Why IT Matters to Higher Education

EDUCAUSE review

SEPTEMBER/OCTOBER 2018

The Future of the IT Profession

Smart Machines and Human Expertise: Challenges for Higher Education
Diana G. Oblinger

Scenarios, Pathways, and the Future-Ready Workforce
Jim Phelps

Perspectives on the Future of the Profession: Looking Forward, Then and Now
Paige Francis, PB Garrett, Cindy Mitchell, Sharon P. Pitt, and Theresa Rowe

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SEPTEMBER/OCTOBER 2018 VOLUME 53, NUMBER 5

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FEATURES

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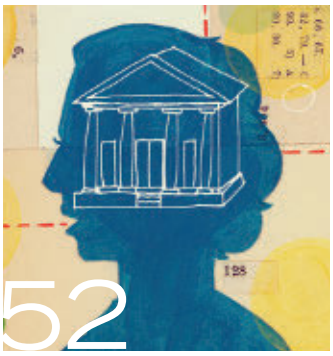

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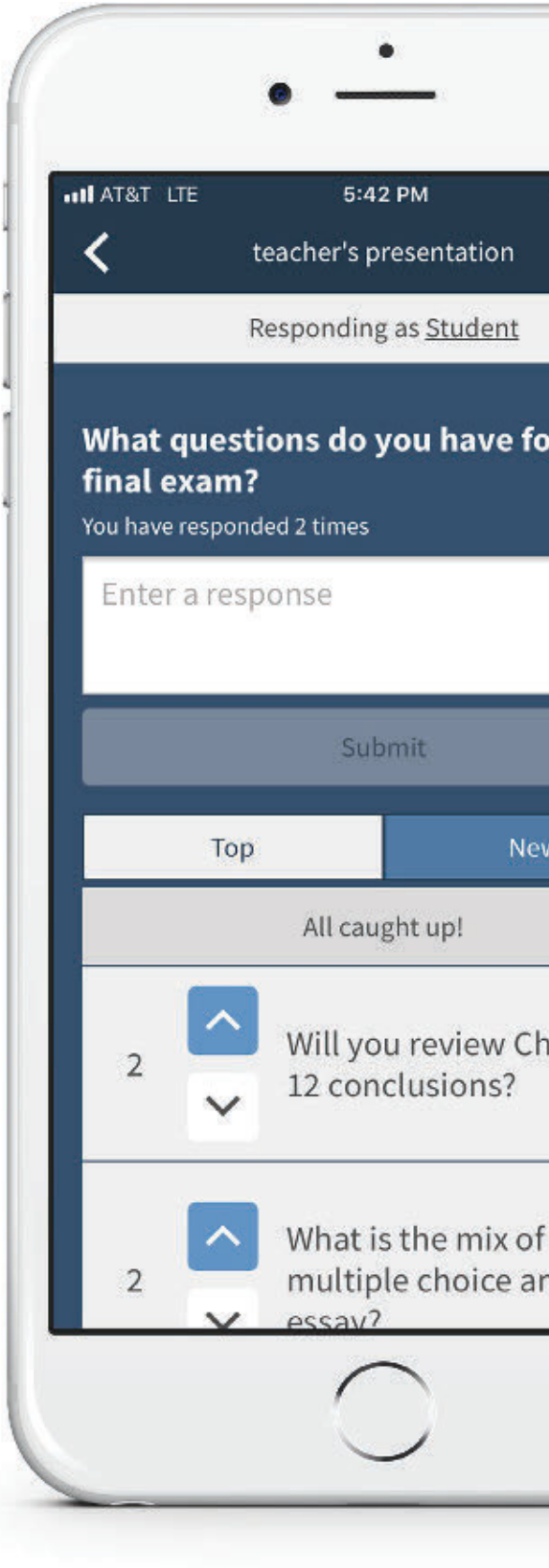

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By JOHN O'BRIEN

Shaping the Future of the IT Profession

Throughout this twentieth anniversary year, we've had many opportunities to look back and appreciate the transformation that technology has made possible at colleges and universities, as well as to look forward and glimpse into the future. In this issue of *EDUCAUSE Review,* we are focused more specifically on the future of the *IT profession and the workforce.* The last few years have seen not only considerable changes with technologies themselves but also emerging trends that will change the higher education IT profession in subtle and profound ways.

Artificial Intelligence and Machine Learning

Artificial intelligence in higher education is still very much in development as institutions are experimenting with various AI-powered technologies. In her article "Smart Machines and Human Expertise: Challenges for Higher Education," EDUCAUSE President Emerita Diana Oblinger writes about the new developments and maps out the challenges and opportunities ahead. In the process, she asks some of the most crucial questions that technology developments will provoke (e.g., What does this mean for people?). Oblinger moves beyond simplistic views and highlights the coming dance between AI and the workforce. The question is not what smart machines will "do to" the future workforce but, rather, how the interaction will unfold. As she observes, "Rather than replacing people, smart machines augment human capabilities, meaning that we need to learn to work with machines as partners."

> In the digital transformation ahead, IT professionals and leaders are not merely along for the ride; they are shaping the future of the IT profession.

Importantly, colleges and universities are considering not just the technologies but the broader role of higher education to help students and communities master the dance moves for the future. For example, Northeastern University President Joseph Aoun offers an approach to educating students in a way that realizes the partnership Oblinger contemplates, again without surrendering human agency. Aoun insists that higher education institutions can and must build on their unique strengths to prepare students for smart machines—using active and experiential learning, for example, to make their workforce experience "robot-proof."[1]

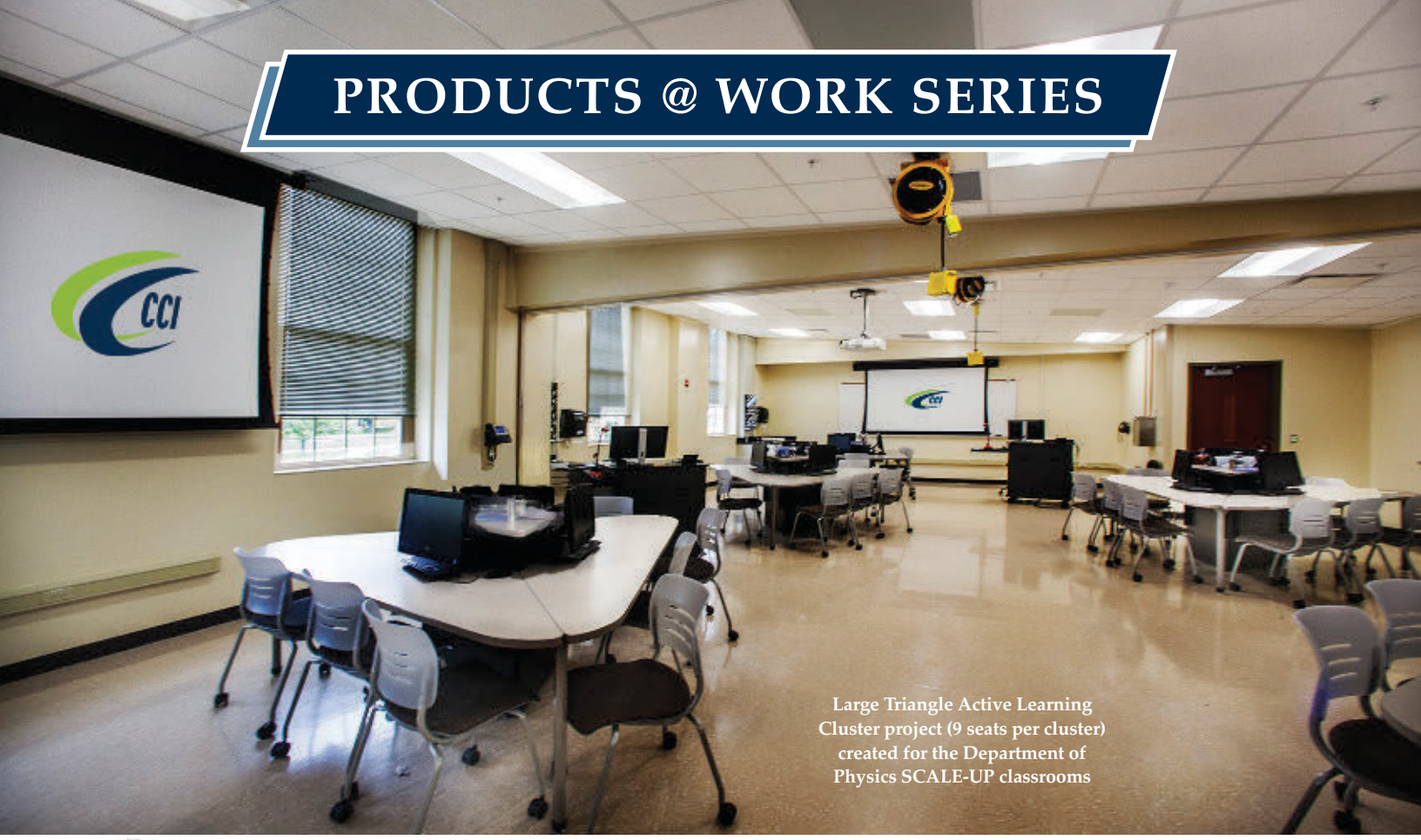
Beyond the Cloud

One of the most consistently talked about changes in our profession for many years has been the workforce consequences of the steady migration of data, services, and applications, as well as entire platforms, to cloud-based hosting. Three years ago, an EDUCAUSE survey found that 85 percent of respondents' institutions were moving at least one service to the cloud.[2] While current overall IT staffing levels have stabilized in recent years, the mix of positions has begun to shift in predictable ways, including job growth in workforce roles related to cloud computing, security and privacy, data integration, and contract negotiators.[3] The EDUCAUSE 2018 *Trend Watch and Top 10 Strategic Technologies* report showed critical mass in cloud technology adoption and deployment (e.g., about half of institutions planning to deploy and maintain public-cloud storage and half to two-thirds piloting or deploying from among APIs, blended data centers, and cloud-based security services).[4]

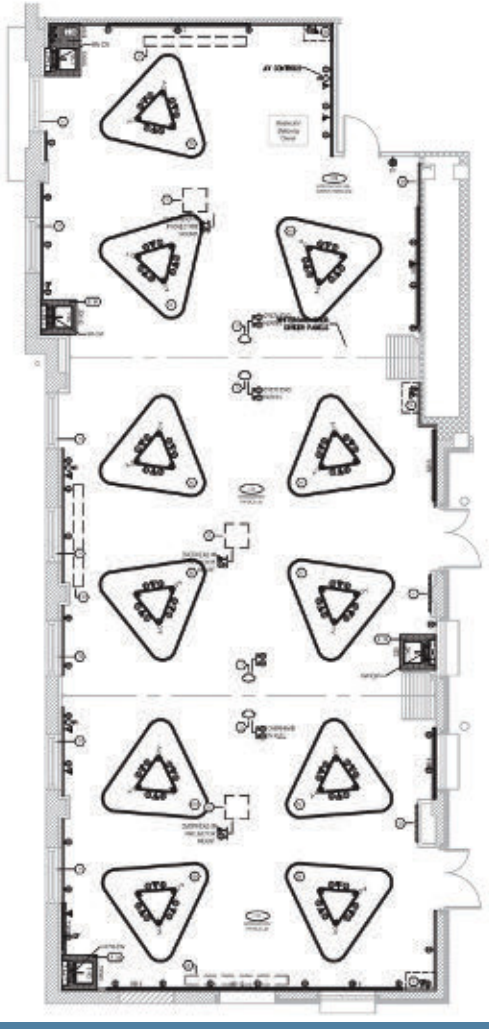
Beyond one-off migrations, the most comprehensive changes will be experienced on those campuses embracing broader digital transformation initiatives that bring together student success programs, data analytics, business intelligence, and a host of developments related to enhancing the student experience.

(continued on page 6)

PRODUCTS @ WORK SERIES



Large Triangle Active Learning Cluster project (9 seats per cluster) created for the Department of Physics SCALE-UP classrooms



Computer Comforts created this triangular shape Active Learning Cluster for Miami University in Oxford, Ohio to increase table top reference room while maintaining proper aisle spacing throughout the classroom. This provided instructors and teaching assistants an interactive environment allowing enough space to walk around during class which was essential for this teaching model.

Computer Comforts, Inc.

The eleven clusters in this classroom offers seating for 99 students.

The center Power-Core was designed with custom cutouts for customer provided gas valves.

(continued from page 4)

Recognizing digital transformation as a cultural, technological, and workforce shift that will require new approaches and structures at many levels, EDUCAUSE has launched a task force to help IT leaders prepare their institutions as they move into this new world.

In his article "Scenarios, Pathways, and the Future-Ready Workforce," Jim Phelps also captures the idea of digital transformation. He acknowledges that this inevitable shift "will be extremely difficult to navigate gracefully." What we need, Phelps argues, is an approach to *strategic workforce development*. Phelps suggests two tools—scenario planning and job pathways mapping—to build a common vision for transforming technological and cultural disruption in higher education into a positive digital transformation.

Diversity, Equity, and Inclusion

A third important change under way in the higher education IT profession is the advancement of diversity, equity, and inclusion (DEI). Research shows that the more diverse a workforce is, the smarter and more focused, innovative, and effective it is.[5] Unfortunately, higher education information technology lags behind national trends in employment for underrepresented groups.[6]

As an association, EDUCAUSE recognizes that DEI is both a current and a future priority. We believe that inclusive and equitable organizations will be best positioned to attract the caliber of talent required to better achieve institutional objectives. With this in mind, we are working to assist our member institutions expand the capabilities they need to engender DEI in their organizations and institutions. Early this year, we created a DEI task force charged with refining EDUCAUSE's DEI statement, recommending specific strategies to advance diversity in the EDUCAUSE community and within the leadership pipeline, and providing feedback and advice on a variety of 2018 EDUCAUSE activities related to DEI. The task force has finished its report, and I look forward to sharing more details soon.

■ ■ ■

In the face of these changes and more that will influence the future of the IT profession (e.g., internet of things, blockchain), in this issue the insights of Paige Francis, PB Garrett, Cindy Mitchell, Sharon P. Pitt, and Theresa Rowe are illuminating. The five panelists address an engaging set of questions that were first presented in the augural issue of *EDUCAUSE Review* nearly twenty years ago—with topics involving the biggest challenges ahead, preparation for the future, tomorrow's leaders, the value added by IT leaders, and the support needed from nontechnical institutional leaders. What has changed over the two decades?

As you reflect on these questions, I encourage you to think about Jisc Chief Executive Paul Feldman's reminder in his Leadership column in this issue: technology professionals and leaders are not merely along for the ride. Rather, they are the "technology tamers" and the "idea wranglers" who can play a key role in shaping the IT profession of the future in a positive and productive way.

Notes

1. Joseph E. Aoun, *Robot-Proof: Higher Education in the Age of Artificial Intelligence* (Cambridge: MIT Press, 2017).
2. D. Christopher Brooks, *The Changing Face of IT Service Delivery in Higher Education,* ECAR research report (Louisville, CO: EDUCAUSE, August 2015), 7.
3. Jeffrey Pomerantz and D. Christopher Brooks, *The Higher Education IT Workforce Landscape, 2016,* ECAR research report (Louisville, CO: EDUCAUSE, April 2016), 4; Brooks, *The Changing Face of IT Service Delivery in Higher Education.*
4. Susan Grajek and Joanna Lyn Grama, *Higher Education's 2018 Trend Watch and Top 10 Strategic Technologies,* ECAR research report (Louisville, CO: EDUCAUSE, February 2018).
5. David Rock and Heidi Grant, "Why Diverse Teams Are Smarter," *Harvard Business Review,* November 4, 2016; Brad McLain, Catherine Ashcraft, and Lucy Sanders, "Why Diverse Teams Matter," *EDUCAUSE Review* 51, no. 3 (May/June 2016).
6. Pomerantz and Brooks, *The Higher Education IT Workforce Landscape, 2016,* 9.

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Check out our Research Hub *The IT Workforce in Higher Education, 2016*.

https://library.educause.edu/~/media/files/library/2016/4/ers1603.pdf

Delve into the EDUCAUSE/Jisc report *Technology in Higher Education: Guiding Aspiring Leaders*.

https://library.educause.edu/~/media/files/library/2016/2/pub9021.pdf

Don't miss the regular contributions to the *Professional Development (PD) Commons* blog,

covering advice and good ideas for enhancing your skills and success as a higher education IT manager and leader.

https://er.educause.edu/columns/the-professional-development-commons

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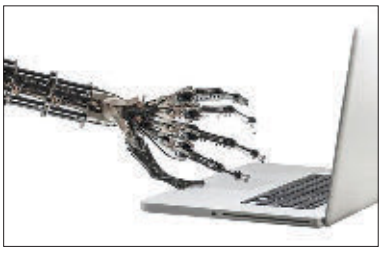
Read (again) these *EDUCAUSE Review* favorites.

"And You May Ask Yourself, Well, How Did I Get Here?"

By Jeffrey Pomerantz and D. Christopher Brooks

https://er.educause.edu/articles/2017/11/and-you-may-ask-yourself-well-how-did-i-get-here

The **September/October 2017 issue**, including:



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"The AI Revolution on Campus"
By Michael King
https://er.educause.edu/articles/2017/8/the-ai-revolution-on-campus

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"The IT Workforce: A Journey of Continuous Change"
By Kelli Trosvig
https://er.educause.edu/articles/2017/8/the-it-workforce-a-journey-of-continuous-change

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"From Climbing Walls to a Culture of Caring"
By Kirk Kelly and Brenna Kutch
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The Future of the IT Profession and the Fourth Industrial Revolution

This issue of *EDUCAUSE Review* is focusing on "The Future of the IT Profession." My reaction? There has never been a better time to be an IT leader, and I've been in and around information technology for almost forty years now, across a wide range of sectors. Over all that time, we IT leaders have been hungry for information technology to be a key topic of discussion at the board level. Today it is. More than that, its impact is being overtly discussed, at least here in the United Kingdom, by government ministers, by policy wonks, and even by those in the media, who are asking questions about the profound changes we are all experiencing in almost every aspect of our lives.

Some of these changes have an intense depth. Are cell phones in college and university classrooms reducing teaching quality? How do we retrain the swathes of white-collar workers who will likely be made redundant by machine learning? What are the moral and ethical implications of research conducted by "thinking machines"? And of course, what about the opportunities for nation-states to impact and fundamentally change each other via cyber-warfare? These are the dark sides of the Fourth Industrial Revolution. But I believe that this revolution is ultimately a force for good and will transform our world for the better. Once we learn how to tame the technologies, the Fourth Industrial Revolution will take us humans to new levels of productivity, artistry, creativity, and discovery—almost a new renaissance. We will be unleashed from our drudgery and allowed to reconnect with those aspects that define us as a species. This revolution is also a real democratizing force.

Today and in the future, the IT profession has a key role to play in taming the technologies of the Fourth Industrial Revolution.

So what does this mean for the future of the IT profession? We are the tamers. We understand technology better than others and have the insights into how to exploit it. In my experience, geeks (of which I count myself one) have great social consciences and will hunger to find the best in our technology. As I write this in June 2018, employees from the world's largest IT organizations are lobbying their bosses for the fruit of their labors to be used for good instead of military purposes. Yet we are far more than the tamers: we are members of the profession that enables the world.

I used to work in the banking field. We always joked that if we ever shut down the bank, the last person to leave would be the data center operator who switched the lights out. Extrapolate this into the future. We will be the engine room operators for the world. I speak to operations staff who are worried that the cloud is making most data centers obsolete—and to an extent it is. In the United Kingdom, we are on a trajectory toward the end of almost all on-premises data centers, of any size. I would be surprised to see this significantly reversed when the pendulum swings back a bit, as it always does. The best IT workers will be able to get jobs with the cloud providers and to play with "train sets" on a scale most of us have never seen. For the rest of us, becoming amazing at managing our virtual data centers spread across the world and optimizing our institutions' use of them will be harder, but it also will be more rewarding and will constitute a highly sustainable engineering profession.

I started as a developer all those years ago. When I look at what our developers do now, their work has not fundamentally changed as a profession, but what they do today would have blown the young Paul's mind. I remember developing exciting graphics systems that are now basic features in Microsoft PowerPoint. The level of graphics development taught in standard university-level video game courses today was science fiction in my day—there wasn't a machine able to process at that level. As part of my PhD work, I used the "revolutionary" Lisa (the Mac predecessor), which was less capable than the cheapest tablet available currently. Yet even with machines at some point able to program machines, I still believe there is an insatiable need for more people to tame these machines—that is, to make what the machines produce valuable for the human race and, more prosaically, for businesspeople, lecturers, researchers, students, and consumers.

The even better opportunity is for us, as leaders, to lead our colleagues to exploit these opportunities. Almost since the dawn of information technology in business, and certainly in all my time, IT folk have been concerned with how to get their voice heard at the board level—how to bring all their influence and knowledge into helping to guide and direct the institution, not just run it. Pity my poor CIO today at Jisc. As an ex-CIO/CTO, I have to stop myself from trying to do his job. However, I do bring all my depth of understanding of information technology into being a CEO, especially helpful for a technology organization like Jisc. (Jisc is a bit like Internet2, the

By PAUL FELDMAN

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U.S. state networks, part of ARL, CLIR, EDUCAUSE, and a software/technology house all wrapped up into one.) There aren't many of us former CIOs/CTOs leading organizations just yet, but there is every reason to aspire for more IT leaders to join boards and to become CEOs. I arrogantly believe that we have a clear vision of the difference that IT will make to our organizations and, more importantly for us, to our members: the universities, colleges, and research institutions.

IT professionals, especially IT leaders, must develop credible, stretching, and ambitious visions for their organizations—for how their work will change pedagogy, transform the student experience, and revolutionize research. And they must sell this to their senior leaders. Once they have succeeded there, they of course need the courage, fortitude, and political skills to turn their vision into reality! They also must become more confident in leading, even owning, the discussions on their institutions' digital strategy, especially the far-reaching impact of "industry 4.0." I watch with amusement, and often bemusement, when nontechnical British commentators opine on the way technology will change the world. Credible medical advice calls on leading medics; credible economic predictions arise from economists; yet very few opinion formers in the use of information technology to change the world come from the IT profession.

Today and in the future, the IT profession has a key role to play in taming the technologies of the Fourth Industrial Revolution. Those of us in the profession are the idea wranglers who can ensure that pragmatism and achievability reign while we drive our colleagues to new heights of ambition, thus allowing the positive benefits of this revolution to shine through. ■

Paul Feldman (Paul.Feldman@jisc.ac.uk) is Chief Executive of Jisc.

SMART MACHINES AND HUMAN EXPERTISE: CHALLENGES FOR HIGHER EDUCATION

By
Diana G. Oblinger

LEXA TALKS TO YOU. Google finds answers to your queries. Amazon knows your preferences. Facebook not only knows your friends but also can help you find the perfect partner. These platforms seem to know what we are thinking almost before we do. Our world has taken on a digital smartness thanks to artificial intelligence (AI), data, natural language processing, automation, and robots that, although nearly invisible, impact much of what we do. This digital smartness is projected to have a massive influence on the world economy, adding $15.7 trillion to global GDP by 2030. It will increase productivity and wages, allowing individuals to purchase more and/or better products. Automation, driven by AI and robotics, is estimated to require the reskilling of one-third of the 2030 US workforce, with nearly 10 percent of positions being in fields unknown today.[1]

ILLUSTRATION BY ANN CUTTING, © 2018

If "smart machines" are having such impact on the economy and our professions, what will they mean to higher education? For example, could a chatbox be your next TA? "Jill Watson," the first chatbot teaching assistant for an AI course at Georgia Tech, responded to students' questions so well that some students wanted to nominate "Jill" as the best TA in the course. At Beckett University in the United Kingdom, chatbots help prospective students find available courses of study. Georgia State University (GSU) uses an AI chatbot to respond to questions about enrollment and financial aid, handling peak volumes of as many as 2,000 calls per day, with 200,000 questions answered in the first summer of use. (When the system is less than 95 percent confident of an answer, the query is passed on to a staff member.) But the impact goes beyond handling call volume. GSU estimates that the timely responses to questions helped reduce "summer melt" (i.e., the loss of students who are admitted but not yet registered) by 20 percent. Deakin University in Australia has created a platform, Genie, that combines chatbots, AI, voice recognition, and a predictive analytics engine to create an intelligent virtual assistant that provides students with advice. Chatbots are being tested as English tutors as well.[2]

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In spite of their growing use, digital assistants only scratch the surface of the coming changes. Colleges and universities are challenged to move beyond the use of technology to *deliver* education. Higher education leaders must consider how AI, big data, analytics, robotics, and wide-scale collaboration might change the *substance* of education. The world around us is getting smarter. What does it mean to be a professional in a world of smart machines?

The Smart Machines Around Us

These increasingly capable systems not only retrieve and present information more quickly and accurately but also solve problems and offer advice. Machine learning allows computers to "consume" information such as medical records, financial data, purchases, and social media and then develop predictions or recommendations. Today's AI uses "brute force" computing, enabled by massive amounts of data, memory, and processing power. Beyond processing instructions at incredible speed, these machines can create their own guidelines and discover patterns invisible to humans. AI allows IBM's Watson, for example, to aggregate clinical guidelines, medical literature, and patient data to help physicians diagnose and treat cancer. AI and imaging software can speed up the diagnosis and treatment of strokes.[3]

Digital smartness comes in other forms too. In healthcare, robots allow surgeons to perform precision surgery. Collaborative robots in e-commerce fulfillment facilities help workers "pick" (i.e., select) items two to three times faster and with close to 100 percent accuracy. ROVs (remotely operated vehicles) allow humans to explore other

IF SMART MACHINES CAN TAKE ON ALL THESE HUMAN TASKS, WHAT DOES THAT MEAN FOR PEOPLE? WILL WE NEED TO KNOW OR DO LESS—OR MORE?

planets, collect data in active volcanos, and search for victims in a burning building—among other tasks. Robotic prosthetics and exoskeletons help amputees and those with impaired mobility. Self-driving cars and trucks promise to make transportation more efficient. Drones, essentially flying robots, have an increasing number of uses, from firefighting to farming, with an estimated value of $127 billion. In-space manufacturing and assembly is being explored using autonomous robots and additive manufacturing techniques (i.e., 3-D printing).[4]

Today's robots interact with the physical world. Robotic sensing gives machines the ability to "hear" through signal processing, "see" through image processing, and "touch" through pressure and pattern processing. In addition, this generation of robots can detect and express emotions. Social companion technology, in which a machine displays empathy, is being explored for the elderly to help combat loneliness as well as monitor wellness. These part-robot, part-AI systems use animatronic gestures and "speak," providing information, reminders, and support as they adapt to and learn from their human companions.[5]

If smart machines can take on all these human tasks, what does that mean for people? Will we need to know or do less—or more? And with these smart machines having such a large impact on the economy and the workforce, what will they mean for higher education? Rather than replacing people, smart machines augment human capabilities, meaning that we need to learn to work with machines as partners. Changes in our professions are becoming more rapid, suggesting that the way we develop and find expertise will change as well.

Augmenting Human Expertise

AI and robotics have catalyzed a wave of automation—based on artificial cognition, cheap sensors, machine learning, and distributed smarts—that will touch virtually all jobs, from manual labor to knowledge work. However, *automation* may be a less apt term than *augmentation*. As Garry Kasparov, former world chess champion, has observed: "Humans are not being replaced by AI, we are being promoted. Machine-generated insights add to ours, extending our intelligence in the way a telescope extends our vision. Think of AI as 'augmented intelligence.' Our increasingly intelligent machines are making us smarter."[6]

As machines can do more, professional roles shift. New tasks take the place of the ones that were automated. Historically, new technologies have spurred the creation of more jobs than they have destroyed. For example, in the United Kingdom, automation is estimated to have eliminated 800,000 lower-skilled jobs (e.g., call centers) while simultaneously creating 3.5 million higher-skilled ones. The higher-skilled positions often require retraining, however. At German auto-parts maker Bosch, welders, joiners, and mechanics were trained in basic coding skills to enable them to use robots as tools.[7]

Thus, whether it is AI, robotics, or another technology, today's machines can work alongside professionals as partners, amplifying human performance and augmenting human intelligence.

Data-Driven Insights

"Knowledge processing"—something much more sophisticated than information retrieval—is an example of a new approach to professional work. Today's systems can capture and reuse massive amounts of information, allowing a computer to compare a patient's symptoms against a database of millions of past patients. In law, intelligent search systems can outperform junior lawyers and paralegals in reviewing large sets of documents. Court decisions can be predicted by tapping databases of hundreds of thousands of past cases. Machines can consume vast quantities of information, discern patterns, and make predictions that allow professionals to work in different ways.[8]

Scientific research is an example of how the work of a higher education professional can change. Data-intensive science and computational science have augmented the traditions of theoretical or experimental research. Today, AI and automated hypothesis generation platforms are used to mine scientific literature and formulate hypotheses to help researchers focus their laboratory resources in areas that are most promising. For example, Baylor College of Medicine used IBM's Watson to design a Knowledge Integration Toolkit (KnIT). One test of KnIT focused on the functional properties of p53, a protein that is important in tumor suppression. At the time of the test, there were over 70,000 scientific articles involving p53. Humans can "consume" 1 to 5 scientific articles a day, so it would have taken a researcher approximately 38 years at best (assuming 5 articles consumed every single day) to assimilate the

existing research. In one month, KnIT successfully helped researchers identify 6 protein kinases that phosphorylate (or turn on) p53; 28 had been found in the prior 30 years. At many steps in the R&D process—observation, hypothesis generation, experiment design, and results analysis—AI can provide insights that augment human capability, increase efficiency, and improve outcomes.[9]

More Accessible Expertise

Smart machines can perform faster and more accurately than humans, but they don't necessarily use the same processes. Consider an example from the legal field. When there is an unresolvable dispute between two parties, the dispute can go to court. Resolving legal claims is time-consuming and expensive—too much so to be viable for low-level claims such as are common in online commerce. Rather than sending the dispute through the courts, eBay resolves an estimated 60 million disputes per year using online dispute resolution (ODR). One approach to ODR involves a three-round blind bidding system that matches plaintiffs' demands with offers from defendants. If the offers are close, the system splits the difference between the bids and declares a settlement. Many disputes are resolved in the first round.[10]

ODR is used for more than e-commerce. It has also been used for no-fault insurance disputes and property tax appeal resolutions. In New York City, for example, ODR has been used for personal injury claims, with 66 percent of the claims settled within thirty days, saving $11.6 million in litigation costs on 1,200 claims. The United Kingdom has explored ODR and an Internet-based court service as future options because the current judicial system for low-level civil claims is too slow, costly, and complicated, making it inaccessible and unaffordable for many people.[11]

The importance is not that machines can do things differently—it is that people can benefit from the outcomes. Society profits from the sharing of expertise, not just in the legal field but also in areas such as health care, education, business, architecture, agriculture, and engineering. Globally, there is huge unmet demand for this expertise. While non-thinking, high-performing machines do not necessarily operate the same way humans do, they may offer guidance or arrive at solutions that allow professionals to make expertise more accessible and affordable than ever before.[12]

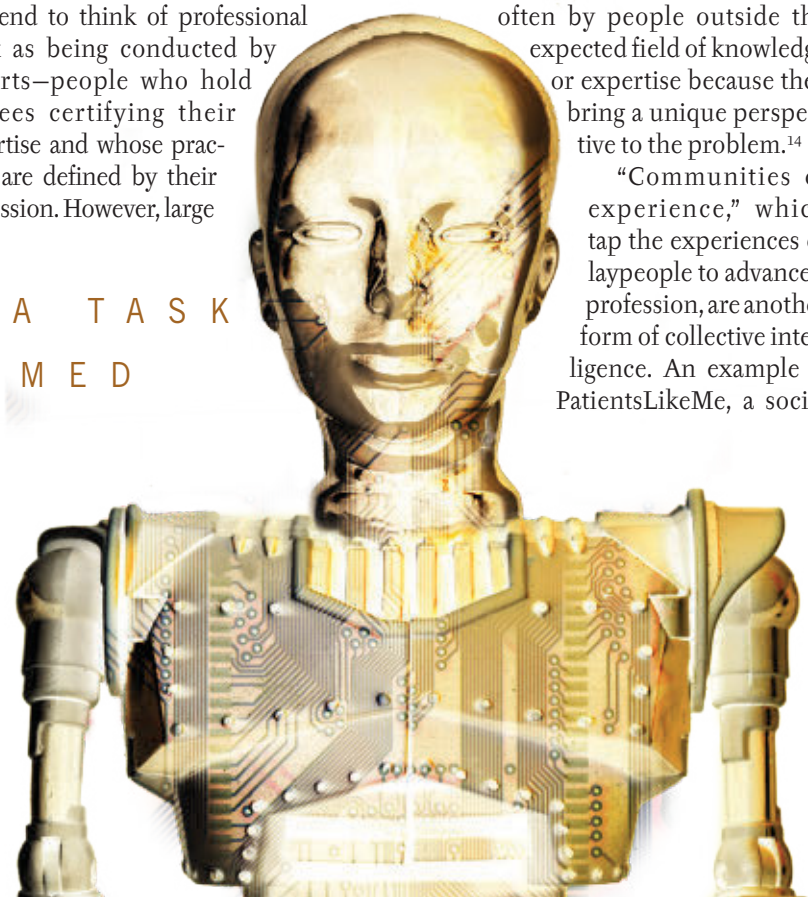
Collective Expertise

We tend to think of professional work as being conducted by experts—people who hold degrees certifying their expertise and whose practices are defined by their profession. However, large numbers of people making small contributions have the power to impact scientific advances, social movements, product innovation, fund-raising, and more.

Online innovation platforms have emerged in the last decade to capitalize on "collective intelligence," encouraging more people—enthusiastic volunteers—to become involved in solving problems. The platforms expand the scale of collaboration possible and the range of expertise tapped. The ideas and insights gained through increased cognitive diversity can spark new ideas.[13] In addition, time to innovation (or discovery) can be reduced. InnoCentive, for example, is a clearinghouse for scientific problems. The "challenges" come from corporations, non-governmental organizations (NGOs), and other nonprofits. Small rewards are offered for the best solution. For example, a reward of $15,000 was offered for finding a way to provide a safe, affordable method to collect rainwater in developing countries for under $20 per 125 gallons. Teams self-organize and submit solutions. Over half of the challenges are solved, often by people outside the expected field of knowledge or expertise because they bring a unique perspective to the problem.[14]

"Communities of experience," which tap the experiences of laypeople to advance a profession, are another form of collective intelligence. An example is PatientsLikeMe, a social

JUST BECAUSE A TASK CAN BE PERFORMED BETTER BY A MACHINE DOES NOT MEAN A JOB GOES AWAY.



networking site for patients who suffer from rare and chronic diseases. The platform does much more than provide moral support for patients and their families. Over 600,000 people report on their experiences with 2,800 conditions. The platform aggregates and organizes more than 43 million member data points and shares the data with clinicians, pharmaceutical companies, federal agencies, and other institutions, enabling research and innovation. Using a give-data-get-data philosophy, patients are helped to find new treatments and connect with others.

Implications for Higher Education

Smart machines are reconfiguring professional work. Although the thought of tasks being performed by a machine can be disquieting, who performs the task is less important than the outcome. Is the task done better by "man" or "machine"? Robots can be more precise and reliable in advanced manufacturing or medicine, for example. However, just because a *task* can be performed better by a machine does not mean a *job* goes away. A robot that sutures a patient does not replace the surgeon. Low-level tasks performed by humans can be replaced with higher-level ones.

What does this mean for higher education? One answer is that AI, robotics, and analytics become disciplines in themselves. They are emerging as majors, minors, areas of emphasis, certificate programs, and courses in many colleges and universities. But smart machines will catalyze even bigger changes in higher education. Consider the implications in three areas: data; the new division of labor; and ethics.

Data. Today's machines and systems develop new knowledge by feeding on data. Compiling large datasets is a prerequisite to the use of AI. Poor data or insufficient data will result in faulty conclusions or decisions. Considering how prevalent AI and analytics have already become, future professionals will very likely need to know how to gather and analyze large datasets as well as how to interpret the results. Data cannot depend on data scientists alone. Data is a critical element of virtually all professions. Higher education leaders should ask questions such as the following:

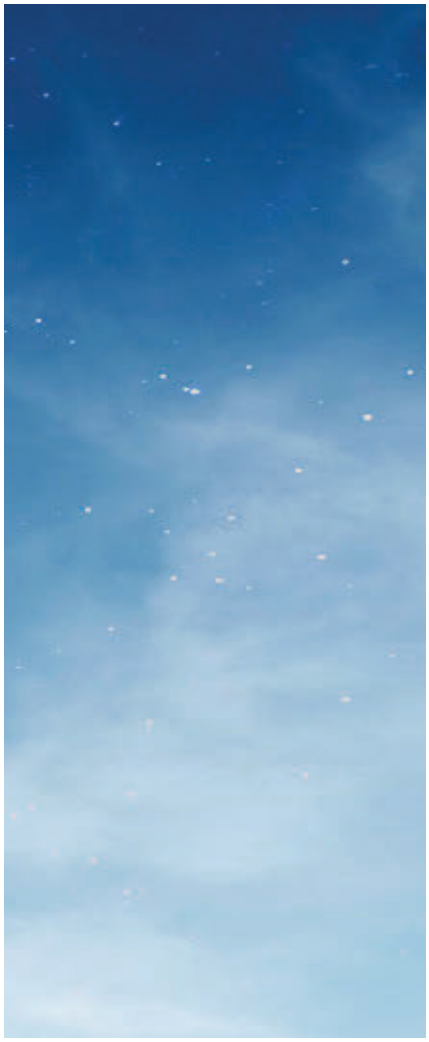
- What place does data have in our courses?
- Do students have the appropriate mix of mathematics, statistics, and coding to understand how data is manipulated and how algorithms work?
- Should students be required to become "data literate" (i.e., able to effectively use and critically evaluate data and its sources)?

The New Division of Labor. The impact of AI and robotics comes from connecting the physical and the virtual, the human and the digital, which can result in combinatorial and exponential change. Our disciplines and professions are no longer confined by physical or virtual boundaries—they can be both, simultaneously. This represents a new division of labor between "man and machine." Core competencies such as problem-solving, cross-functional collaboration, and teamwork will be more important tomorrow than they are today. However, the best way to integrate human expertise with machines and collective intelligence is largely uncharted. Higher education leaders should ask questions such as the following:

- How might problem-solving and discovery change with AI?
- How do we optimize the division of labor and best allocate tasks between humans and machines?
- What role do collaborative platforms and collective intelligence have in how we develop and deploy expertise?

Ethics. Professionals will need many capabilities in the era of smart machines. One is cognitive capability—the ability to think, reason, solve problems, and reflect. Another is affective capability—the ability to feel and relate to others. Motor skills and manual capacity constitute a third capability. A more nebulous, yet critical, capability is moral—the ability to distinguish right from wrong, just from unjust, or to take responsibility for one's choices. While our machines and systems are increasingly capable, they lack this last capability.[15] In a world where new technologies present complicated choices, ethics may become more important than ever. Higher education leaders should ask questions such as the following:

- Even though something is possible, does that mean it is morally responsible?



A FUSION OF EDUCATION, TRAINING, AND EXPERIENCE WILL BE REQUIRED FOR THE LONG-TERM CAREER GROWTH OF TOMORROW'S PROFESSIONALS.

- How do we achieve a balance between technological possibilities and policies that enable—or stifle—their use?
- An algorithm may represent a "trade secret," but it might also reinforce dangerous assumptions or result in unconscious bias. What kind of transparency should we strive for in the use of algorithms?

Finding and Developing Human Expertise

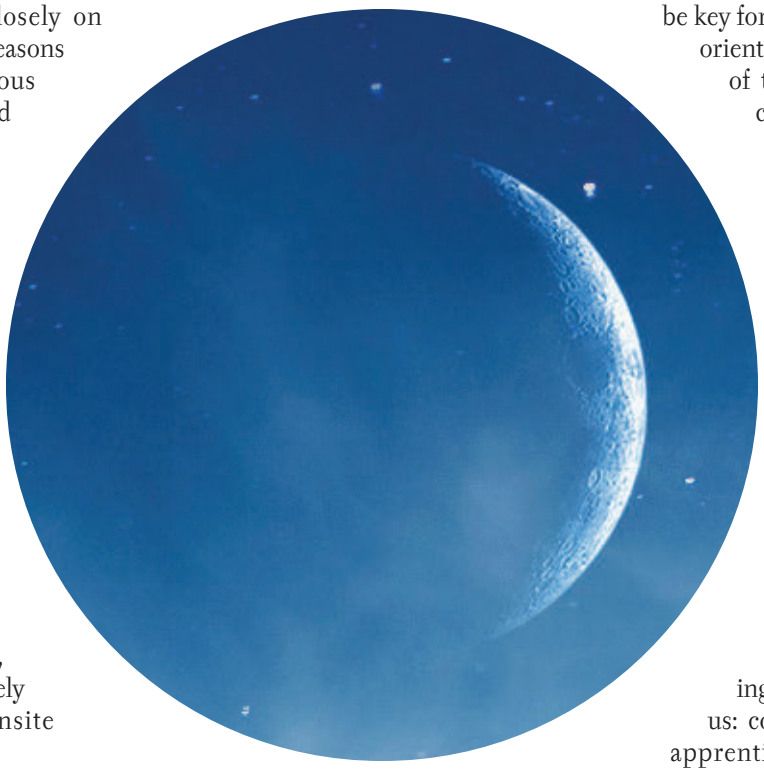
As our professions are changing due to smart machines, big data, and robots, the capabilities we look for in professionals—and how those professionals are selected and advanced—are changing as well. AI is playing a critical role in this shift.

Virtually all position descriptions are advertised online. Credentials (e.g., resumes, transcripts, and test results) are available in digital format, making it possible for natural language processing and big data to power talent analytics platforms. Massive amounts of data can be aggregated and analyzed to gain new insights. For example, employers are using talent analytics to answer questions such as "What are the characteristics of employees who are being promoted?" Quality-of-hire analysis helps answer "What skills do they have?" and "Where and how did they learn this skill?"[16] Detailed analyses of the competencies associated with professional success are informing position descriptions and enabling competency-based hiring.

Machine learning and AI are being used in nearly all phases of talent recruitment:

- AI-powered chatbots are being used to recruit possible employees and to ensure that candidates have a positive experience. These digital assistants can converse with potential candidates and answer questions as well as make sure they receive regular updates about their application status.[17]

- The process of screening and judging candidates based on resumes often fails to recognize core capabilities. AI and machine learning are tapping publicly available data to provide insight beyond what is available in a transcript or resume in areas such as leadership and technical skills.
- New interview protocols and pre-hire assessments are being used to focus hiring more closely on ability.[18] One of the reasons is diversity. Unconscious biases can be triggered by aspects such as a person's name, gender, age, institution attended, or appearance. For example, women are 11 percent less likely to make it through application reviews, 19 percent less likely to get through recruiter screens, 12 percent less likely to proceed through assessments, and 30 percent less likely to move on from onsite interviews.[19]



New ways to assess and credential professionals' qualifications, communicate those qualifications to the market, and match talent with positions are emerging. Badging is just one example.

Performance-Based Assessment

Historically, the best indicator of intellectual and interpersonal skills was a degree. However, supplementing the degree by measuring ability through performance simulations may result in better matches between candidates and positions. EquitySim, for example, is a simulation platform that helps employers identify top talent for entry-level financial trading positions. Because it is performance-based, it helps reduce biases, such as those associated with age or gender. The platform can also identify talent at institutions where employers don't usually recruit. The simulation involves having the user trade stocks, bonds, currencies, and securities, yet the data collected is much richer. The platform captures more than 100,000 behavioral data points per user (e.g., order of steps followed, duration of time spent). These data points are associated with important characteristics, such as risk management capability, in order to target candidates based on competencies that are predictive of success and retention. Although the simulation measures performance, success in the simulation can result only from critical thinking, problem solving, and other core cognitive skills. When companies use EquitySim, 48 percent of candidates hired are female, compared with 25 percent when using traditional approaches.[20]

Transferable Skills

A fusion of education, training, and experience will be required for the long-term career growth of tomorrow's professionals. A 2016 survey found that 54 percent of Americans believe it will be essential and 33 percent believe it will be important for them to develop new skills throughout their career to keep pace with changes.[21] Competencies will be key for the future of professionally-oriented education because many of them (e.g., problem-solving, collaboration) are common across industries. Sustainable career paths depend on transferable skills and competencies. Although the term "soft skills" is often used to describe problem-solving, communication, collaboration, critical thinking, and teamwork, a better term may be "mobility skills" because they enable individuals to move from one position to another.

The options for developing these skills are all around us: competency-based education, apprenticeships, internships, certificates, boot camps, and badges. Do-it-yourself learning opportunities are available online, all the time. Stackable credentials offer learners pathways from today's jobs to tomorrow's. Whether skills and competencies are developed at a college, university, or corporation or were self-taught matters less than the ability to transfer that expertise to new problems. Employers are interested in "agility"—the ability to adapt rapidly and on an ongoing basis.[22] As a result, the adoption of approaches such as badging is growing among both professionals and employers.

Co-created Degree Alternatives

If training and education must become more frequent across a career, blocks of

courses in two- or four-year degrees will be too inflexible for a continuous work-learn model that may span forty to fifty years. Alternative models are emerging.

One example of a blended work-and-learn model is Northeastern University's professional master's degree programs that provide pathways from IBM badges to academic degrees. Under IBM's "New Collar" program, 15 percent of its skilled jobs are now held by workers without college degrees. Badges are being used as a way to develop skill and verify talent with "competency stacks." IBM has issued more than 850,000 badges. When Northeastern administrators reviewed the badges, they found many that could be applied toward academic degrees. To date, 3 professional master's programs build on IBM badges, with another 51 degrees and 17 certificate programs under consideration. Other large employers that have recently announced badging programs for talent development or competency-based hiring include Microsoft and Ernst and Young.[23]

to demonstrate and certify what they know, regardless of where the skill was gained. The program scores skills in areas such as writing, sales, programming, and leadership through a process that involves peer and expert review. It uses machine learning and inter-rater reliability to improve consistency and confidence in the reviews. As a result, companies can codify the skills of employees, and employees can have their skills professionally certified, adding a degree of certainty and potentially helping to reduce forms of bias.[25]

Online talent platforms such as LinkedIn help make the connections between education, experience, and the labor market more transparent. LinkedIn has become a credential and competency clearinghouse for consumers, employers, and educators with approximately 560 million registered users as of June 2018. Employers and job-seekers are matched on a massive scale. Beyond helping users find jobs, LinkedIn can assist individuals in identifying skill gaps, developing new capabilities (e.g., through courses offered by LinkedIn Learning or Lynda.com), and charting new career paths.[26] By supplying market information and training, LinkedIn does not just find and connect talent—it grows talent.

the massive disruption smart machines represent. But to what extent does that future education look like today's?

In the near term, changes may be felt by college/university career planning and placement offices as students prepare to enter the job market. But it is not only new college graduates at the start of their career who need assistance in developing their talent; this shift includes adults at varying stages of professional and lifelong learning.[27] Longer-term impacts revolve around the transparency of what a degree signifies. Students invest in credentials to advance their careers. Though the significance of a degree and the power behind a college or university brand are likely to remain, data-driven and competency-based approaches will challenge higher education institutions to provide greater transparency into what graduates can *do,* both on graduation and throughout their career. Ultimately, talent platforms will enable employers and educators to better align professional demands with educational options.[28] Higher education leaders should ask questions such as the following:

- Are we making students aware of possible career pathways and how they can develop and demonstrate the intentional, continuous learning and agility they will need to be future-ready? Are we helping students learn how to develop and share digital credentials that will serve them throughout their careers?
- To what extent are programs aligned with the labor market? How "industry-

HIGHER EDUCATION'S GREATER CHALLENGE IS TO ANTICIPATE WHAT IT MEANS TO BE A KNOWLEDGE WORKER IN A WORLD OF SMART MACHINES.

Integrating Credentials Online

Learning and credentialing take place on the job as well as at colleges and universities. Hundreds of organizations offer an estimated 250,000 credentials such as badges, micro-master's, certificates, and degrees.[24] Now that credentials are digital, online platforms can integrate education and experience into a single online identity. Degreed, for example, will aggregate an individual's learning experiences in something akin to a "credit score." Degreed Skill Certification goes a step farther, allowing individuals

Implications for Higher Education

How will higher education (either through degree programs, certificates, or continuing education) help ensure that millions of new and existing professionals have the skills to transition to new positions? Clearly education is a critical component of how society manages

informed" is the curriculum? How well-informed should it be?
- How will colleges and universities work with business and government to grow talent on a lifelong and global scale?

Challenges for Higher Education

AI and other technologies will find their place in higher education. Today chatbots are responding to questions about registration, course availability, and homework assignments. AI is already conserving resources and saving money for colleges and universities, such as by reducing the amount of water used by sprinkler systems.[29] But higher education's greater challenge is to anticipate what it means to be a knowledge worker in a world of smart machines. Changes brought about by AI and robots are taking

place in the professions faster than they are in higher education. Without a close connection to business and industry, higher education will be challenged to anticipate the changes in our disciplines and professions. Even if higher education is a keen observer of changes, can programs adjust quickly enough? Are hybrid business/academic options more likely to be successful?

A focus on competencies, credentials and certifications—and what they mean to the labor market—will become increasingly important. With greater transparency between educational experiences and expertise being created by talent platforms, colleges and universities may need to refine how they certify what graduates know and can do. Enhanced transcripts, badges, and competencies are existing options. More options are likely to emerge. No matter what the mechanisms, the speed of innovation and implementation will matter. Without rapid change in higher education, large-scale solutions in the market may circumvent traditional approaches.

Finally, with career mobility hinging on education, training, and experience, is higher education sufficiently focused on the skills and competencies that are transferable to fields that have yet to be created? With the need for lifelong education becoming more critical than ever, can higher education develop shorter, more flexible, and more closely connected paths to needed education and training?

There will be no "one-size-fits-all" future. Some higher education institutions may change the structure and flexibility of their programs. Others may focus on competencies and how they are certified. Still others may choose to not change at all.

Our machines and systems are increasingly smart and capable. They can work alongside humans as professional partners, augmenting human expertise and growing talent. Together, humans and machines can create great value for society. What role will higher education choose to play in this new world? Will we take on the challenge? ■

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UNCOMMON THINKING FOR THE COMMON GOOD

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Scenarios, Pathways, AND THE Future-Ready Workforce

BY JIM PHELPS

What is the difference between *disruption* and *transformation*? I can look to my own backyard for some examples. When we lived in Wisconsin, we brought home a new labradoodle puppy. The chipmunks who lived in our yard were utterly surprised by this change. They were disrupted out of their habits and homes by our new dog. In the end, they decided that our neighbor's basement would be a much better place to live, which passed the disruption on to Rick and Karen, our neighbors.

In our current backyard, baby squirrels come down out of our tree every spring to practice jumping and climbing, often with funny results. You wouldn't think a squirrel could completely miss a tree from just a few inches away. Yet the squirrel pups continue to work on their skills, and soon they have transformed themselves into graceful and amusing acrobats dashing about our wooded backyard.

For many people, the change in digital technologies has been and will continue to be a great disruption to their livelihood, their social interactions, and their worldview. Like the chipmunks, they react against or flee from this new force. Other people, however, see the developments in digital technologies as a way of transforming their work, their lives, and their society. They see an opportunity to provide real-time medical aid, to reduce traffic fatalities, to enable fuller lives for people with a variety of impairments, and to deliver a lifelong learning experience. Like the squirrels, they will work to transform themselves with new skills and abilities in order to build better lives.

If those of us in higher education want to be in the latter group, we need to understand the three phases of technology shift. And we need to utilize two tools to shape the workforce in order to respond to the changes caused by the new digital technologies. These tools and understanding will help us build a strategy for transformation.

Historically, technology shifts follow a regular pattern with three phases: *refinement* of the technology, innovative *disruption*, and societal *transformation*.

Three Phases

Technology shifts have shapes and stages. Historically, they roll through civilizations following a regular pattern with three phases: *refinement* of the technology, innovative *disruption*, and societal *transformation*.[1] It is important to understand where we are in this process in order to plan for future impacts and opportunities. This context also explains what can and cannot be known at any particular time, providing the groundwork for scenario planning and job pathways mapping.

Refinement

The refinement phase is marked by the introduction of improvements to the original technology. For instance, the internal combustion engine was an improvement to the steam engine, and the electrical grid distributed power away from its point of generation during the Industrial Revolution.

During this period, technologies are being refined and improved, and the infrastructure that supports these technologies is being matured (e.g., the railroads and the electrical grid were being built out). A characteristic of this phase is that new technologies replace existing technologies one for one. For example, electric lights replaced gas lamps, and electric trolleys replaced horse-drawn trolleys. In the case of digital technologies, computers replaced the people who added up columns of numbers or calculated trajectories. Machines replaced pocket address books, hardback encyclopedias, paper calendars, and wall phones—among many other objects.

During the refinement phase, computing became cheap, ubiquitous, and continuously connected. Computing power, storage, and connectivity grew exponentially while the computer's form factor shrank to the size of a hand. The internet, digital cellular networks, and Wi-Fi brought the network to devices everywhere, not just on a desktop connected to a modem. This maturing of the technologies and of the supporting infrastructure allowed us to move into the next phase.

Disruption

The disruption phase is marked by entirely new inventions. During the disruption phase of the Industrial Revolution, the washing machine, refrigerator, car, and radio appeared. Henry Ford invented a whole new manufacturing process that allowed for the mass production of cars. His architect, Albert Kahn, created a radically new design for manufacturing plants. Introduction of the car and road system completely disrupted the horse-based transportation system that had existed before.

In the disruption phase of digital technologies, artificial intelligence (AI) is supplementing diagnostic medicine with wearables that detect heart arrhythmias, and the cellphone and wireless technologies are providing the ability to find a restaurant and book a table in almost any city while on the go and listening to music or watching a video. (See the "Digital Technologies" sidebar.) Many Third World areas have leapfrogged the Industrial Revolution technologies of land-line phones and brick-and-mortar banks, moving straight to smartphones and micropayments.

This introduction of entirely new technologies causes waves of disruption to society, to existing economies, and to practices and norms. In time, the technological disruption becomes mature enough that the final phase begins to take shape.

Transformation

In the transformation phase, society itself is transformed to new norms supported and enabled by the capabilities of disruptive technologies. In his TED Talk "The Magic Washing Machine," Hans

Digital Technologies

DIGITAL TECHNOLOGIES can be thought of in three layers: Customer Experience Delivery; Automation and Intelligent Systems; and Enabling Technologies.

Customer Experience Delivery

Some have said that the Information Age is over and that we are now in the Experience Age.[1] User experience design, hyper-personalization, and mobile devices are three key trends focused on using technology to deliver exceptional experiences for customers. These form the upper-most layer of digital technologies.

- *User experience design* builds on the design thinking trend that became popular in the 1990s and 2000s. It puts the users, the problems or tasks they are trying to solve, and their experience at the fore of the design process. This design idea was at the core of Steve Jobs's statement that "no product should need a manual." Using a product should be so intuitive to users that they can just do their tasks on their own.
- *Hyper-personalization* provides information tailored just for the customer—information that is timely and that is location and context aware.
- *Mobile devices,* tablets, and wearables (e.g., smart watches) mean that the experience can be delivered to the customer on any device, at any place, and at any time.

An example of a hyper-personalized experience that was designed with user experience design practices occurs when you are on an airline flight and receive a text saying, "Your bag is now on carousel 8." The text is tailored just for you: it is about your context (getting off an airplane and picking up your luggage) and is focused on solving your immediate problem (finding your bag).

Automation and Intelligent Systems

Artificial intelligence, machine learning, and algorithms all fall into this second, middle layer. Together they build smart systems that can perform complex tasks and learn new tasks. They are used in image recognition (e.g., finding faces in photos or performing optical character recognition) and complex pattern recognition (e.g., using an Apple Watch to detect heart arrhythmias). These autonomous and intelligent systems are rapidly expanding their capabilities and applications into administrative tasks, autonomous vehicles, order fulfillment, farming, and customer support (among many other uses).

It is these technologies that take the information about you, your flight, and your bag and build the automatic notifications that help you navigate the airport. Operating in the middle of the digital technology stack, they gather data from layers below, perform deep analysis, and act on the outcomes. Those actions vary widely, from braking automatically when you get too close to another car to finding patterns in brain scans to detect disease.

Enabling Technologies

The two upper layers build on many enabling technologies in the bottom layer, for example:

- In the *internet of things (IoT)* everything is now on "the network"—from refrigerators to lightbulbs, tractors to moisture-level sensors, trashcans to smart watches. Beacons detect when devices pass by (e.g., smartphones in stores or robots in a warehouse). Smart thermostats know when residents arrive home. The fact that everything is on the internet means there is data everywhere and this data can be used by autonomous systems to perform more and more tasks.
- *Big data* is the term for all of this data that is being produced by IoT devices as well as by people (e.g., on Twitter, Facebook, OpenTable, Yelp). Because there is so much data, complex patterns can be found. With all of this data on the internet and available in real time, you can get instant notification when your bag is removed from the airplane.
- *Cloud computing* is software that is run by a third party and is available over the internet, usually via a web browser. The user does not have to install or maintain the core application. Cloud computing allows for rapid development and deployment. It also allows IT organizations to focus on their core competencies rather than running a computer center and maintaining physical hardware.

This enabling layer provides the computing, the data, and the connections that allow the other layers to act on the data and then deliver an amazing experience.

Note

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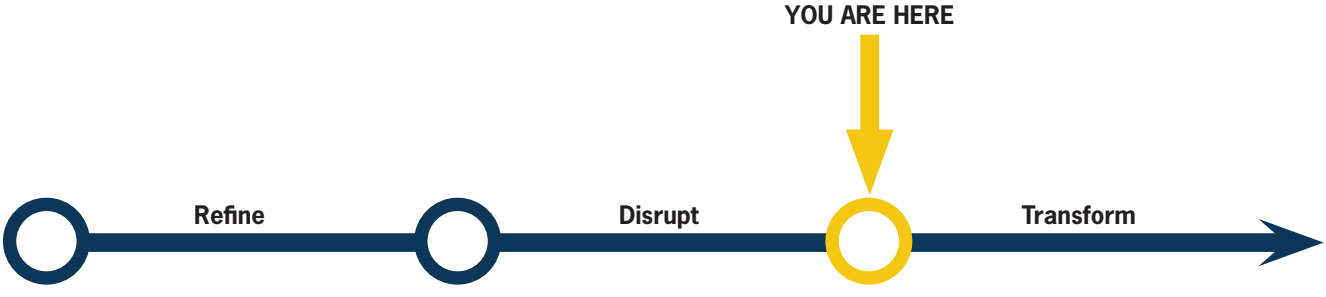
Rosling argues that the washing machine freed up time for women, who then could get work outside the home, organize themselves politically, and finally, get the vote.[2] Similarly, the invention of the car radically changed our economy, the way our cities are built, and our lives. Ford's assembly line changed craftsmen, who had previously worked in cottage industries building carts or wheels, into part workers who each did one step in the process. This change in working conditions led to the rise of the union as a force in economics and politics, radically reshaping our culture.

In the transformation phase of digital technologies, we are starting to see societal transformations occurring within world economies in the form of retail disruption and a workforce shifting to the "gig economy," but the full impacts and transformation have yet to occur. We are on the cusp between disruption and transformation (see figure 1). We do not know what will happen to society as new technologies roll through the economy, the workforce, and our personal lives. Whole new technologies will still appear (disruption) as the current set of digital technologies matures and drops in cost and in complexity to implement. For example, Apple's next release of the macOS Mojave has built-in machine learning capabilities that will simplify the application of machine learning for developers. Intel has just launched Movidius Neural

We need *strategic workforce development* to constantly readjust employees' skills and competencies as the disruption phase progresses to transformation.

Figure 1. On the Cusp between Disruption and Transformation



Compute Stick (NCS), a USB 3.0 stick that provides high-powered visual recognition AI at the hobbyist price of $80. Scientists have built on the Apple Watch to detect a variety of conditions such as sleep apnea and hypertension.[3] Elon Musk's Solar Roof tiles, along with ever cheaper solar and wind power, could reshape the electrical grid and the entire coal and natural gas workforce and economy.

Workforce Changes and Strategy

Because of all of this rapid advancement in digital technologies, we do not yet know what the digital transformation will bring to the workforce. Jobs of all kinds—in the medical profession, in blue-collar trucking and oil/coal extraction fields, in high tech—will be radically changed during the next decade. This amazing shift in the structure of our society will be extremely difficult to navigate gracefully.

And of course, higher education will not be immune to these changes. Both staff and students will need new skills for success in their jobs and their education. Users' expectations for hyper-personalized experiences driven by AI and big data will exist for higher education just as it exists for retail and airlines. There will be a strong drive for efficiency through the automation of administrative tasks as colleges and universities face tight budgets and increasing student loan debt. The need for intelligent systems to gain an edge will apply not only to research but also to student-recruitment efforts. As a result, those of us in higher education IT organizations must be strategic about how we develop our workforce so that they will have the skills to respond to these forces across our institutions. We need *strategic workforce development* to constantly readjust employees' skills and competencies as the disruption phase progresses to transformation.

So if we want to be squirrels, gracefully transforming ourselves as we navigate the ever-changing digital woods (how far can I push this metaphor?), we need to be thoughtful about how we grow workforce skills and competencies. Two tools can help create a roadmap for workforce development goals and build

Two tools can help create a roadmap for workforce development goals and build a common vision for the transformation.

Apply This

THIS FACILITATION PLAN involves two half-day sessions, with work occurring between the two half-days. Ideally, the sessions would be scheduled one or two weeks apart, but not longer. The overall question for the sessions is, "How does our workforce need to change over the next ___ years?" The time horizon chosen should be far enough out for there to be significant changes but not so far that you cross into the world of science fiction. Four to ten years would be a good range to choose from.

First Session: Scenario Planning

The goals of this session are the following:

1. Ground session attendees in the drivers and concepts of the digital transformation as input into scenario planning
2. Brainstorm additional drivers both internal and external to the institution
3. Rank the drivers on their impact and likelihood, and decide which are most important to the scenario planning (a matrix can be used)
4. Come up with a set of scenarios
5. Pick three to five scenarios that are representative and that everyone understands

Agenda for the Scenario Planning session:

1. Welcome and agenda (5 minutes)
2. Describe the digital transformation: shape of a transformation; digital technologies (30 minutes)
3. Discuss the digital transformation: thoughts; big ideas; questions (15 minutes)
4. Brainstorm other drivers/forces (15 minutes)
5. Build a common list of drivers/forces (15 minutes)
6. Break (time as needed/available)
7. Explain scenario planning (10 minutes)
8. Work in small groups: develop one or more future scenarios (30 minutes)
9. Share scenarios from each group (30 minutes)
10. Choose top three to five scenarios (20 minutes)
11. Work in small groups: determine the roles/skills needed to adapt to each scenario (30 minutes)
12. Report out: big ideas; questions; plus/delta (10 minutes)
13. Introduce job pathways mapping and homework (10 minutes)

After this session, individuals or small groups should brainstorm their own job pathways. They can look online at job listings at high-tech companies or other higher education institutions.

Second Session: Job Pathways Mapping

The goals of this session are the following:

1. Ground session attendees in the scenarios and why they are important
2. Gather ideas for workforce development
3. Identify a set of skills and competencies that are most strategic for the IT organization to develop
4. Build an action plan for developing these skills and competencies

Agenda for the Job Pathways Mapping session:

1. Welcome (5 minutes)
2. Revisit the scenarios (30 minutes)
3. Review the skills and roles that need to adapt (15)
4. Gather any new insights about the scenarios or new scenarios (15)
5. Break (time as needed/available)
6. Share job pathways (30 minutes)
7. Determine which skills are most important (20 minutes)
8. Decide which skills have the greatest gaps (20 minutes)
9. Discuss common skills and competencies (15 minutes)
10. Break (time as needed/available)
11. Update job pathways based on the discussion (30 minutes)
12. Align current roles to job pathways (30 minutes)
13. Outline next steps (20 minutes)

At the end of these two sessions, the attendees should have identified some common themes and common skills and competencies that the group thinks are important to develop. Next steps can include bringing in outside training, attending conferences and workshops, choosing people who will learn about one new skill or competency and report back to the group, and/or creating small coaching triads to work on developing a new skill or competency.

a common vision for the transformation: scenario planning and job pathways mapping. (See the "Apply This" sidebar for a facilitation plan.)

Scenario Planning

Many people think that scenario planning is about predicting the future. But the true goal of scenario planning is to find the institutional or organizational areas that need to be adapted so that they can meet a number of possible futures.

In scenario planning, three or four future states that represent different possible outcomes from known forces and their inhibitors are identified. Planners then ask questions about "what needs to adapt" in order for each of these future states to be negotiated successfully. This is the important bit: often, the same things need to adapt for various futures. They might have to adapt differently, but they still need to change or adapt. Planners then work on making those things as easy to change, or as adaptable, as possible—which might mean refactoring technology, reworking the IT organization, reskilling the workforce, or redesigning business processes.[4]

A simple example can be found in buying an old house. There are several possible scenarios. The roof could leak, resulting in water damage; old plumbing could burst, causing water damage; an old furnace could fail, filling the house with smoke; or a hot water heater could break down, again leading to water damage. The key is that the same two things need to adapt to successfully respond to any and each of these scenarios: insurance and savings. It doesn't matter which scenario happens; insurance and savings would be needed. Therefore, almost all homeowners have insurance and savings in case of an emergency. It isn't the accurate *prediction* of which thing will fail that is important. The trick is to find what is needed in order to successfully adapt to most or all of the scenarios.

A second example, this one from higher education, concerns student enrollment in the future. Student debt is at a crisis level in the United States: $1.524 trillion as of March 2018.[5] There is also a huge need for lifelong learning and adult education. If we take these facts as two drivers, we can think about the following possible scenarios:

1. The bulk of college/university enrollment will shift from traditional four-year undergraduates and graduate students to adult learners who are looking to reskill after a job loss or to maintain their job.
2. Traditional four-year undergraduates will become ten-year undergraduates as they work full-time while obtaining their education.
3. Students will no longer be focused on a degree. Instead, they will want badges and credentials that show they have gained a skill or set of skills so that they can advance at work.

What would need to be adapted for each of these three scenarios?

1: Lifelong learners become the majority of enrollment.	
External Drivers	• Job market changing rapidly • New technologies and inventions impacting job duties and roles • Globalization creating economic challenges and opportunities
Internal Drivers	• Desire to grow enrollment to meet funding gaps • Lack of space to grow traditional on-campus enrollment • Strategic goal of community/workforce development
Future Goals	• Expand support for online, self-paced learning • Focus marketing to adults • Change policies about enrollment, applications, eligibility
What Needs to Adapt?	• The LMS will need to host more online, asynchronous courses and multimodal courses (blended courses). • Curriculum design will need to include courses targeted for lifelong learners and more adaptable course progressions. • The SIS will need to support different requirements regarding enrollment, eligibility, degrees, etc. • Marketing will need to focus on new demographics, with more personalized/targeted marketing.
2: Ten-year undergraduate degree becomes the norm.	
External Drivers	• Student debt load preventing full-time enrollment • Cost of living causing more students to work full-time while attending college/university
Internal Drivers	• Desire to support undergraduates • Need to maintain enrollment numbers
Future Goals	• Expand support for online, self-paced learning • Change policies about enrollment, applications, add/drop • Enable LMS and SIS to support badging and competencies
What Needs to Adapt?	• SIS will need to support different requirements (e.g., enrollment, eligibility, badging). • New data and analytics capabilities will need to produce measures of success when the four-year graduation rate is no longer viable and will also need to track student progression and success.
3: Badging and credentialing overtake degrees in importance.	
External Drivers	• Student debt load preventing full-time enrollment • Cost of living causing more students to work full-time while attending college/university • Demonstration of skill attainment increasingly being required to advance at work • Rapid changes in skills needed for work leading to constant lifelong learning
Internal Drivers	• Desire to create more graceful entrances and exits for students • Need to support more types of learners to increase tuition income to fill budget gaps
Future Goals	• Expand support for online, self-paced learning • Change policies about enrollment, applications, add/drop • Enable LMS and SIS to support badging and competencies
What Needs to Adapt?	• LMS will need to allow badging and credentialing. • Curriculum design will need to redefine learning outcomes in terms of badges and credentials. • SIS will need to support different requirements reporting for earning badges and credentials. • Data and analytics capabilities will need to produce measures of success based on badges and credentials, provide analytics about enrollment and attainment in different badging and credentialing areas, and track student progression and success.

Common to all three of these scenarios is the need for the Student Information System (SIS) and the Learning Management System (LMS) to be adaptable. If the SIS and/or the LMS are rigid and hard to change, they are key systems to refactor or replace. In this process, the staffing needs are just as important to consider as the technical issues. Business architects, business analysts, and solution architects are important roles going forward. Business architects help determine the organizational design and business processes for both the present and the future. They also help define the strategic goals and roadmaps. Business analysts manage the requirements and conduct impact analyses of various suggested changes. In some organizations, they would also configure systems as solutions are implemented. Solution architects can design a loosely-coupled, adaptable system that more easily scales going forward.

Business architects, business analysts, and solution architects are important roles going forward.

Curriculum design appears in two of the scenarios. Curricula need to be designed away from traditional on-campus undergraduate progressions

The key to thinking about the future creatively and productively is to find three to five scenarios that ring true for the institution and the IT organization.

to lifelong learners and to badges and credentials for courses or for sections within a course. Likewise, data and analytics capabilities show up in two of the scenarios. Being able to measure outcomes to produce new measures of success will be critical to demonstrating that higher education is still a valuable investment for students and lifelong learners. Data analysis will also be critical for making constant improvements to the systems and curriculum. This suggests that the institution will need strong data architecture, data science, and data warehousing skills.

There are many other possible scenarios to consider; mergers between colleges and universities are a growing trend; students and workers are expecting a hyper-personalized experience that is tailored just for them based on their location and activities; budgets are getting tighter and tighter, with little opportunity to raise tuition to meet the gap; the internet of things and machine learning are automating many parts of facilities management; and AI and algorithms are mechanizing administrative tasks and redefining information seeking and help-desk activities. The key to thinking about the future creatively and productively is to find three to five scenarios that ring true for the institution and the IT organization. From this work, needed skills and positions can be identified, providing inputs for job pathways mapping.

Job Pathways Mapping

Job pathways map the progressions a person can take to move from a job to one or more new jobs. For example, in the January 2018 World Economic Forum report "Towards a Reskilling Revolution: A Future of Jobs for All," job pathways are used to show possible employment opportunities for displaced workers. The pathways capture the number of opportunities (i.e., how many positions are available for each displaced worker) and the salary for the new position. They also show how positions link together to make a larger job transition.[6]

In higher education IT organizations, job pathways can be used to talk about the skills required for a person to move from his/her current position to a position that is needed in one of the scenarios noted above or another scenario. For this work, a job pathway is best when it maps to several possible future roles. In addition, a job pathway that shows more than one step forward is good for longer-term career planning. For example, let's say a Java developer on the SIS team is interested in being closer to the student experience. A job pathway could be created to show how this employee could become a business analyst, then on to become a business architect or a user experience designer (see figure 2). Note how the skills build on each other as the person advances. What the employee learn as a business analyst is foundational in the move up to the positions of business architect or user experience designer.

A second example is a data center engineer whose job is being phased out by a cloud-first strategy. This pathway might take the employee to becoming a cloud platform engineer and then on to the position of cloud financial engineer (see figure 3).

Figure 2. Job Pathway for a Java Developer

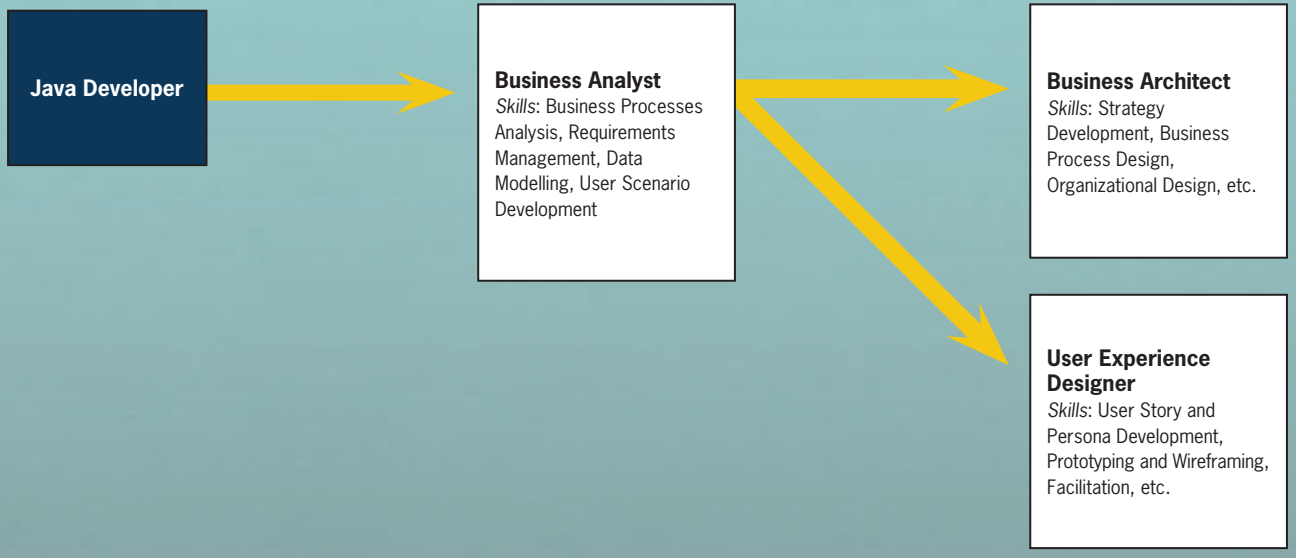


Figure 3. Job Pathway for a Data Center Engineer

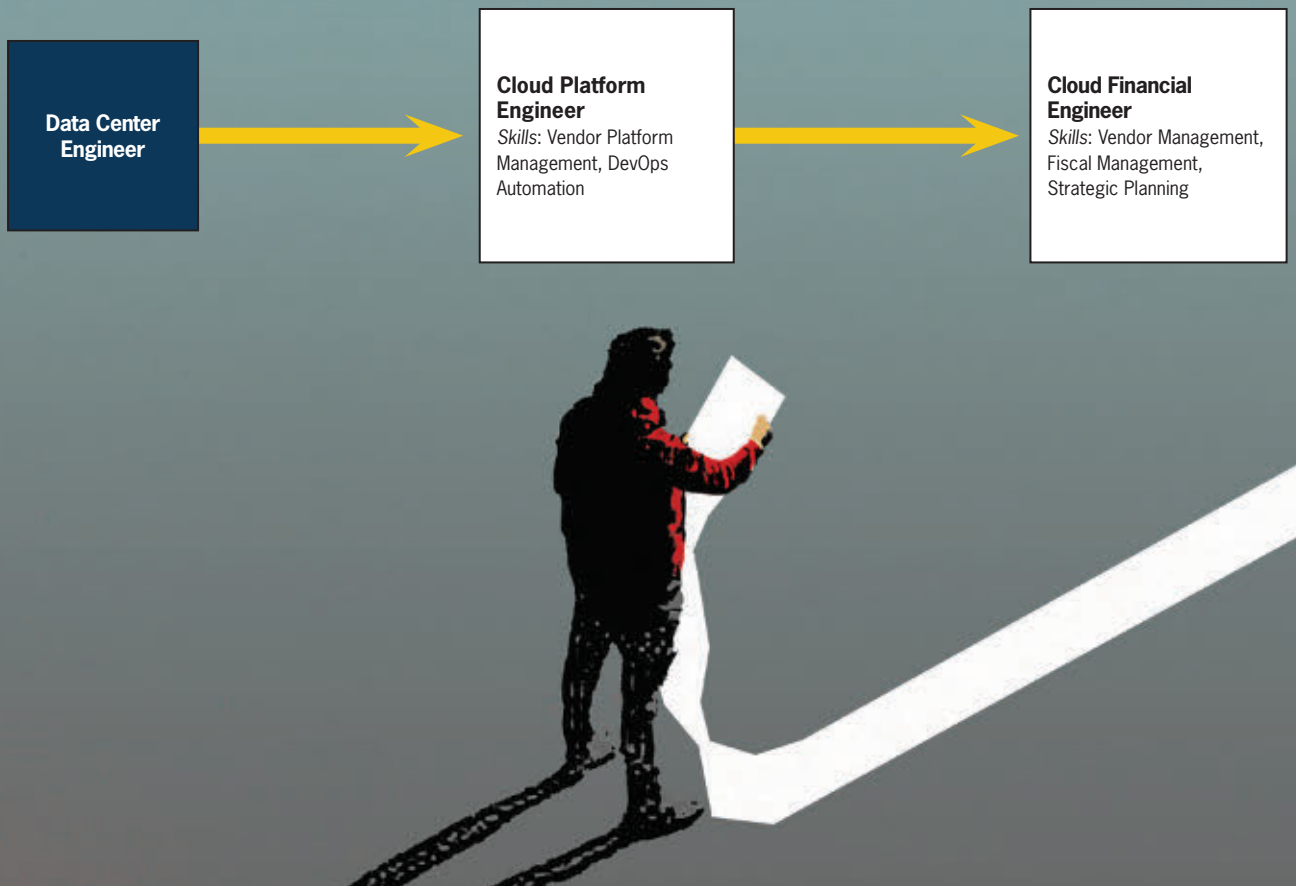
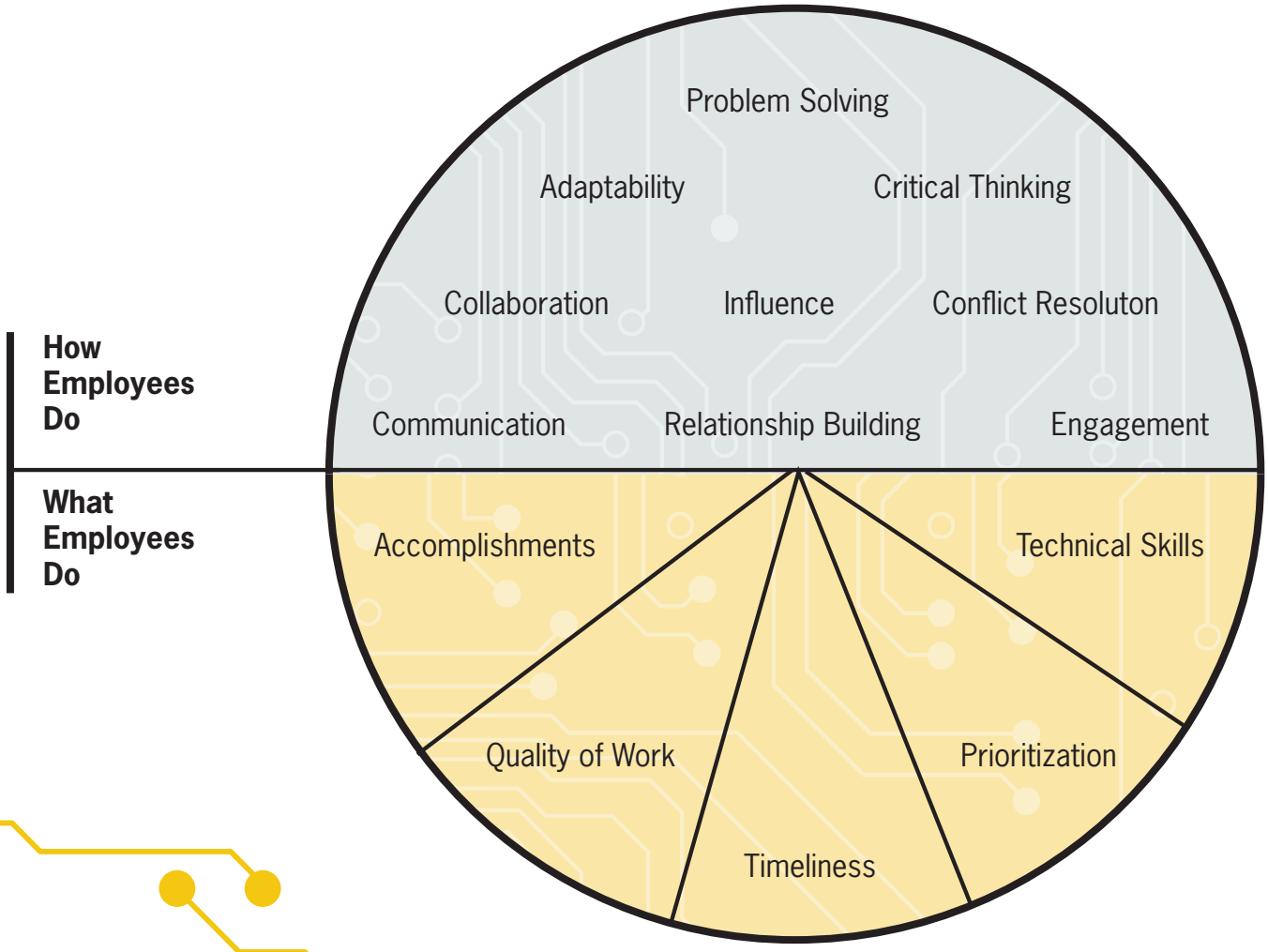
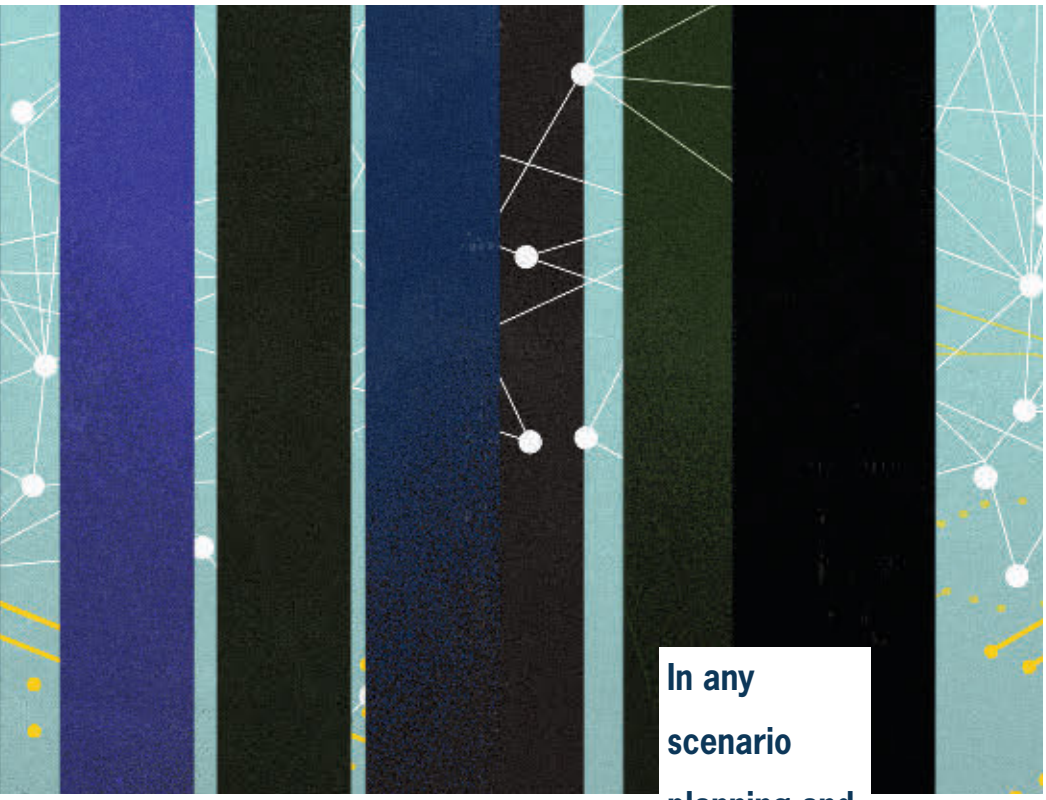


Figure 4. Above-the-Line and Below-the-Line Job Competencies



One critical aspect that often gets overlooked is the above-the-line competencies ("how you do" the job) that are needed in various positions. The below-the-line ("what you do") competencies are often easy to capture (see figure 4). For instance, the data center engineer needs to switch from running on-premises virtual machines and configuring servers to managing instances and containers in one or more cloud platforms. But what about the above-the-line competencies? Will the employee need to be more collaborative? Will he/she be required to gain vendor-management skills? Will communication become more critical in the new positions? If the data center engineer moves all the way up to the cloud financial engineer position, above-the-line competencies will be necessary: negotiation; vendor management, fiscal management, strategic



In any scenario planning and job pathways mapping, IT leaders must be clear about their expectations and must also manage employees' expectations.

thinking. Job pathways must capture both the below-the-line and the above-the-line competencies.

Conclusion

In any scenario planning and job pathways mapping, IT leaders must be clear about their expectations and must also manage employees' expectations. If leaders appear to be promising workforce and skill-development opportunities but do not have the funds or resources to deliver these opportunities, they will likely anger and alienate their teams. Staff will wonder: "Why did we waste all this time and effort when nothing will change?"

IT leaders need to be clear, up front, about the expectations, the processes, the goals, and the opportunities. Is this work that cannot be funded and that the employee is expected to pursue on his/her own? Is there a budget for workforce and professional development, and will it be used to prioritize investments? How will investment decisions be made? By whom?

If we are going to positively transform the employees in our IT organizations into the workforce needed for the digital transformation, we must have the resources to invest in strategic workforce development. Doing scenario planning and job pathways mapping will build a shared vision of the changing future. Staff will see a role for themselves in that future and will have a roadmap for skill development. Meanwhile, IT leaders will understand the internal and external drivers behind possible scenarios, will gain insight into what aspects of the organization need to adapt, and will have a vision of the competencies required for a future-ready workforce.

A shared vision for the future, a roadmap for growing and adapting, and sufficient investment in the skills of the future are what will allow us to transform gracefully. These things help shift the fear of change and the pain of disruption into the positive opportunities of the digital transformation. ■

Notes

1. Chris Eagle, an IT strategist and enterprise architect at the University of Michigan–Ann Arbor, discussed these three phases in his talk "The Changing Shape and Value of Enterprise Architecture," Itana Face2Face 2017.
2. Hans Rosling, "The Magic Washing Machine," TEDWomen 2010 (December 2010).
3. Tom Simonite, "AI Can Help Apple Watch Predict High Blood Pressure, Sleep Apnea," *Wired*, November 13, 2017.
4. To learn more about rigorous scenario planning, see Peter Schwartz, *The Art of the Long View* (New York: Doubleday/Currency, 1991).
5. Board of Governors of the Federal Reserve System, "Consumer Credit," July 9, 2018 (release date).
6. World Economic Forum, "Towards a Reskilling Revolution: A Future of Jobs for All," January 2018.

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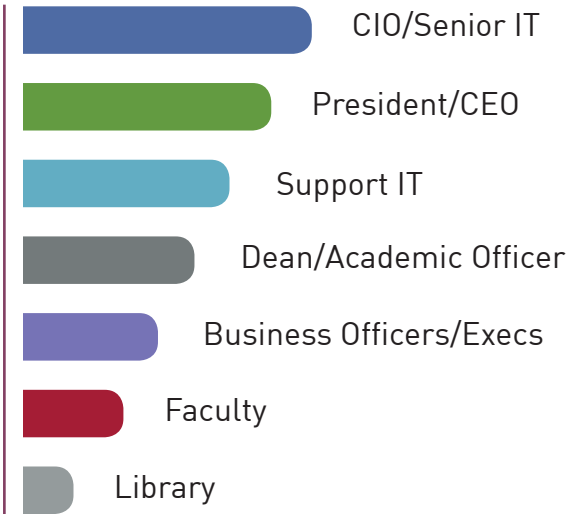

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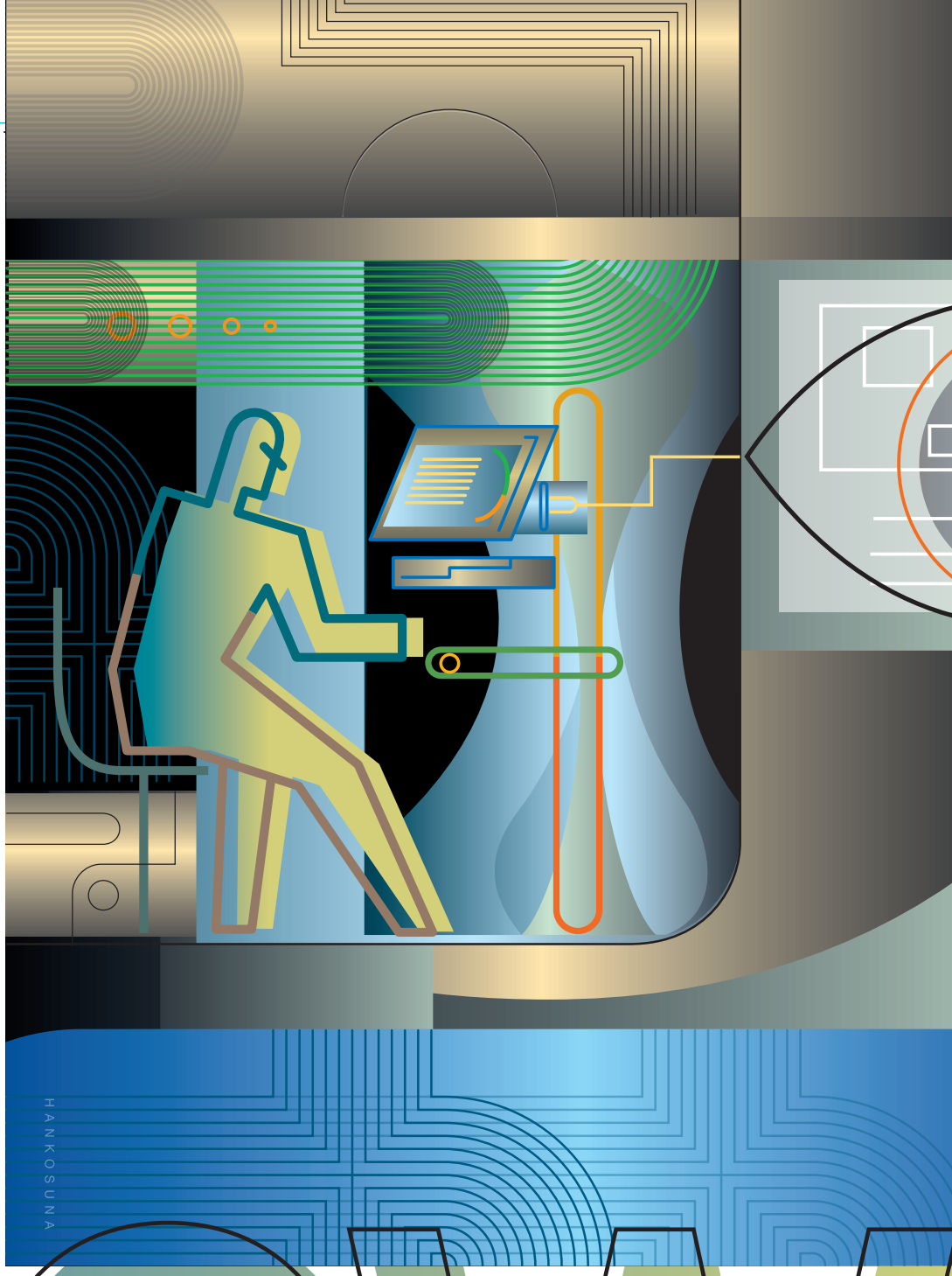
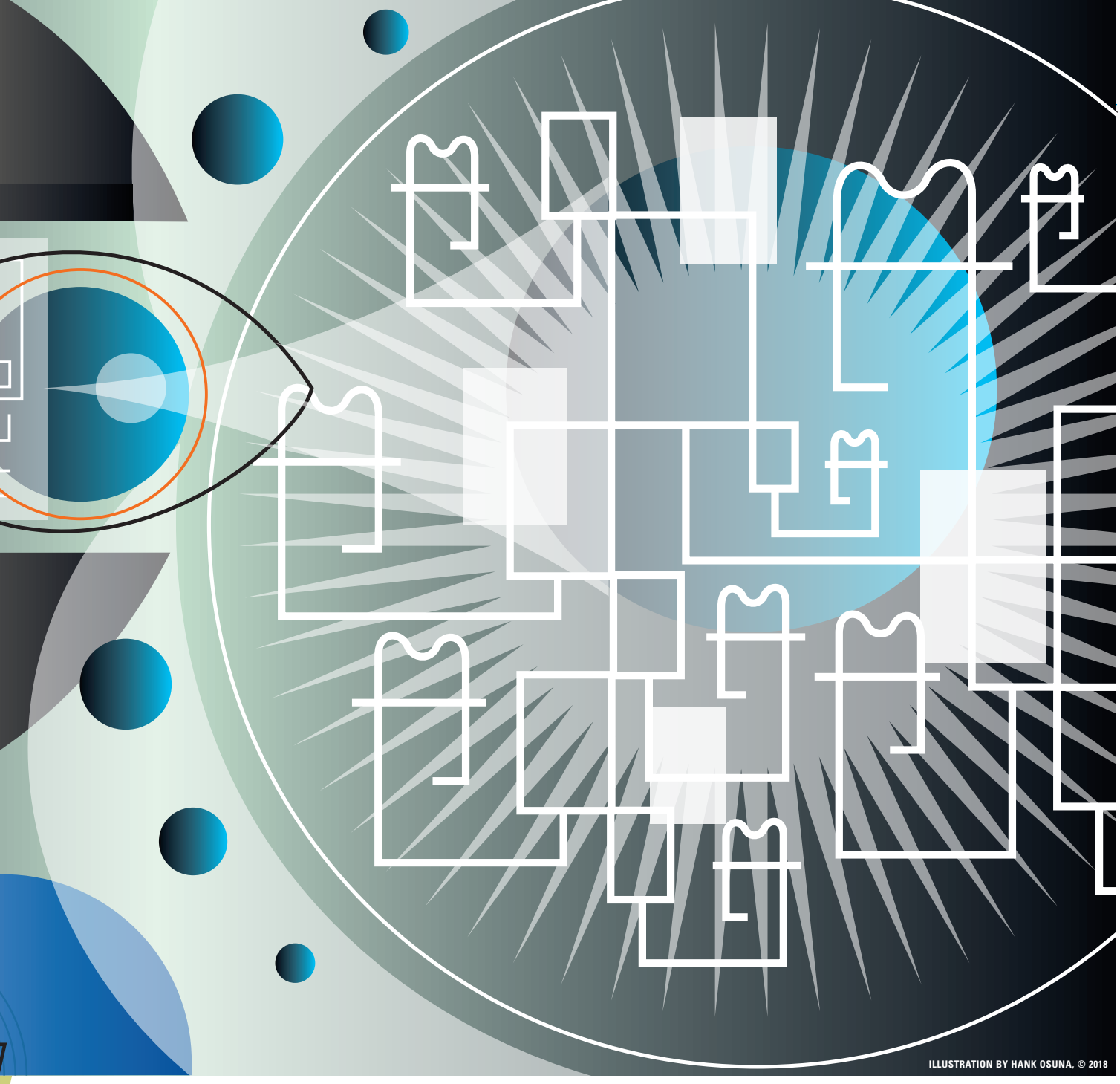
By Paige Francis, PB Garrett, Cindy Mitchell, Sharon P. Pitt, and Theresa Rowe

Perspectives on the Future of the Profession: Looking Forward, Then and NOW





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NEARLY TWENTY YEARS AGO, a panel of technology leaders selected by *EDUCAUSE Review* answered questions about the future of the higher education IT field.[1] Much has changed since. IT professionals are engaged in more than could even have been imagined two decades ago. Yet the issues discussed then continue to resonate today and offer insight into the future of the profession. Below we offer our thoughts on, and answers to, these same questions.

Q What is the biggest challenge facing IT professionals today?

Paige Francis: Crafting long-term vision and shepherding its timely execution in a fiscally smart way is very difficult. Within higher education, the business funding model is not in sync with the pace of the technology, leaving IT professionals to make decisions that are oftentimes not funded until much later. By the time there is consensus and funds to move forward, the original solution and/or strategy may be outdated and need to be replaced with something better, smarter, cheaper, more integrative. The discussion becomes: Do we move forward with what we originally sold to the campus, or do we pivot and risk looking flaky with a new choice? *Answer*: Educate the campus on the process and "the why" early and often. It is never too late to make a smarter decision.

Cindy Mitchell: I can't pick just one challenge. Information security is a concern: efforts to improve our security programs for infrastructure, endpoints, data, and awareness are high priorities for institutional leadership and boards. Agility and responsiveness are critical as well: we are challenged to acquire the skills, the funding, and the capacity to research, procure, and implement solutions, as well as to integrate data at the rate our colleagues want it incorporated into their work—all while balancing the efforts required to maintain our legacy solutions.

PB Garrett: The biggest challenge is that there are too many challenges we have to face every day: increasing information security, furthering faculty development, finding appropriate resources to fund new initiatives, and sustaining existing services. However, without students, we would not have jobs at higher education institutions. So improving student outcomes is paramount and a priority at most institutions, but with that imperative comes the need to successfully manage the implementation and integration of various student success initiatives. The ability to be agile and to adapt to the insane pace of technology change in academic transformation in order to achieve aspirational institutional goals is crucial, but it requires conceptualizing and prioritizing resources.

Sharon P. Pitt: The technology profession, whether in higher education or beyond, needs greater diversity. As IT professionals, we partner and collaborate within our institution, across institutions, and across industry. Yet our organizations and our vendor partners often do not reflect the diversity of the institutions and regions we serve. We need to make a considered and concerted effort, locally and beyond, to ensure that everyone in our community feels included and has an opportunity in our profession. Taking action can be difficult, because we may not feel that we have the training or the expertise to make a difference. But we must start somewhere. Higher education institutions and professional organizations have resources to help us become aware, develop a message, and take action. We can participate in a diversity discussion; we can be an ally, be a mentor, be a friend. We can help to forward someone's dream.

Theresa Rowe: In a 1965 Oakland University memo, D. C. Beardslee, the director of "data processing," spoke passionately about the growing volume of work required without adequate resources. He stated there were only three possibilities:

1. Vastly increased university support
2. Outside funds
3. A drastic scaling down of expectations

In reviewing the original *EDUCAUSE Review* panel discussion from 2000, I see that Linda Fleit, then president of Edutech International, identified the biggest challenge as "Managing campus expectations. . . . The gap between the supply of and the demand for information resources will continue to be large." And now, in 2018, I find that this gap remains and impacts our decisions on a daily basis. What would we do with technology if resources did not constrain every aspect of a technology decision? We are trying to handle the resource gap by throttling introductions of innovative or efficiency changes, supplementing staff with consulting and student labor, outsourcing or moving to the cloud where we see resource allocation improvement, deeply evaluating priorities for strategic alignment and focus, and delaying some decisions. The resource gap appears to be a permanent challenge; with more than fifty years of history, the gap remains a strong and common characteristic of any IT operation. The leadership challenge of communicating and evaluating management of the resource gap is even more important now, in an era when many are questioning the value of higher education.

What would we do with technology if resources did not constrain every aspect of a technology decision?

Q How can IT professionals best prepare themselves for the future?

Francis: Be the person in the room who adds value, develops meaningful and reciprocated relationships, embraces criticism as an opportunity, and enjoys communicating at every turn. With the

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Education is the most powerful weapon which you can use to change the world.

~ Nelson Mandela

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We should actively talk about the sense of fulfillment, purpose, and joy to be gained from working in the higher education and IT fields.

abundance of devices in the world today, the technology field has its own version of "Dr. Google." But seeing the "big picture" and connecting all the pieces cannot be done by searching online. This requires vision—someone to solve the puzzle and formulate the best path forward. Be that person.

Mitchell: Be curious. Learn what your colleagues across institutions are doing with technology in academics, research, administration. What do they see as their next big need? Attend conferences, webinars, seminars. Read. Develop relationships with creative, innovative people. Ideas, future thinking, continuous improvement, and innovation keep us pointed in the direction our colleagues and our students are going.

Garrett: Bloom where you are planted. Learn to conceptualize at the 50,000-foot level of where the institution is going or needs to go to align with its strategic plan, and then build a concrete path for actually achieving that plan. Develop trusted and authentic relationships with stakeholders both internal and external to the institution. Cultivate strategic partnerships across the academy and within professional organizations. Become the boss that you hoped you would work for, and listen to your team. Seek feedback, often, from everyone. Get used to change—it is the one thing that remains constant in this field.

Pitt: To repeat Paige's excellent point: Add value. There is never a time when we are not in service to our students, our faculty, our staff, our teams, or our profession. Our field changes rapidly, so we need to understand the capabilities, challenges, and emerging opportunities of various technologies in order to be full partners in the success of our institution. Anywhere we participate—at any "table," virtual or real—we need to add value. The caveat is that our expertise must be offered without defensiveness and without conceit but with helpfulness and with empathy for the challenges of others. And when you find yourself without answers, ask for help.

Rowe: For me, the key is PB's "Bloom where you are planted" advice. Those of us who are perennial gardeners have a goal of continuous blooms all season long. Yet no single perennial will provide a season-long show. Sometimes a plant has to be nurtured for years before it flowers. A gardener knows that the garden needs constant renewal. This is a parable for an IT employee and an IT organization. What are we doing today that will flower in three to five years, in addition to adding value daily? This commitment is the best way to prepare for the future.

Q Where will tomorrow's leaders in our profession come from?

Francis: Everywhere. I used to be an anomaly with my communication undergraduate degree and my mad respect for the arts and sciences. Now I see technology leaders coming from all directions, and it just makes sense. Technology departments and their staff are no longer solely basement dwellers. We are finance and human resource professionals; we are project managers; we are developers and user experience gurus. Our trajectory is no longer to simply reach CIO stature and stay there. More and more often, our next steps are CEO, COO, or chancellor. Tomorrow's technology leaders are ingredients in a truly cross-discipline melting pot.

Garrett: Our new leaders will come from disparate areas. No longer is it required or the norm to have a doctorate in computer science in order to be a successful technology leader. The research shows that the top attributes for being successful in our profession now, and in the future, are communication skills, political savvy, and strategic business knowledge. Now is a great time to aspire to be a leader in our profession—particularly for women and African Americans. A recent study of individuals in higher education leadership roles found that only 22 percent are women and only 3 percent are African Americans.[2] A more diverse and inclusive workforce is needed to provide a balance that embraces leaders irrespective of race, gender, or disability.

Pitt: What was suggested nearly twenty years ago is still true today. IT professionals will come from everywhere. As Fleit noted: "The leaders will come from among the many pools of bright and capable people on campus—from the computer center to the library, from the faculty to the finance office." In terms of leadership paths for IT professionals, we now need to encourage inclusion and diversity. At our institutions, we need to adopt hiring processes that lead to inclusiveness, for example accepting expert credentials instead of the sometimes restrictive requirement for a degree. We also should actively talk about the sense of fulfillment, purpose, and joy to be gained from working in the higher education and IT fields.

Mitchell: Our leaders can come from anywhere, and it is up to us to be developing leaders from within our own departments and institutions. Leaders aren't just born (well, some are); their development requires intentional investment, encouragement, mentoring, and professional development.

Rowe: Expanding on Cindy's comment, "intentional investment" is critical. Some of that investment is championed by existing leaders and professional development organizations. But individuals too have to intentionally invest in their own career and their career decisions. A career is not a trip plan or a checklist; some of the efforts needed to advance haven't been invented yet and will emerge five or ten years from now. A career leading to a leadership role consists of a series of intentional decisions to ensure an individual has not only years of experience to draw on but also the confidence to choose innovative pathways that will lead to a new horizon.

Q How can IT leaders show the value that we add to the institution and to institutional decision-making?

Francis: Through conversations, modeling, and results. A story to illustrate this involves budget time at my last institution. To increase process transparency, campus leaders gathered to share our needs for the next fiscal year. As the CIO, I had already had a pre-discussion with the executive vice president (my boss), who had told me that in the next year, I could expect to see less additional funding because so many other areas had increasing needs. At the gathering of leaders, my funding request was presented first and was received as reasonable. Each report after that, from Student Services to Advancement to Academic Affairs, asked for significant technology funding to be given to my area on their behalf. My boss just stared at me across the table and shook his head. I smiled. Long story short, our value comes from aligning with the business of our institutions. When our campus partners are the ones evangelizing our value, we have arrived.

Pitt: For institutions that value student success and effective decision-making, technology professionals are already relevant and valued. Information resources and technology are core institutional assets and capabilities. Essential to our continued value is demonstrated transparency, openness, agility, and progress. When those of us in information technology, as leaders and as a profession, demonstrate these essential competencies, we build and sustain trust. Part of sustaining that trust is measuring, assessing, communicating, and celebrating our shared progress with our institutional partners, in addition to expressing our shared requirements to achieve success.

Garrett: The focus should be on the value drivers, and the overarching goal should be to solve our institutional problems, not our IT problems. We should always use data and metrics to support the decision-making process, benchmark against peer institutions, and partner with other campus stakeholders to strengthen requests.

Mitchell: As Paige noted, we show our value when we engage in the business of our institutions. We also show our value when we speak the language of our students, faculty, and staff and demonstrate our understanding of their work. We show our value when we engage in solving problems holistically even if the solutions or options don't include a new technology. We show our value when we share—in a way that connects to their work and in language that connects to them—the value of the services we offer, from firewalls to data warehouses to workflow to business continuity. We show our value when we are present, listening, and engaged at all levels of the institution.

Rowe: The idea that IT leaders need to understand the *business* of higher education was an underlying theme in the year 2000 and remains so today. But the business of higher education is changing. Our colleges and universities are doing more to reach nontraditional students and new population markets, create innovative and attractive programs, and provide successful educational outcomes through new methods and processes. As IT leaders, we must address the challenge of understanding—and being a thought leader for—how the business model is changing, the impact on information technology, and the value that information technology can add to this model.

Q What can nontechnical institutional leaders do to support IT professionals in their quest to be more effective partners in institutional decision-making?

Francis: Higher education is working tirelessly toward changing the legacy

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of territorialism and siloed decision-making. This is a tough but necessary transition, especially on campuses where past interactions with technology teams were unhelpful at best. Oftentimes we are facing disparate and numerous duplicative, nonintegrative systems that all need replacement. Persistent, positive collaborations and communications must take place in order to build reciprocal confidence and bridge the conversation gaps between technical and nontechnical. IT professionals must place learning and understanding the business as their highest priority. Conversations, not declarations, need to happen. Listening and consuming new ideas is key. If we, as technology professionals, walk into the room with all the answers, we likely won't be asked back to hear the questions. Today's institutional leaders need to demand strong technology leadership including vision, grit, and inclusiveness. Once the right IT leaders fold into the mix, they should naturally emerge as more effective business partners, working with other campus leaders to identify, ideate, solve, and measure institutional problems.

If we, as technology professionals, walk into the room with all the answers, we likely won't be asked back to hear the questions.

Mitchell: The most important thing nontechnical institutional leaders can do is include technology professionals in initiatives from the beginning. They should assume there will be a technology component and then create the space for IT professionals to be a part of the entire process, not just when someone realizes that a technology conversation must occur. Nontechnical leaders should invite technology leaders into institutional strategy discussions, on the ground level of key initiatives, and expect them to contribute beyond technology knowledge itself.

Rowe: There must be collaborative, ongoing, and immersive engagement among all institutional leaders, pulling in subject-matter experts as needed. This engagement must also have a strategic focus. The complexity of the IT environment is not handled in an annual report or with an occasional check-in meeting. The comments by Marty Ringle, president of the NorthWest Academic Computing Consortium and CIO at Reed College, in the January/February 2000 *EDUCAUSE Review* panel still ring true: "Including IT/IR professionals in the highest-level strategic conversations will achieve two-way communication and thus serves the best interests of the institution."

■ ■ ■

Where do we go from here? Forward. Technology has evolved from systems to solutions and services. Leadership has changed from task-driven to strategy-focused. Response has moved from reactive to proactive. For the most part, technology leadership and vision has matched the pace of change with little fanfare. Responsibility has pivoted to the entire institution in holding IT professionals accountable for performance and response and for meeting campus needs and wants. The campus as a whole must remain engaged in strategy, understanding that technology is no longer simply a (sometimes confusing) utility but is a strong, complementary facilitator in all facets of the mission and operation of the higher education institution.

Just the idea of how these questions above might be answered in 2038 is mind-blowing. ■

Notes

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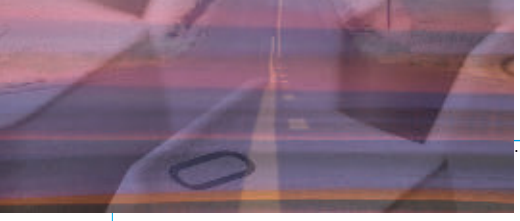

Leveraging Technology to Create Social Readers

Working in open-access institutions with a large majority of underserved populations, community college instructors often face the twofold tasks of helping students become conversant in discipline-specific coursework and also bringing students up-to-speed in their academic skill sets. Between publishers' higher costs of textbooks and students' struggle with large amounts of reading materials, getting students to both access and engage more deeply with texts is a challenge.

E-Texts

The rise of the e-textbook format at first might seem like a way to equalize access to and interest in academic materials. However, a recent global study of over 10,000 college/university students found that students still overwhelming prefer print materials, particularly when the goal is a deeper level of comprehension of the text.[1] The study found, however, that e-texts were preferred for shorter readings where the goal is to review materials. Thus, students' perceptions of the text format itself may have an impact on its use in the classroom.

An *EDUCAUSE Review* column on Open Educational Resources (OER) noted the case of a community college professor who found that his students seldom accessed texts in electronic format.[2] Meanwhile, a quick glance at the Open SUNY Textbooks website statistics—just to take one example—shows that students are not downloading texts in ePub format but, rather, as PDFs. The format in which these materials are available to students, then, has an impact on students' willingness to access and use materials, which in turn can inform how we utilize these in both remedial and general education instruction.

Developing Community College Readers

Basic skills courses are not the only place where scaffolding active reading practices should occur. General education community college instructors can also benefit from reframing their reading lists as tasks rather than as standalone assignments that students do in isolation. Metacognitive frameworks like Reading Apprenticeship, which trains students to read more deeply using think-aloud protocols and annotation assignments, aid students' problem-solving competencies and foster critical thinking skills.[3]

These methods encourage a social dimension to reading, where multiple students together can engage in a dialogue with the text. Reading is then something that is recursive: understanding is not linear but, rather, is a process of revising assumptions to gain deeper insights.[4] Social reading is nothing new, argues Anne Trubek in a reflective essay on reading and technology. Before print became ubiquitous, readings often occurred as a public, communal experience. Trubek defines social reading vis-à-vis technology as that which occurs *ex post facto* via online discussions or social media sharing or as an interactive experience within a text through hyperlinks.[5] Current technology takes this a step further as modern annotation tools combine, in one platform, both the social sharing/dialogue and the ability to engage in ways beyond the text.

Annotation Tools

Traditional online publishers have developed ways in which students can highlight and even annotate e-texts, but for many community college students and instructors, these tools may lack the practicality of other, free and open-source web-based annotation platforms. Publisher e-texts assume students are paying for or buying their textbooks; however, according to a 2013 survey, 65 percent of students decided to forgo buying textbooks because the cost was prohibitive.[6] This, coupled with the fact that the market is not set up for students to purchase used e-texts, means that the annotation tools that are native to publisher platforms are often not a realistic option for the community college population.

Several free and open-source web-based annotation tools can be used to engage students with texts in new ways, in addition to ensuring equitable access to course materials. These tools rely on platforms, which add a layer to existing PDFs or web pages, do not expire, have various privacy settings, and allow students to develop the 21st-century skills needed for digital literacy.[7] As an added bonus, instructors can use these tools to provide content in a format that students tend to prefer, whether PDFs or web pages. While each tool has differing ways in which it can be used in the classroom and with various Learning Management Systems (LMSs), they all have one feature in common: the ability for students to highlight, annotate, and share thoughts on a given text.

One of the more widely used tools that also allows for deeper Learning Tools Interoperability (LTI) integration with various LMSs (e.g., Canvas, Blackboard, or Moodle) is Hypothes.is, a web-based open-source platform with a simple and intuitive user interface. Because Hypothes.is can integrate within an LMS, the platform is easy to use through existing institutional authentication systems once students have set up their individual accounts. While it qualifies as a third-party

Connections Editor: **Bret Ingerman**

By KATIE DATKO

software application for many districts, the facts that students can use it within the system and that their work is recorded in the LMS gradebook (e.g., the SpeedGrader in Canvas) help to demonstrate that students and faculty are engaging in regular and effective contact in online courses.

Another tool that allows free access is Ponder, a social reading platform that emulates many aspects of social media with *micro-responses* and *sentiments*. Ponder also lets instructors create a list of course themes, which students can use to identify key topics and concepts while reading. Ponder can be used via a desktop version or a browser add-on or with an iOS app, making it a useful tool when third-party authentication is not an issue. The free version allows for unlimited class creation, but LMS integration requires a site license and institutional technical support. More advanced features incorporating video and various search functions are available with the paid versions.

Additional platforms—including Stanford's Lacuna—offer varying levels of LMS integration, privacy settings, and analytic tools. When assessing these tools for the community college population, instructors should consider ease of use and the cleanness of the interface. Additional "layers" on top of an annotated layer could easily take away from the pedagogical purpose for which the tool is being employed. Another consideration is whether the platform can easily be added to a course by instructors or if it requires more advanced technical support at an institutional level.

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Classroom Applications

Annotation tools can be used in a variety of ways to support both reading instruction and reading comprehension. When used with shorter texts, they can be used as an alternative to traditional discussion forums in which students are asked to highlight something about which they want to know more or have questions. Students can either respond to each other's questions/posts/highlights or share their ideas external to the platform. What differentiates annotation comments from discussion posts is that as each student reads, responds, or asks a question, other students can see that work. For students who might struggle with reading, this can be a way to start training them to generate and share pre-reading questions—akin to the popular reading strategy SQ3R (Survey, Question, Read, Recite, Review). When students are asked to comment on others' annotations, they use the text as a springboard for their ideas. Rather than having threaded discussion posts that show up based on the time posted, annotations are based on the text itself, which in turn exposes students to a wider range of opinions and ideas. Students actively aid each other in constructing meaning from the text. For basic skills and remedial courses, Hypothes.is in particular can be used as a check on students' ability to highlight only key information from a text and as training for the academic reading strategies that they will need in general education and discipline-specific classes.

With the range of options that web-based annotation tools provide and the ever-increasing sophistication of these applications, community college instructors can help their students develop critical thinking, digital literacy, and collaboration skills through their reading assignments. Annotation tools provide an alternative to the image of the solitary student sitting in the library reading a text. Instead, these tools leverage 21st-century technology to bring social reading back to its traditional roots. ■

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On Being in Libraries

"Why are they coming?" a new colleague asked me earnestly. She was wondering why students are coming to visit our university library in the digital age. If we understood the answer to this question, could we prepare more wisely for the future of the IT and library professions? Indeed, there is reason to be curious. At the University of Miami Libraries, for instance, the number of people entering our largest library, Otto G. Richter Library, has risen approximately 20 percent since 2015. During peak periods, such as final exams, the number of students entering often exceeds seating capacity. Our students advise incoming peers that the best place to study is the library, and they are acting on these recommendations by visiting in person and staying for many hours at a time.[1] But the students who visit our library are not entirely satisfied with what they are finding. When asked what needs to be improved, students request more seats, more power outlets, and longer hours. These requests might be understood not just literally but also philosophically: students seem to want a library that is more capacious, connected, and open.

In higher education and libraries, *openness*—as a value—is actively promoted. In practice, this value is commonly interpreted as *access* itself: freedom from censorship, paywalls, and discrimination. Could it also be interpreted as intellectual *spaciousness*, as awareness itself? Learning within a 21st-century college or university necessarily involves *limiting* the scope of learning—selecting majors and minors—and submitting oneself to ongoing critique and assessment. Libraries have the ability to offer students the opposite: limitless possibilities for exploration and freedom from judgment. At our best, 21st-century libraries might be functioning as "third places"—informal learning spaces that bring people together and build community—and also as *restorative* places, where "one can engage in thinking, wondering, figuring out things, and feeling congruent with where one wants to be."[2] For students, who are often uncertain about what to study or become, the opportunity *to be* in a state of *not-yet-knowing* or *openness* within the library could literally be a relief. Designing spaces and services that allow for open-ended dialogue, creative expression, and contemplative inquiry may support students seeking greater spaciousness of mind and being.

Designing for Conversation

Since 2015, I've been leading an effort at the University of Miami Libraries to develop a Learning Commons—a hub for academic services—in Richter Library. Located on the entry level, the space chosen for the Learning Commons was previously filled with compact shelving housing periodicals that were already digitized or no longer needed. The opportunity to reimagine this space has allowed us to begin fulfilling one of the students' requests: provide more open space for *people* to study. We are also achieving administrators' aspirations of raising the visibility of academic services on campus and modeling the essence of the intellectual experience—learning in relationship with others. For librarians, the initiative has offered a chance to work collaboratively with campus partners to reimagine how the library might serve the next generation of students.

Because of the complexity of the project—involving more than eight different academic services reporting to four separate deans—we decided on an inclusive planning approach managed by a third party. We hired brightspot strategy, whose team guided us through user research and participatory design exercises. The opinions and ideas gathered from our student, faculty, and service-provider community resulted in actionable findings.[3] We learned that the majority of students were coming to the library at least once a week to study, meet with peers, use computers or other technologies, and access materials. Students were curious to find out more about academic services available in the library, and they expressed interest in gaining more opportunities for improving communication and creativity skills. These findings, among others, informed the development of a service model and space strategy that we have piloted over the last two years and are now beginning to implement in phased renovations. In March 2018, we opened the first phase of the Learning Commons.

The service model we designed aims to promote *learning by doing*. Students are invited to choose services that match desired activities, such as writing, researching, analyzing, communicating, or creating.[4] The focus is on process, and the library is where students can stay in "flow," not getting stuck but, rather, progressing through challenges by consulting with peers and experts and making use of tools and resources.[5] The Learning Commons features a consultation zone, consisting of modular stations ideal for two to four individuals to learn together. Unlike the traditional reference desk oriented to transactional experiences, this space encourages sustained dialogue and seeks to destigmatize the act of seeking help. A welcoming service point provides a place to check in for appointments with consultants, who provide assistance with research, writing, modern languages, math, statistics, data analysis, GIS,

E-Content Editor: **Joan K. Lippincott**

By KELLY E. MILLER

digital humanities, and more. The launch of the consultation zone is also well-timed to support the University of Miami's new accreditation-related Quality Enhancement Plan (QEP), which aims "to enhance student learning through dialogue and discussion-based learning in undergraduate courses."[6]

Designing for Creativity

To enter the Learning Commons, students move through an exhibit gallery, where they can discover rare and unique materials from Special Collections and University Archives—objects to inspire curiosity and stimulate conversation. Over the next several years, exhibits will feature curricular projects emerging out of CREATE, a program funded by the Andrew W. Mellon Foundation to promote faculty and student engagement with collections. Creativity is also supported in a digital media studio situated at the center of the Learning Commons; here, students use emerging tools and technologies, such as 3D printing and virtual reality, to make and develop projects. We're also piloting programs to entice students to practice research and creativity skills outside of the formal curriculum. A Library Research Scholars Program gives undergraduate students an opportunity to propose their own projects and work with librarians over the course of an academic year. Examples of projects include writing an original dramatic play informed by primary sources in Special Collections, conducting oral history interviews with LGBTQ alumni, and co-curating an exhibit on university history. Each of the projects involves a combination of inquiry, consultation, and experimentation. Now, thanks to an endowment from Adobe Systems, we are expanding the program to include Adobe Scholars. These students participate actively in the foundational program while receiving specialized training from emerging technology librarians and staff. They develop multimedia projects of their own design and, in turn, serve as "*creative consultants*" to help their peers learn about Adobe Creative Cloud and other creativity software and tools.

Designing for Contemplation

In partnership with Scott Rogers, director of the Mindfulness in Law Program at the University of Miami Law School, we've also begun offering guided meditation programs in Richter Library. Why? Researchers are discovering that mindfulness—the act of paying attention "on purpose, in the present moment, and nonjudgmentally"—can reduce physical and psychological symptoms, produce positive changes in biological markers, and increase neuroplasticity.[7] The library's guided meditation programs complement formal courses, such as Mindfulness-Based Stress Reduction (MBSR), offered elsewhere on campus. Students are taught to observe their breath, witness their thoughts, and practice non-doing. With the knowledge that anxiety and depression are on the rise among our student population, we're hopeful that offering such programs in the library will make a positive difference in student well-being.[8]

Now that the Learning Commons has been open for a few months, we've been able to take a step back and reflect on what we've learned. Besides requests for yet more seats, students and consultants working in the space are asking for noise reduction. After years of striving to increase libraries' embrace of active learning, I am humbly recognizing our students' profound need for quiet space and also the role of contemplative inquiry in fostering dialogue, creativity, and research. I am appreciating our "quiet floor" and individual carrels in the stacks, where students work in companionable silence, and I am consulting with architects, interior designers, and audiovisual technicians to develop sound-abatement solutions.

So, back to the question posed by my new colleague: why are the students *really* coming? Are they gravitating to the library because it embodies opportunities for human connection and creative expression? Are they coming because the library helps them cultivate inner quiet and coherence? Are they coming because no one is judging or grading them and they can work peacefully, if they choose? Or, are they experiencing in the library a spiritual sense of belonging to a larger community and centuries-long scholarly conversation?[9] While we seek answers, I'm offering gratitude for their presence. ■

Notes

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Fostering Human Connection for Meaningful Learning in Technologically Advanced Learning Spaces

The EDUCAUSE community is reimagining the very essence of higher education: what it looks like, how it's designed, who it's for.[1] A major focus of this reimagining is to integrate new technological tools into our learning spaces.[2] From immersive technology to mobile displays and digital devices and even to furniture and writable surfaces, every aspect of the classroom is under scrutiny. Everything is being upgraded to the "Classroom 2.0" experience. As we engage in this level of innovation, it is easy (and fun) to get excited about educational technology. But it is also important to balance this excitement with a sprinkle of caution: essential elements of teaching and learning might be easily overlooked in a technology-focused environment. Furthermore, as technological tools take on new roles in classrooms, people's roles will almost certainly shift. If we do not attend to this shift with intentionality, we risk watching professors and students lose opportunities to engage in teaching and learning in meaningful ways. To this end, we must consider how to promote the affective elements of meaningful learning and how to foster them in technologically advanced learning spaces.

As technologically advanced learning spaces become more abundant, how do we revise and support the role of *people* in teaching and learning?

Meaningful Learning (and Teaching Too)

Joseph Novak, in his theory of *meaningful learning*, posits that learners have to make an affective commitment to learning in order for "meaningful" (versus "rote") learning to occur. Furthermore, he asserts that human feelings are tied to the construction of new knowledge and that human empowerment underlies meaningful learning.[3] Professors also need to feel an emotional connection—not only for the sake of enjoying their work but also for the reason that authentic human connection is a two-way street and students are smart enough to know when "connection" is being manufactured.

In my own research, a tenured science professor (pseudonym "Jackson") at a large research-intensive university described the essential role of human connection in his classroom. In fact, Jackson learned how valuable this connection was as he developed his teaching skills over time. At first, he attempted to take on an austere façade in his classroom: "I tried to mimic what I had seen some of my past instructors do. . . . I could tell I was alienating a decent portion of my class through those interactions." Eventually, Jackson began to open himself up to more meaningful connections with his students. He describes his classroom now as a "team" environment of "mutual respect." He is happier, and his students are "willing to try harder" as a result of his revised teaching strategies.

Keeping the importance of human connection in mind, consider the changing landscape of technologically advanced learning spaces. Technology adds excitement and increases the teaching capacity of learning spaces in many ways, but these changes might also present challenges for the formation of human connection.

New Opportunities for Professional Development

By necessity, classroom priorities are constantly changing to meet the needs of professors, students, and other stakeholders. But the primary purpose of higher education—to teach students—has never been up for debate, and human connection is an essential element of the teaching and learning process. We will best serve our students by preemptively troubleshooting the new challenges that arise for faculty working to develop human connection in technologically advanced spaces. Faculty and students are supported by communities of instructional designers, educational developers, education researchers, and more. There is now an opportunity for an entirely new form of professional development—one that addresses reimagining the roles of teachers in these spaces. We know that meaningful professional development should be job-embedded, ongoing, and co-constructed.[4] We know that we must work with faculty to understand their (and their students') needs in our rapidly changing spaces. Beyond this, however, there is much we don't know. Please consider the following questions:

- As faculty and students engage with new educational technologies, their focus may shift away from interpersonal interaction and toward interaction with the technological tools. How can faculty and students take advantage of new tools without disrupting the communication that supports meaningful human connection?
- Access to a wider variety of more advanced tools has increased the need for students to develop a novel skill:

New Horizons Editor: **Jennifer Sparrow**

By JENAY ROBERT

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digital fluency.[5] Faculty are now tasked not only with teaching content knowledge and specific tool use but also with supporting digital fluency. How do faculty maintain a focus on students' progress in learning disciplinary content and practices while also teaching tool use and digital fluency?

- Finally, as faculty and students are discovering new ways of integrating educational technology into the classroom, support staff are simultaneously working to provide technological training. How do educational technology experts *synchronously* support the development of technological skills and human connection skills?

As we engage in conversations around these questions, we must maintain focus on our mission—to support the success of students at our institutions—without being distracted by secondary goals.

Higher education spaces are shifting dramatically. Technological tools are allowing us to support student learning in ways we never imagined. As educational technology becomes more prominent and even, occasionally, steals center stage, let us remember that educational technology does not replace human beings in learning environments; it complements them. Now is a time of great possibility, a time to harness the potential of educational technology and make leaps in progress. At the same time, we must pause and take notice of the most basic and most essential elements of teaching and learning to be sure that none of them are being left behind. As we shed outdated tools and methodologies, we can and must retain our ability to connect with each other as people. This connection will maintain the highest quality of teaching and learning on our campuses. ■

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The Puzzling Future of the IT Profession

Note from Theresa Rowe, Viewpoints column editor: For some of us, the IT "shiny object" that engaged our attention and provided energy for our first IT classes or jobs may be a distant memory. What inspires the next generation about the future of the IT profession? Jamira Hollis is an early-career professional currently focused on networking. The future of the IT profession depends on engaging Jamira and her colleagues and helping *them* succeed in the IT world of tomorrow.

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To early-career professionals like myself, the future of information technology is a puzzle with infinite possibilities. Our own cell phones have more processing power than our desktop computers did ten years ago. Sink faucets can respond to verbal commands, and cars can drive themselves. Businesses run paperless operations, and people have groceries delivered to their homes. The growth of information technology has truly been exponential, so are there any real limits?

When I began my college career in 2013, information technology was an impressive major or minor for students to pursue. It's the reason I chose Management Information Systems (MIS) as my major. I was primarily interested in project management, and I could have aimed for a general business degree, but I thought a better option would be to have some additional IT experience. Programs in cybersecurity, database administration, networking, and more have become increasingly popular because of how technology has transformed over the years. These paths help to prepare those who will continue to work in an ever-changing industry.

Information technology has become thoroughly integrated with society. The internet is a large part of how the industry has grown, of course, but how we *use* the internet has become much more complex as well. At this point, consumers aren't just using the internet to visit a website. The internet of things (IoT) is now mainstream, for our convenience and for our entertainment; it has substantially changed our lifestyle. Earlier I mentioned a sink that responds to vocal commands; in fact, there are entire smart bathrooms that utilize voice-enabled technology. Information technology is changing all aspects of our lives.

When I was in college, I worked with Boban and Nathan as student network engineers before we all started our full-time careers. So it was interesting to listen to their perspectives today. Boban mentioned how smart bathroom technology

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By JAMIRA HOLLIS

could change how plumbers work with faucets and similar appliances. Plumbers will have to be trained to diagnose technological issues, a quality perhaps previously not necessary for workers in that field. He also mentioned: "Information technology, to some capacity, will actually become smaller. Helpdesk support, and jobs like that, will become automated." This was something I hadn't thought about before, as I tend to focus on how technology will become *bigger* and better.

IoT has created a new environment for internet connectivity. We use it to connect to resources in the cloud, which accesses servers holding massive amounts of data storage for consumers on a global scale. The internet is now integrated with everyday items like our cars, home devices, and credit cards, yielding even greater potential for careers in information technology. The combination of opportunities from the variety of college programs and the variety of job markets gives people like me a sense of confidence and job stability. There is ample opportunity.

As Nathan noted: "There's always going to be a technological shift. As things become more automated, people will lose their jobs, but there will be more jobs coming in other areas. The main reason I gravitated toward the IT field was job growth and job security." When I questioned Nathan about the future of information technology, he continued: "We went from terminal mainframe to host computing, where everything was done on a desktop. Now we're seeing more of the cloud infrastructure, where corporations have virtualization and employers are pushed to use virtual machines (VMs). As we move toward interconnecting devices, the internet's going to be shifting more toward a lifestyle or a utility." This mention of having the internet as a utility got me thinking on the subject of municipal broadband, which is essentially broadband internet access provided by local governments (rather than Internet Service Providers, or ISPs). Our generation could end up paying internet bills just as we know pay our city heat or water bills, in this case with rates based on usage of megabits per second.

The future of information technology also has some significant concerns for those in the field. As noted by Nathan, there will be a change in job opportunities. Although automation will result in layoffs of certain positions, the employees in those situations will have to understand and learn the technology in order to remain marketable in the industry. The process of learning the technology, getting a degree in an IT-related field, or obtaining a technical certification can be costly and takes time to achieve. Older generations may feel less capable of completing that achievement, or they simply may not have the time to establish a new career requiring that kind of commitment.

I tend to brush up on the latest IT developments in a more relaxed manner. Whether subscribing to technology reviewers on YouTube or mobile notifications from news sites, I find using online, just-in-time content to be a simpler way to stay up-to-date. I'm also fortunate enough to work for an organization that not only values change and improvement but actually invests in these values and sends employees to conferences annually to maintain technological proficiency. Sure, those "limitless possibilities" seem intimidating and can be scary for me, but once I increase my knowledge of current topics and understand purposes, I have another opportunity to advance in the IT world.

I am committed to the idea of learning as much as possible for the purpose of not feeling intimidated or out-of-the-loop. And while this is an idea for me, it's a culture for my organization. The fact that we support thousands of students, staff, and faculty at the university increasingly solidifies the need for our department to obtain a firm understanding of developing technologies. In the years to come, we will need to support students' countless IoT devices that they want to use on campus. When other departments start to upgrade their offices with whole-room audio systems, we will need to adjust to fulfill those requests. Customer satisfaction is an important part of any organization that provides a service. Not understanding the possible failures along the way of implementing certain changes is probably one of my biggest fears. A large part of my job is to support people and ensure that they can connect with one another, so I must prepare accordingly. Attending conferences, utilizing informational webinars, reading news articles, and watching technology reviews online are all pieces in how I complete the IT future puzzle.

Those working in information technology must not only understand the technology they're working with but also be aware of how it could transform in the future. As network engineers, my team and I are responsible for keeping our network infrastructure up-to-date. We train for network certifications, we implement hardware refreshes every few years, we learn how certain upgrades affect our customers, and this process continues. I think that one of the biggest lessons I've learned is that in this field, you never stop learning. You have to accept that information technology is an endless practice of updates and changes and that you will be responsible for continuing to adapt.

I truly believe that the IT industry has limitless potential. Whenever the highly anticipated replica DeLorean sports car becomes a reality for consumers, there will still be a drive to make it better, more popular, and more convenient—this applies to all future endeavors within the industry. Changes like these will continue to prompt shifts in the job market and the educational preparation needed for those new jobs. Our society has become advanced in our lifestyles, yet we continue to challenge these accomplishments and commit to innovation. The future of the IT profession is an exciting, intimidating, and promising puzzle. ■

Jamira Hollis is a network engineer at Oakland University.

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