The Profession of IT, The Whole Professional

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Communications of the ACM, Vol. 57, No. 12, December 2014
http://hdl.handle.net/10945/46355
The Profession of IT
The Whole Professional

A new book inspires a reflection on what it means to be a whole, competent, and effective professional—and may portend a wave of disruption in education.

A new book invites deep reflection about what it means to be a whole engineer. That is, an engineer who is not only competent at the analytics and technologies of engineering, but can bring value to clients, team well, design well, foster adoption of new technologies, position for innovations, cope with accelerating change, and mentor other engineers. The book is *A Whole New Engineer*, by David Goldberg and Mark Somerville. The authors summarize their principles in “The Big Beacon Manifesto.” What they say applies equally well to computing professionals. The book’s invitation could not be more timely given the building forces of disruption to education (see my June 2014 *Communications* column).

Michelle Wiese and Clayton Christensen released a report about how private organizations are developing new education offers with online, competency-based modules. They see a bigger wave of innovation after MOOCs, threatening an even greater disruption. Whereas MOOCs automate traditional classrooms, OCBMs automate skill testing by employers that hire based on performance rather than credentials. *A Whole New Engineer* portends a third disruptive wave, where students disenchanted with automated classes and tests seek education that cultivates their mastery as designers and innovators.

This column summarizes my own journey on the question of educating this kind of professional, illustrating the difficulties of trying to get a traditional university to do this. Three experiments begun in the 2000s show that it can be done in a protected setting and that its students have been wildly enthusiastic. Mainstream education, which is struggling to produce value for students, may now be ready.

**The New Engineer**

In the 1980s I directed RIACS, a research institute at NASA-Ames Research Center that brought computer scientists together with NASA scientists on big problems in space and aeronautics. Our scientists pioneered in applying supercomputers instead of wind tunnels to the design of full aircraft, conducting science operations from great distances over a network, and studying neural networks that could automate tasks that depend on human memory and experience.

But there was a breakdown: our NASA customers frequently complained that our engineers and scientists failed to make their deliverables. This was a major issue, since the research funding for the institute came...
mainly from our individual contracts with NASA managers. Failure to make deliverables was a recipe for non-renewal and loss of jobs. NASA managers said, “your work is of no value to us without the deliverables we agreed to,” and our scientists responded, “sorry, we can’t schedule breakthroughs.” This disconnect seemed to be rooted in the gap between what engineering and science schools teach and the realities of customer expectations in the workplace.

I did my best to lead my people to a satisfying relationship with their NASA customers. But I constantly puzzled over why the disconnect existed and was so hard to overcome. Around 1990, I began conversations with Fernando Flores on what kind of education was needed for engineers in the 21st century. These conversations led me to write and publish in 1992 a manifesto, *Educating a New Engineer.* These ideas resonated with a project manager in my own way of teaching engineering. They all believed they could craft the New Engineer was a powerful and attractive offer for students. Even when we offered just a small part, students embraced it with great enthusiasm. I was disappointed that I was not able to sell this to my department or to my school. I gave frequent lectures about the New Engineer and my experience with Sense 21; while students welcomed the idea, most faculty considered the approach too much of a break with their way of teaching.

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and, by building their listening and design skills over time, they might eventually produce a “big” innovation. They were surprised and delighted to learn that they were all innovators.

I was even more astounded when students told me, “This course transformed my whole life.” The language-action basics were enabling them to be more effective listeners, communicators, and designers throughout their lives, not just for classroom projects. They petitioned me to keep the group together and continue learning together. So I invented the “Sense 21” group. We met after school once a month and went over issues they chose where language-action gave new insights. As each new section of the course completed, the graduates joined the group and many attended the meetings. No student had ever suggested forming an alumni club for my operating system class! They found the language-action material of Sense 21 so powerful, it made a difference in their lives that they wanted to remember. Although the Sense 21 group disbanded in 2002 when I left George Mason, some of the students stay in touch with me to this day. I was amazed that an alumni group for a course would stay together for so long.

My own ability to teach the design course well improved considerably when I studied coaching with Richard Strozzi Heckler and was later certified as a Master Somatic Coach. This experience left me more convinced than ever that the vision of Educating a New Engineer was a powerful and attractive offer for students. Even when we offered just a small part, students embraced it with great enthusiasm. I was disappointed that I was not able to sell this to my department or to my school. I gave frequent lectures about the New Engineer and my experience with Sense 21; while students welcomed the idea, most faculty considered the approach too much of a break with their way of teaching engineering.

**Olin, iFoundry, and Neumont**

Beginning around 1997, three like-minded groups independently came to believe in ideas like the New Engineer and laid plans to launch experiments for a new kind of engineering education. They all believed they could craft new education offers that would be
enormously appealing to students and potential employers.

In 1999, a small team founded the Franklin W. Olin College of Engineering (see http://www.olin.edu) and designed it from the ground up. They wanted to graduate engineering innovators who would be leaders in solving pressing global challenges. They wanted their engineers to be client-centered and capable of developing systems that make people’s lives better. They wanted students to learn through hands-on projects, find their own voices, and work on teams in partnership with the faculty. Olin’s students absolutely love their school. In just a dozen years, Olin has achieved numerous high rankings in various education surveys and is now much sought-after by other engineering schools trying to rethink their own approaches.

In 2007, a small team at the University of Illinois decided to transform their experiments, begun a decade earlier, into an incubator for new educational approaches in engineering. They called their project iFoundry or the Illinois Foundry for Innovation in Engineering Education (see http://www.ifoundry.illinois.edu). Their earlier classroom experiments demonstrated the effectiveness of student-led teams in promoting student engagement. Five departments joined the incubator. Drawing on reports about “Engineers of 2020” and their own experiences with students, they formed a vision of a new engineer. In 2008, they signed a partnership with Olin College to share educational methods and insights. As at Olin, their students became wildly enthusiastic about learning engineering in the new way.

In 2003, a group from Northface University (now called Neumont University, neumont.edu) in Salt Lake City, UT, asked me to help them with an idea they had been working on for several years. They were designing a software engineering degree from the ground up and were convinced the principles of “Educating a New Engineer” would attract students and industry and would be accreditable. I helped them design a three-year project-based software engineering curriculum that used methods like the modern “flipped classroom,” minimized lecture classes, involved industry mentors, and did most of the work in student teams. They since expanded to five degrees (computer science, software and game development, information systems, technology management, and Web design and development) all based in the same set of principles and methods. The students say the experience is intense and the connection to industry mentors extremely worthwhile.

These three examples demonstrate that “new engineer” principles can flourish in protected settings. The students have been enthusiastic about their education.

The New Engineer Principles

A Whole New Engineer gathers the New Engineer principles in use at iFoundry and Olin into one place. It gives solid justification based on education history about the pedigree of each principle. The principles are:

- Become competent at engineering practices and technologies.
- Demonstrate competent performance in solving engineering problems, not in taking tests and quizzes.
- Become competent at using language for effective coordination and communication—especially speech acts, disclosing, and listening deeply for concerns in individuals and their communities.
- Learn to be a designer—someone who can propose combinations of existing components and technologies to take care of real concerns.
- Learn to be an entrepreneur—someone who can help a community transform their practices to generate a better life for them.
- Learn how innovation works and how to detect and navigate the waves of possible change.
- Appeal to each student’s intrinsic motivation, the sense that they can “invent it for themselves.”

Goldberg and Somerville characterize the skill set of the new whole engineer as six minds:

- Analytical. Ability to rigorously analyze problems and apply scientific and mathematical principles to their solutions.
- Design. Ability to imagine what does not exist, make unexpected connections, and propose new combinations of components that solve problems.
- Linguistic. Ability to use language
for coordinating, communicating, disclosing, building trust, and orchestrating productive moods.

- **People.** Ability to use emotional intelligence to read and listen to people and interact effectively with them.
- **Body.** Ability to develop leadership presence and blend with the movements and energies of other people.
- **Mindful.** Ability to be thoughtful and reflective, learn from mistakes, find meaning, and choose the observer.

This way of organizing the skill set is inspired by Howard Gardner’s multiple intelligences. The “whole engineer” is one who has integrated all these skill sets into his or her own style.

They also designed the learning environment to produce these six skill sets in the context of five “pillars”:

- **Joy.** Finding delight in engineering, science, solving problems, building artifacts, and in satisfying interacting with clients.
- **Trust.** Earning the assessment that you are competent, sincere, and reliable—you have people’s best interests at heart and will not betray them.
- **Courage.** Willingness and emotional fortitude to take risks and deal with the consequences.
- **Openness.** Willingness to listen to others without judgment and to seek out new ideas by interacting with people who do not think like you.
- **Connectedness, collaboration, community.** Willingness to work with others, form communities, and mobilize networks.

These five pillars might also be called prevailing moods or dispositions (see my December 2012 Communications column). Not only are all the faculty practitioners in these moods but also they cultivate dispositions for these moods in the students. The students leave with more than a memory of a wonderful school; they leave with the dispositions to operate in these ways in their own workplaces.

Goldberg and Somerville have mined the bountiful literature of brain, social, and organizational science for pragmatic methods of transforming education. Other engineering educators can use their methods of developing intrinsic motivation, coaching, culture, and change management.

There are many other efforts to engage students in engineering and science in real problems with real customers. These include Engineers Without Borders, Junior Enterprise, and the growing number of design competitions and coding academies. These activities attract students in droves. Some engineering schools are collaborating with them. However, these activities are outside the engineering school and do not promote engagement with the curriculum inside the engineering school. The New Engineer principles offer a means to reform the culture of mainstream engineering education so that it too will engage students.

**Conclusion**

What does this mean for you? Can you get these skill sets for yourself without having to go to Olin, iFoundry, or Neu­mont, enroll in a more mainstream engineering school that uses these principles, or wait for reform of engineering education? Current education of professionals emphasizes the analytical mind; how can you backfill design, people, body, linguistic, and mindful mind for yourself (and your kids)?

The current spread of design thinking beyond industrial design into the business world is encouraging. It offers practical coursework that gives experience in interviewing customers, constructing linguistic frameworks for customer domains, asking open-ended questions, listening with empathy, and working collaboratively (see my December 2013 Communications column). Working with a coach is one way to accelerate your progress. Companies are making coaching services available or you can hire a coach.

Coursework in emotional intelligence, leadership presence, and business mindfulness has been customized for engineers by Chade-Meng Tan of Google. His course is a cost-effective way to get started.

If you have an activist streak, you can lobby education leaders. Because they generate high value with students, the New Engineer principles should be of interest in universities struggling to survive in increasingly challenging financial environments. You could share the book or one of the manifestos mentioned here with your favorite dean or department head.

If you are a teacher or educator, you can transform your own teaching and educational context with these principles. Olin offers regular courses in their collaboratory (see http://www.olin.edu) that teach personal and organizational change for educators. You can also take training as a coach (see http://www.coachfederation.org), which will turbocharge your ability to offer your students New Engineer principles.

The principles were easier to ignore in the 1990s when there were few working examples or financial challenges. Today, we have at least three success stories to imitate and an urgent financial need to upgrade the value of engineering and computing education. Analytical skills are not enough. Let us all work together to prepare for a future world in which the professional’s heart is as important as the mind.

**References**


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