

Lifelong Learning to Leverage Project and Career Success: 21st-Century Imperative

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Abstract: Technological innovation. Lifelong learning. Two forces—continual and interwoven—that not only define the workplace in the 21st century, but also demand that workers in every discipline exhibit a commitment to lifelong learning as a fundamental necessity and ingredient for success. For construction companies, the use of computer estimating programs, building information modeling, the Internet, advanced communications devices, and platforms such as Facebook and Twitter has provided more flexibility and connectivity and a need for continued learning. DOI: 10.1061/(ASCE)SC.1943-5576.0000201. © 2014 American Society of Civil Engineers.

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Introduction

Think for a moment beyond the engineering and construction industries to other sectors within the economy that have experienced sweeping changes attributable to technology. The financial services industry, automobile industry, and newspaper/news media are all driven by technology and the need for the workforce to retain a commitment to lifelong learning.

Banking

Imagine trying to manage your financial resources today without automated teller machines (ATMs), bill-pay services, and Internet banking. Gone are the days when mobile banking meant arriving at a drive-up window. The future promises continued innovation with smartphone banking applications, cloud computing, and connecting with your bank through social-media platforms. For financial services organizations, it is a continually evolving digital landscape—a landscape that, if navigated skillfully, will enable growth and market differentiation for those on the leading edge.

However, a bank does not get to the leading edge alone. Instead, the true leading institutions are driven by technological change and people who know how to leverage it. Banking professionals enhance their knowledge of industry changes by enrolling in banking-certification and continuing-education programs that are offered by financial or insurance associations, 4-year institutions, and 2-year

institutions. For example, courses provided by the American Bankers Association and the American Institute of Banking address such topics as lending, retail and business banking, risk management, compliance, and wealth management and trust. Such courses can be taken in community-based (face-to-face) or online formats.

Automobile

The automobile industry has been affected by technology in a number of areas. These include technology-based control systems for nearly everything you could possibly want to adjust in a vehicle—from interior-lighting controls to navigation systems to rearview cameras—as well as green initiatives to improve fuel efficiencies. Furthermore, Internet-based shopping services enable consumers to contact private sellers everywhere and to solicit competitive bids from used- and new-vehicle dealers.

Newspaper

Newspapers have been particularly hard-hit by technology—droves of consumers now expect to find all content online and available on new distribution channels such as Twitter or rich site summary (RSS) feeds that they can access 24/7 on a smartphone or an e-reader that fits in their pocket. As a response to consumer demand, some newspapers have added subscription-based online access to their print publications. Other news sources, such as the *Seattle Post-Intelligencer* and the nationally circulated *Christian Science Monitor*, have elected to publish online only. *Newsweek* magazine, after publishing a print edition for nearly 80 years, produced its final print edition at the end of 2012 and became a digital-only publication.

Engineering and Construction

As in every industrial sector, professionals in financial services, automobile, and news industries, like those in engineering and construction, face formidable competition and a continually evolving digital landscape. That digital landscape has exerted a profound impact on the construction industry as well. Gone are the days of measuring with rules and tape, estimating partly by hand and partly by the seat-of-your-pants, and estimating with adding machines. Then, when

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a change order came in, you had to start all over. Today, changes are entered into computer programs, and calculations are automatic.

Fifty years ago, as an example, a construction estimator would put his or her best guess together based on hours, equipment, and supplies, and then add a few percentage points as a margin. Now, computer-based estimating programs make the process much more precise and adaptable to change.

Most observers would agree that the basic components of construction have not changed significantly in recent decades. There is still the fundamental nature of excavation of soil by use of machines, the placement of concrete, and the erection of structures of all kinds. What has changed, however, is the complexity of projects because so much is now a reconstruct. “Highways are being widened by constructing new lanes within existing rights of way, around existing utilities and congested traffic. You’re dealing with existing facilities, gas lines, water lines, all of that, and putting things where they weren’t intended to go. It’s changed the whole complexion of our business,” said Jim Waltze, former president of the Associated General Contractors of America (Bergeron 2012). This increasing level of complexity has demanded a new set of tools as construction companies develop and construct all types of buildings and infrastructure.

Construction Management in the Cloud—and So Much More

To say that construction companies have taken to information technology is putting it lightly. A range of information technology tools and applications now include computer-aided design and drafting, three- and four-dimensional visualization and modeling programs, laser scanning, cost-estimating and scheduling tools, and materials tracking (Goodrum 2009).

Some of the nation’s largest and most respected contractors have embraced the digital world through finely crafted websites that feature links to their Facebook, Twitter, Google+, Pinterest, and LinkedIn pages as well as their RSS feeds. Scroll down to the bottom of any of their home pages and you are likely to find prominent links to their social-media pages.

Generally, one might not readily associate social media with construction companies. However, many such companies are taking advantage of the social media sites mentioned previously to showcase what they do and how they do it, and to build relationships with current and potential clients. What is the best way for your construction firm to venture into social media? A few brief suggestions follow:

1. Look and learn. It does not require a great commitment of time to observe how leading construction companies use social media. Visit their websites and social-media pages and take notes. Also, look to companies that are in your direct competitive set. Visit their Facebook, Twitter, LinkedIn, and Pinterest pages to learn how they position themselves and showcase their work. Then, think how you can illustrate what you do even better.
2. Consistency is a good thing. The best social-media pages have content that is fresh and frequently generated. Do not go all out for a week or two and then let it drop. Build slowly, delegate if you need to, and maintain a consistent stream of fresh content for your social-media outlets.
3. Build a blog. A recent survey by HubSpot, an Internet marketing–software firm, shows that businesses are now in the minority if they do not blog. According to HubSpot, from 2009–2011 the percentage of businesses with a blog grew from 48 to 65% (HubSpot 2012). There are several things a blog can accomplish for a construction company, including the following:
 - Personalize the company;
 - Enhance visibility;
 - Build credibility and trust;
 - Showcase recent projects and successes;
 - Drive website traffic from search engines; and
 - Generate sales leads.

A good way to start your blog is to develop a dozen or so posts in advance and have them ready to go. Then, make a post at least once per week. Nothing can damage your online credibility more than a reader coming across blog posts that are stale and out of date.

The marketing and communications landscape has changed and continues to change at a rapid rate. Staying on top of the best ways to communicate with customers is just another branch of lifelong learning. Although the way construction companies communicate and market has evolved, so too has construction project management. For many firms today, construction project management has taken to the cloud. Cloud computing for construction helps project managers track the details that can make or break the profits on any given project. Obtaining complete information for submittals, keeping track of contract updates, making sure that change orders have written sign-offs instead of verbal approvals, and organizing and managing documents can feel overwhelming when project managers are handling multiple projects and share team members who may be across town or around the world. Such cloud-based construction-management services provide a single hub through which owners, architects, engineers, and specialty contractors all stay current on progress, changes, and information.

Construction companies in this emerging digital world will compete less on products and service and more on the value added—derived from learning and innovation—that they can deliver to customers. In fact, construction companies will not be able to succeed without creating an environment of innovation and a commitment to lifelong learning. Indeed, such a commitment has no finish line; without it, these companies will find themselves irreparably behind.

Technology Transforms How Work Is Performed

Technology has transformed not only industries but also the nature of the workplace and how work is performed within it. This is an ongoing evolution that changes the process and systems of work and the workers themselves. The current period is one of profound historical discontinuity brought about by new markets, technology, and the changing nature of work.

Technological advances including wireless Internet access, high-speed broadband, mobile phones, instant messaging, personal digital assistants, and cloud storage and retrieval services have all transformed one’s ability to work where and when he or she chooses. Meetings regularly occur across time zones and countries, and sometimes those that confer, deliberate, and collaborate together across distance have never met in person. Today’s workforce performs its responsibilities on the move, from airports, commuter trains, affiliated offices, or from home, the result being that workers have adopted a flexible approach to where and when they do their work. Technological advancements challenge the traditional notion of the office as the primary work location; walk into any Panera or Starbucks and notice the dozens of personal offices constructed simply by a mobile device and a wireless Internet connection. Work is no longer a place but an activity that can occur literally anywhere in the world.

The smart use of technology does more than enable workers—it also can provide the company or organization with competitive advantages. Businesses that adapt their systems and structures to maximize technology will be in the best position to meet future challenges and competitive pressures. In construction, for example, building information modeling (BIM) increases efficiency and, once firms get up and running with the required software and staff

training, saves time and money; BIM, which envisages virtual construction of a facility before the actual building begins, helps reduce uncertainty, improve safety, work out problems, and simulate and analyze potential impacts (Smith 2007).

Technology Transforms Workers

Although working on the go between the office, Starbucks, or home may seem unappealing to some, current generations of younger workers have grown up in a different reality, one of personally owned (and often multiple) mobile devices and an associated way of life, one of constant connectedness—to the Internet, to unprecedented amounts of information, and to people both near and far. Connectedness is neither luxury nor add-on; it is integral. Consider the following findings from the 2011 Cisco Connected World Technology Report, which surveyed 3,000 college students and young professionals in 14 countries (Cisco 2011):

- One of every three college students and young employees believe the Internet to be as important as air, water, food, and shelter;
- Four of five believe the Internet to be a vital and important part of their daily existence (two of three college students would choose an Internet connection over a car); and
- Two of five indicated they would accept a lower-paying job that had more flexibility with regard to device choice, social-media access, and mobility than a higher-paying job with less flexibility.

The results of this study and many others can tell us something about the future: The 2020 workforce will look a lot different from what is experienced today. Future generations of workers will enter their careers with clear expectations for their professions. They will expect mobility, flexibility, technologically based communications, and fluid use of both devices and computing services in their jobs—in other words, they will demand an extension of the constant connectedness in their personal lives into their professional lives.

Technology Transforms Education and What Is Expected from It

The previously mentioned demands are certain to appear among newer generations of workers, if they have not already. Still, even though younger generations have grown up in a world of constant connectedness, their use of technologies has occurred most frequently in the personal arena rather than in their professional or academic lives, and the rigors of the workplace are different than the demands of social engagement through technology and media that characterizes younger workers' current patterns. These workers will need to be skillful in a whole set of abilities related to the performance of complex thinking and tasks, supported by technological aids. In other words, they will need to be able to engage intellectually and professionally with and through all kinds of media to meet the demands of the workplace.

For these reasons, the past decade has seen the emergence of various attempts to redefine and articulate what graduates of K–12, postsecondary, and graduate education should be able to do. Significant educational efforts are underway to bring digital skills to the future workforce. Whereas former educational outcomes tended to be framed in terms of knowledge and skills particular to subject areas, and the basic presumed literacies were reading, writing, and arithmetic, current skills and competencies are framed more broadly, reflecting today's increasingly diverse, global, and complex world. Any participant in the professional spaces of today and tomorrow will need these skills to function.

For example, Henry Jenkins, media professor at the University of Southern California (USC), and colleagues argue that the “new

mediated landscape of mainstream news sources, collaborative blog projects, unsourced news sites, and increasingly sophisticated marketing techniques aimed at ever-younger consumers demands that students be taught how to distinguish fact from fiction, argument from documentation, real from fake, and marketing from enlightenment” (Jenkins et al. 2007, p. 81). New media, write Jenkins et al., “is affecting every aspect of our contemporary experience and, as a consequence, every school discipline needs to take responsibility for helping students to master the skills and knowledge they need to function in a hypermediated environment” (Jenkins et al. 2007, p. 109). Jenkins et al. have probed the success of networked computer gaming, online fan communities, social-networking websites, and emerging news media sources to surface the skills that matter, increasingly, in today's world. At USC, Jenkins et al.'s Project New Media Literacies encourages development of curricular materials and activities supporting the teaching of new media literacies. These literacies do not read like a typical skills list, including such behavioral skills as distributed cognition, the ability to “interact meaningfully with tools that expand mental capacities”; negotiation, which involves participation in diverse communities to learn “discerning and respecting multiple perspectives, and grasping and following alternative norms”; and even play, “the capacity to experiment... as a form of problem-solving.” Even multitasking, often blamed for fracturing attention, is viewed as essential for being able to “shift focus as needed to salient details” (Jenkins et al. 2007, p. 4).

Another example comes from the 21st-Century Fluency Project (CFP), a collaborative effort to enable K–12 educators to help students develop skills needed in today's digital world. The group has coined the term *infowhelm* to describe the constant bombardment of information from e-mailing, calling, texting, updating, Tweeting, chatting, posting, blogging, searching, downloading, and streaming (CFP 2012). The CFP argues that technology is ubiquitous and already integrated into daily life; today's children do not know a world without technology, and the devices are increasingly easy to use (iPhones do not even come with a manual). Thus, education focused on memorization and regurgitation of information is inadequate for addressing the challenges of the infowhelmed life. Students need to know how to ask good questions, access information from appropriate sources, analyze and authenticate to determine fact from opinion, and apply information to real-world problems. The CFP has defined five areas of fluency: solution fluency, creativity fluency, collaboration fluency, media fluency, and information fluency. Together, these create a responsible, competent digital citizen prepared for the rigors of 21st-century problems.

These 21st-century fluencies, then, are not so much about technology and hardware, but about headware and the associated skills of information processing, critical thinking, problem solving, technology comprehension, and graphical communication. This organization provides a number of resources to educators, including curriculum-integration kits with interactive online lesson- and unit-planning tools, speakers and presentations, and complimentary downloadable digital books with titles such as *15 Ways to Become a Smarter Teacher*.

The final example of how to meet the needs of a digital society comes from Tony Wagner, who argues that schools need to ensure that all students graduate innovation ready (Wagner 2012). As former codirector of the Change Leadership Group at Harvard University and the university's first Innovation Education Fellow at the Technology and Entrepreneurship Center, Wagner, who consults to public and independent schools, districts, and foundations around the world, notes that students will one day be competing with talented students worldwide who will work for far less. As a result, the high school and college graduates who will get and keep good jobs in the new global economy and contribute solutions to the world's most pressing problems are those who can bring what *New York Times* columnist and

author Thomas L. Friedman calls “a spark of imagination” to whatever they do (Wagner 2012). Wagner’s seven survival skills include more familiar terms like critical thinking and problem solving, but they also include less common goals, such as agility and adaptation, initiative and entrepreneurship, and curiosity and imagination.

According to Wagner, preparing students to be innovation ready will require different thinking than what is currently the trend. He argues for federal and state education agencies to develop methods to assess essential skills with digital portfolios that accompany students through school. Furthermore, Wagner encourages the use of tests such as the College and Work Readiness Assessment, an online test of problem-solving, complex-thinking, and writing skills used by a number of schools, districts, and colleges around the country. He also notes that districts need to learn how to assess teachers’ effectiveness by analysis of their students’ work rather than on the basis of test scores.

The three examples presented, whether framed by a futurist innovator or a media scholar, collectively illustrate that these newly imagined competencies converge around important themes: collaboration, complexity, creativity, communication in various forms and across many dimensions of time and space, and media savvy.

For leaders in industries and work environments, the main challenge is to deal effectively with, manage, and take advantage of all these changes simultaneously: technological change, changing work patterns, changing expectations and skills of newer workers, changing demands, and increasingly complex problems to solve. This requires recognition of lifelong learning as an important part of corporate and organizational culture. Workers need to be continually trained to make best use of existing technologies and to be quickly updated when technological innovations emerge.

The next section details some of the recent trends in education at various levels, with implications for lifelong learning both within and outside the workplace.

Higher Education Reaches Out Free and Online

The Internet has long had an ethos that information wants to be free. Could it be that some elements of online higher education want to be free as well? At least some institutions of higher education appear to agree, and they have helped to initiate or facilitate massively open online courses (MOOCs) and open education resources (OERs).

The MOOCs are online courses made available via the Internet and aimed at wide-scale participation. MOOCs differ from typical online courses in that usually they are free, do not offer college credit, and have unlimited enrollment. Anyone with an Internet connection can take part. Participants typically can earn certificates for completion and can take advantage of regionally based discussions; some may provide for proctored exams. In theory, the classes expand a university’s reach from several-thousand tuition-paying students to hundreds of thousands around the world. Coursera, Udacity, and edX have become acknowledged as the big three MOOC providers, partnering with more and more universities by the day to offer online MOOC versions of an institution’s most heralded courses. Coursera and Udacity are both for-profit entities with Stanford University roots. As of November 2013, Coursera has close to 100 university partners and offers over 500 courses in 25 subject areas and Udacity offers about 30 courses. EdX is a nonprofit run by the Massachusetts Institute of Technology and Harvard University with affiliated schools such as the University of California at Berkeley and the University of Texas system. As of November 2013, EdX offers close to 100 courses in 25 subject areas. Recently, some universities are experimenting with the idea of offering transfer credit for students that complete a MOOC, provided that sufficient proof of engagement and learning can be determined.

The OERs, which offer another excellent resource for teaching and learning, are materials available freely online for anyone to use, whether student or teacher. One such source, OER Commons, offers more than 40,000 free-to-use, openly licensed resources from K–12 to college.

Social-Media Model for Ongoing Learning

Technological innovation has also transformed classrooms into more interactive and engaging environments. *Scholar*, an online social-media resource for educators and students, is a result of an ongoing partnership between the University of Illinois at Urbana-Champaign’s College of Education (Champaign, IL) and Common Ground Publishing (University of Illinois Research Park, Champaign, IL). As one part of a comprehensive new learning approach created by Mary Kalantzis and Bill Cope of the University of Illinois at Urbana-Champaign, *Scholar* offers a Web-based, cloud-computing writing and learning environment that unites formative assessment (diagnosis and feedback) and summative assessment (measuring student progress over time and in comparison with other learners). Within *Scholar*, students at any level of learning can work individually or collectively in creating multimedia projects, from science-based reports to essays, in which they embed images, sound, and video. The software helps teachers and students set up knowledge communities for publishing, presenting, and discussing projects. Teachers can also use *Scholar* to share their ideas and network with others in education.

Scholar incorporates significant peer interaction and is based on the premise that the social network can also be a learning network. It integrates various modes of communication—text, images, video, audio—allowing students to complete their assignments and express themselves with more than just writing. As more is learned about the value of peer interactions for learning in online environments (e.g., LaPointe 2005), Web environments like MOOCs and *Scholar* seem to hold great promise for facilitating lifelong learning over time.

Competency-Based Online Education

Future directions for higher education include a growing commitment to competency-based online education. Western Governors University (WGU) is one such example of an online university dedicated to expanding access to higher education through online, competency-based degree programs at a low cost.

Founded in the late 1990s by the governors of 19 U.S. states and supported by 20 major corporations and foundations, WGU serves more than 30,000 students. According to an article in *Bloomberg BusinessWeek*, the goal of WGU is right for the time: “to help adult students who had dropped out of college before getting their degrees” (Strauss 2012). The university offers online degree programs in education, business, information technology, and the health professions to adult learners, who average 36 years of age.

The learning and business models of WGU’s approach are unique: WGU charges a flat rate of tuition for every 6-month period of enrollment, so students pay only for the time they need to develop competence in a given course. By tying fees to demonstrations of competence, rather than course completion, WGU claims that its tuition costs are typically half of what other reputable online universities charge. According to the WGU website, “if you can complete your program in less time, you only pay tuition for the time it takes” (Western Governors University 2013). With programs starting the first of every month, WGU’s program reflects the scheduling flexibility that adult learners need, a key factor in reaching its target market.

However, WGU is not the only choice for adult learners. A simple Google search of choices in online higher education

provides more than 530 million links. What is evident is that technological innovation has met the lifelong learner, enabling thousands to pursue bachelor's, master's, or doctoral degrees online. It stands as a superb option for students who need the flexibility of completing assignments on their own time and for those who are working, have family commitments, are older with perhaps some degree requirements already completed, or who may just not be that interested in traditional on-campus experiences.

Key Findings and Recommendations

Be it through online higher education, competency-based options, OERs, or MOOCs, organizations can count on increasingly diverse options to help their employees meet the ever-changing demands of the 21st-century workplace.

The National Academies of Engineering (NAE) has taken note and in 2009 initiated the Lifelong Learning Imperative (LLI) to assess current lifelong learning practices for engineering professionals. According to NAE, "the U.S. is facing a crisis in its engineering workforce just as global competition is becoming very intense. During the next several years there will be massive retirements of skilled and experienced engineers, and the U.S. has one of the lowest rates of graduation of bachelor-level engineers in the world. Perhaps even more critical, the pace of technological change continues to accelerate, making the specifics of engineering education and skill development obsolete in short order" (NAE 2012).

The importance of lifelong learning for engineers has been argued in the National Academies report *The Engineer of 2020*, which highlights the likelihood that engineers' typical career trajectory will be nonlinear, following many directions owing to rapidly changing technologies.

As part of its findings in the LLI report, NAE suggests the following:

1. For businesses
 - Develop a learning culture; and
 - Invest in lifelong learning for employees.
2. For professional engineering societies
 - Emphasize the urgency of the need to change the culture of lifelong learning among engineers in the United States;
 - Communicate the value of lifelong learning;
 - Develop cost-effective ways to disseminate lifelong learning programs; and
 - Develop means of evaluating lifelong learning programs.
3. For educational institutions
 - Teach engineers that learning is a lifelong endeavor that is not limited to the classroom; and
 - Develop a variety of lifelong learning programs.
4. For policymakers
 - Enact policies that encourage financial support for lifelong learning; and
 - Enact policies that provide regulatory support for lifelong learning.

It has been said that humans often struggle with change. However, it is also true that big opportunities exist for businesses and organizations that best understand the new world of work and enable their employees to achieve that elusive and delicate balance between work and life. Businesses and organizations face the challenge of ensuring that technology never replaces talent and tenacity: talent to apply technology wisely and appropriately, and tenacity to pursue the leading edge through lifelong learning. And, although technology gives human beings greater capabilities, it is the human relationships that provide the clarity needed for optimal application.

Some recommendations for workers and organizations are as follows:

1. **Educate to enable.** Employees are the most important asset for any organization. Provide ongoing training on emerging technologies that affect your industry, and facilitate both in-house and outside lifelong learning opportunities and training in how to help employees manage information and the critical work/life balance.
2. **Mentoring matters.** Mentors within and without your organization can provide positive direction for all workers as they confront changes in their world of work.
3. **Meet expectations of employees.** Today's technology-driven world of work expects the workforce to be flexible, mobile, and familiar with the tools at their disposal to help them succeed. Technology, coupled with ongoing employee training and a commitment to lifelong learning and professional development, is instrumental to success in this new era of technology-assisted work.

Finally, lifelong learning occurs through the process of formal schooling and in a variety of other settings and at any age. For professionals in the engineering and construction industries, lifelong learning serves as an able foundation that fosters investment in individuals' abilities to take part in a world of work increasingly driven by knowledge and technology. As Malone has noted, "to be successful in the world going forward, we will need a new set of mental models. We need to shift our thinking from 'command-and-control' to 'coordinate-and-cultivate'" (Malone 2005).

The world is becoming much more Internet-focused, and this reliance increases with each new generation. How you and your organization respond to electronic information access and decision making is changing the nature of project management, estimating, and communications within your workplace and across the globe.

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