

iFoundry and the Creative Engineer of the Future



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Background. Depending upon whom you read the world is flat (Friedman, 2005), we live in a creative era with a rising creative class (Florida, 2002), or the successful professional needs a whole new (creative) mind (Pink, 2005). Regardless whom you believe, there seems to be growing consensus that professionals in developed economies need to be more creative to stay ahead and drive innovations in an increasingly global economy. Alarms have been sounded in the engineering education community and have stressed the mismatch between skills being acquired by engineering graduates and those needed; a cacophony of reports (Duderstadt, 2008; National Academy of Engineering, 2004, 2005) recommend a variety of reforms to better prepare tomorrow's engineering graduate for a changing world.

Key Problem No. 1: Cold War Curriculum in an Internet World. When Vannevar Bush, head of the wartime Office of Scientific Research and Development wrote *Science: The Endless Frontier* (1945) he helped unleash forces that directed the engineering academy away from design and toward science and mathematics. Those forces culminated in the 1954 [Grinter report](#) (Grayson, 1993) that recommended sweeping changes to the engineering curriculum that removed emphasis on drawing and practice and replaced them with science, math, and engineering science and analysis. Those changes were perhaps well matched with the hierarchical and specialized nature of large cold war organizations, but they have increasingly become untenable in an age focused on customer satisfaction, product quality and innovation, and the creation of whole new categories of product. **Response:** Develop curriculum appropriate to the internet era that trains *category creators*—creators of new products and services—not just enhancers of existing categories.

Key Problem No. 2: Universities Perfectly Designed to Resist Change. With the many calls for change and good models of change, why do we remain stuck in a cold war rut (Spalter-Roth, Fortenberry, & Lovitts, 2007)? A key problem is that universities are products of the middle ages and departments are products of the 19th century, and their function is to ratify existing knowledge and disciplines, not create whole new categories of knowledge and artifact. At a micro-level, curriculum change is an academic NIMBY (not in my backyard) problem; curriculum reform is fine, but don't change my course or courses of interest to me. The usual dynamic is a form of what political scientists call *logrolling*. Coalitions form fairly easily among those who band together to protect their own interests, and reform is thwarted. **Response:** The University of Illinois is piloting open source curriculum reform through the formation of interdepartmental and intercollegiate curriculum incubators. iFoundry, or Illinois Foundry for Innovation in Engineering Education, was first described in the iFoundry [whitepaper](#) (iFoundry, 2007).

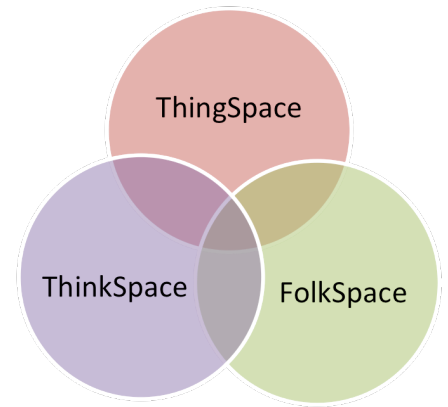
Seven Things Engineers Don't Learn and Why They Don't Learn Them. General Engineering at Illinois was an early pioneer in the 1960s and 1970s in industry sponsored senior design courses. A revealing exercise is to examine what senior design students don't know when they approach the senior project. Based on the first author's 18 years of experience in coaching senior design teams, engineering education falls short of what real engineers need because (1) they don't know how to *ask* questions about the project and what has been tried and by whom, (2) they don't know how to *label* components, assemblies, and systems of technology, (3) they don't know how to *model* how an artifact works in simple causal, qualitative terms, (4) they don't know how to *visualize* solutions to the problem, (5) they don't know how to *decompose* the larger design problem into different subproblems, (6) they don't know how to *measure* key system parameters in model, prototype, or constructed form, and (7) they don't know how to *communicate* their findings in words and pictures. **Response:** Address qualitative and elementary quantitative thinking skills before running

engineering students through the current math-science death march. Better philosophical underpinnings to the engineering curriculum will result in a better understanding of artifacts (ThingSpace), engineering thought (ThinkSpace), and the social enterprise of engineering (FolkSpace).

How Forward-Thinking Corporations and the University of Illinois Can Transform Engineering Education.

To help bring the creative engineer of the future to fruition, the College of Engineering is seeking corporate support for iFoundry, an ambitious program designed to promote open-source, interdepartmental, and intercollegiate curricular innovations that result in graduates who are better prepared for the workplace.

iFoundry will provide resources for networks of faculty and students to explore and develop creative ways to help our engineers excel in thinking, communicating, and solving problems. Early efforts focus on realigning humanities and social science coursework in student-selected themes, injecting new digital media content into new and existing coursework, and making the first two years of engineering education more effective and attractive. But the door is wide open for more. **Response:** Initiate discussions among iFoundry faculty and students, and personnel in forward-thinking corporations, to consider partnerships and promising directions for collaboration.



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References

Bush, V. (1945). *Science the endless frontier*. Washington, DC: US Government Printing Office.

Duderstadt, J. (2008). *Engineering for a changing world* ([Technical Report](#)). Millennium Project, University of Michigan, Ann Arbor, MI.

Florida, R. (2002). *The rise of the creative class*. New York: Basic Books.

Friedman, T. (2005). *The world is flat: A brief history of the 21st century*. New York: Farrar, Straus and Giroux.

Goldberg, D. E. (1996). Change in engineering education: One myth, two scenarios, and three foci. *Journal of Engineering Education*, 85(2), 107–116.

Grayson, L. P. (1993). *The making of an engineer: An illustrated history of engineering education in the United States and Canada*. New York: Wiley.

iFoundry (2007). *Whitepaper for an Illinois foundry for tech vision and leadership* ([Technical Report](#)). iFoundry, University of Illinois at Urbana-Champaign, Urbana, IL.

Macaulay, D. (2008). *The new way things work*. New York: Houghton Mifflin.

National Academy of Engineering (2004). *The engineer of 2020: Visions of engineering in the new century*. Washington, DC: National Academies Press.

National Academy of Engineering (2005). *Educating the engineer of 2020: Adapting engineering education to the new century*. Washington, DC: National Academies Press.

Pink, D. (2005). *A whole new mind: Moving from the information age to the conceptual age*. New York: Riverhead Books.

Spalter-Roth, R., N. Fortenberry, & Lovitts, B. (2007). *The acceptance and diffusion of innovation: A cross-disciplinary approach to instructional and curricular change in engineering*. Washington, DC: American Sociological Association.

For More Information

Web: <http://ifoundry.illgal.uiuc.edu>

YouTube: <http://www.youtube.com/illinoisfoundry>

SlideShare: <http://www.slideshare.net/ifoundry>

Facebook Group: Friends of iFoundry