis on openness, the use of digital resources, a distributed student and faculty base, and global reach. Information technology is a critical infrastructure for such institutions.

**Expanded Options for the Educational Experience**

The educational experience is increasingly connected, experiential, flexible—and driven by individual preferences and needs. With information changing rapidly, with the complexity of problems increasing, and with the need for skill renewal becoming constant, the focus of education is shifting from instruction to discovery.

Students must develop the skills to discover what they need to know, where to find it, how to validate the quality of the information, and how to assemble the resources necessary to solve problems.

Students search for information—from wherever they are, on any device they choose, at any time, with near-instantaneous results, in their preferred medium (e.g., audio, animation, video, text). With an increasing amount of the world’s literature and archives available online, students’ access to information is not limited by location or library collections. Search tools are increasingly sophisticated (e.g., semantic searches), but even more powerful are students’ networks of peers, mentors, and experts—networks that lead them to information and insight. Networks enable connections and collaboration, whether social, scientific, or civic. Social networking tools enable personal and professional connections. Emerging reputation and recommendation systems allow networks to go beyond being lists to assigning value.

Mobile devices allow groups to stay in touch, no matter where they are. With a billion new mobile devices manufactured each year, mobiles are becoming the world’s affordable and ubiquitous computing platform. Mobile applications are exploding, and the difference in computing power between PCs and mobiles is shrinking, with high-end mobile phones approaching the processing power of low-end PCs. Geolocation and geotagging augment texting, talking, and surfing.

Collaboration is facilitated by information technology. Collaboration tools are freely available on the web (e.g., Google Docs, Zoho Wiki) and numerous communication options are available as well (e.g., Skype, Facebook, Twitter). Videoconferencing is merging into telepresence, where people in different locations feel as though they are in the same room thanks to life-sized displays and high-definition signals.

Beyond enabling access to global resources and communication/collaboration tools, information technology provides learners access to highly interactive and immersive tools that allow students to move from simply learning about a topic to role playing and scenario building. Virtual worlds allow students to “experience” weather, mathematical models, civic participation, or interviews. Massively multiplayer online gaming environments allow students to compete, cooperate, and solve problems as teams. Visualizations and simulations allow stu-
Data is becoming essential to learning environments. It not only forms the basis of important collections that learners can explore, but data about students themselves serves as an analytic resource. Data can be used to understand which educational models are most effective and which students might be at risk and to document learners’ educational records. Governments and educators are increasingly interested in aggregating data about students so that it can be mined for trends and predictions, allowing individuals and institutions to improve outcomes.

As students become more diverse and as learners’ needs expand across a lifetime, more flexible models for education are emerging. For many students, education must fit alongside work and family responsibilities. Online learning and accelerated programs provide greater flexibility than traditional campus programs. Transferability of credits from one institution to another becomes more important as time-to-degree increases and lifelong learning grows. If lifelong learning credits become a reality, learners will be provided with opportunities to refresh their education throughout their career. The odds that a single institution will provide all of an individual’s learning throughout life may not be realistic.

**Innovation and Economic Vitality**

Innovation, which may be defined as the successful development and fulfillment of new ideas, is now essential to success for individuals and economies. Colleges and universities are “sources of new knowledge and innovative thinking.” Over 50 percent of basic research is conducted at universities, and that research creates the foundation for new industries and technologies. Rather than being “owned” by any single institution or country, innovation is spread across tens of thousands of researchers from developed and emerging economies that are linked (by technology) in a global science and innovation system.

Research and innovation are increasingly interdisciplinary, inter-institutional, and international, generating vast amounts of data. Particularly in scientific fields that rely on highly specialized, expensive instrumentation, research involves a distributed network of researchers, instruments, and datasets. Knowledge generation is increasingly a collaborative, iterative process. Scholarly communities now pursue their research and learning goals in real time and without regard to geography. The technology (information, grid, and networking technologies with
as an enabler of the future, several themes are emerging between privacy and access over issues such as security, data-handling, and identity. Although institutions might make better decisions by centralizing and mining student, staff, patient, and financial data, how do they guard against misuse or inappropriate disclosure? And as data, finances, research instruments, and purchasing cross institutional boundaries, how do institutions ensure that identity, institutional affiliation, and role are validated and trustworthy?27

Governance too may shift in response to the needs of the future. Because technology now supports the entire institution, IT directors have been given broad responsibility, but they also need unprecedented flexibility.28 As information technology has become a more powerful game-changer, the roles of senior IT staff (vice presidents and chief information officers) have changed from managing information technology as a utility to combining technology with business strategy, communication, integration, finances, and risk management. Senior IT staff participate in decision-making with the most senior executives of the institution, joining academics and administrators in institutional leadership.

Questions for the Future

Higher education faces numerous challenges posed by the drivers of change, including worldwide demand for education, financial constraints, and a constantly changing knowledge base. Those of us involved with information technology in higher education thus need to ask ourselves several critical questions:

- How can we accommodate the increase in numbers of students without compromising quality?
- What can we do to lower the cost of learning resources?
- How flexible is our higher education system? Does it provide paths to degree completion that suit all students?
- If we were to transform the student experience, what would it look like? What would we do differently? How would those changes affect the individual? The workplace? Society?
- Can we create a better linkage between research and instruction, creating new opportunities for discovery and community?
- What can we do to speed the translation of research into solutions that benefit society?
- What type of administrative services and support will allow the institution,
faculty, and students to optimize their time and talents?

- If the college/university metaphor today is a network rather than a campus, what does that mean for our work in information technology?

Information technology—with its ability to link people, ideas, and resources and to increase both scale and personalization—is enabling new ideas and new models. As a result, information technology can bring unique value to the future of higher education. The purpose of higher education has not changed in centuries: higher education benefits individuals and society, and we rely on higher education for innovation and economic vitality. But information technology has increased the options for achieving that purpose. The IT-enhanced enablers of the future—new models, an intense focus on the student experience, and a drive for innovation and entrepreneurism—will ensure that higher education continues to meet the needs of individuals and society worldwide.

Notes
2. CAUDIT, JISC, SURF, and EDUCAUSE, “The Future of Higher Education: Beyond the Campus,” white paper, January 2010, <http://www.educause.edu/library/PUB9008>. Contributors to the white paper are Bas Cordewener, SURFfoundation; Ted Dodds, University of British Columbia; Ian Dolphin, JISC; Jocelyn Manderveld, SURFfoundation; Peter Nissen, CAUDIT; Leo Plugge, SURFfoundation; Sarah Porter, JISC; and Stephen Whiteside, University of Auckland. Our hope is that this view of the future of higher education will catalyze discussion, helping us all to find shared solutions and to take actions that will best serve society. Please join us in this exploration by adding your questions, discussions, and suggestions to the following document: <http://tinyurl.com/Future-of-Higher-Ed>.
16. Wheeler, personal correspondence with the author.
18. Wheeler, personal correspondence with the author.
19. Ian Dolphin, personal correspondence with the author.
20. Dodds, personal correspondence with the author.

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