



interdisciplinary by design



(a discussion)

**Who will create the products of our future?
Everyone from the engineer to the psychologist.**

By Tim Simpson, Russell Barton, and Dave Celento

Design is ubiquitous. Engineers, architects, and industrial designers all practice it, but who studies *design—the verb, not just the noun*? Many speculate on the *outcomes* of design but how many consider the *process* by which designs are executed: how different disciplines engage in the practice of design, how creativity unfolds and manifests itself during the design process, how designers use different tools and methods to make their decisions, how different disciplines interact to develop innovative new products.

The list goes on and on, and the questions are as diverse as the products that surround us. It is only recently, however, that formal programs—graduate and undergraduate—have started to emerge in the United States to study these questions in detail and with an interdisciplinary focus, by combining, for example, engineering design with marketing and psychology; architecture with design computation, engineering analysis, and emerging materials; or science, technology, and society (STS) with engineering and industrial design.

The seed for many of these emerging interdisciplinary programs in design is not new either—cutting edge research and advancements invariably lie at the boundaries of departmental silos. This time, there seems to be a

greater sense of urgency than ever before, due in large part to increasing competition in product design and innovation from around the globe. This competition has generated a desire for much broader design skills in the workplace, requiring academic institutions to respond.

The need to improve the creativity and innovativeness of graduates is becoming a matter of national importance in the United States, as echoed in numerous reports, including the 2007 report from the Council of Graduate Schools, which states on page 19, “The United States must increase the number of graduate education programs that reflect the interdisciplinary dynamism characteristic of most innovative research centers.”

Despite the imperative for training an innovative workforce, many wonder: What is the best way to prepare

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our students for tackling the complex design problems of the future, some that we know about and others that are yet to be discovered? While we argue about who owns design or how it should be taught, most agree that design is at the heart of innovation. Increasing innovative potential through design not only improves the likelihood of creating a competitive economic advantage, but also increases the probability of producing advances in areas such as medicine, alternative fuels, and information technology for developing countries, innovations which, in addition to being economically viable, stand as substantive and necessary contributions to society as a whole.

With these thoughts in mind, we gathered 40 faculty from engineering, architecture, industrial design, business, psychology, computer science, education, and STS programs along with a half-dozen industry practitioners at the National Science Foundation in Arlington, Va., in May 2008 to discuss interdisciplinary design.

Funded through the Engineering Design and Innovation Program at NSF, the workshop provided a forum to examine how existing interdisciplinary design programs are transforming education not only in engineering but also in architecture, industrial design, and related fields. This background provided a foundation to think about how to further develop the discipline of interdisciplinary design.

While the focus was primarily on graduate programs, notable undergraduate programs that were planning to expand to the graduate level were also presented. In total, nine programs were showcased, and three panel discussions were held, focusing on the benefits and opportunities of interdisciplinary design, industry's desire for and proactive integration of designers with broad skills, and the hurdles imposed by traditional academic structures and processes for such cross-cutting initiatives.

'SCHOOLS HAVE MORE BARRIERS'

The workshop attracted participants from numerous fields with a shared passion for design. The group engaged in a series of productive discussions about the nature of design, the role of design research, and the interdisciplinary barriers that many of us face.

Schools are taking innovative steps to overcome some of the obstacles to interdepartmental collaboration. The Massachusetts College of Art and Design, for instance, is developing an interdisciplinary graduate design program. Among those working to create it is Chris Hosmer, who is on sabbatical from his job as design strategist with Continuum, the international design consultancy that operates from Boston; Milan, Italy; and Seoul, Korea.

According to Hosmer, "Schools have more barriers than most of the companies that I've worked for."

David Goldberg, the Jerry S. Dobrovolny Distinguished

Professor at the University of Illinois at Urbana-Champaign, noted that organizational resistances to interdisciplinary programs lie not only in the departments (organizational structures of people that define fields) but also in the degrees conferred (reward structures that control the dissemination of knowledge and the assessment of mastery), as well as in the "digs" (location of resources).

While hurdles will always exist, successful programs have found ways to lower these barriers. The iFoundry is a recently approved think-tank for piloting curriculum change within the College of Engineering at the University of Illinois at Urbana-Champaign. It is just getting started, and will begin its first course work this fall. Goldberg calls it an interdepartmental curriculum incubator. It involves the departments in the College of Engineering and has ties to faculty in the arts, humanities and social sciences. The iFoundry Web site is <http://www.ilgal.uiuc.edu/web/ifoundry>.

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John Nastasi, a practicing architect and director of the Product-Architecture Lab at Stevens Institute of Technology, offered a view into a hybrid educational/practical model where "design collaboration plays a critical role driving the integration of knowledge and nascent methodologies into new modes of practice."

The product-architecture program at Stevens has successfully integrated architecture, engineering, computation, and product development, attracting students with wide-ranging interests and diverse backgrounds in architecture, visual arts, industrial design, mathematics, computer science, and mechanical, aerospace, and biomedical engineering. By focusing on the product or system being designed, the program is "dissolving boundaries in design education" and launching students "along trajectories of design leadership and social entrepreneurialism." As a testament to their success, every student in the program receives financial support through industry

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partnerships. “NBA games would be boring if the point guards, centers, and forwards all hung out separately,” Nastasi said. “The real fun lies in how the game is played by the team. The same goes for design.”

According to the lab’s Web site, “The program will explore intense and creative collaborations between designers, engineers, scientists, and manufacturers.”

Connections like that may address some of the concerns of Keith Zobott, a corporate director of Honeywell International. His recommendation to the workshop was: “Focus on the product lifecycle in your programs, all the way from communicating with your customers, getting clear needs defined, out into operations and manufacturing.”

Alison McKay, professor of design systems in the School of Mechanical Engineering at the University of Leeds in England, brought an international perspective to the workshop. The product design program at Leeds was developed to “respond to what we saw as an industrial demand for graduates with a unique educational experience that blended creativity, innovation and technology,” McKay said.

Following the design research methodologies described by C. Frayling (specifically, 1993/4, “Research in Art and Design,” *Royal College of Art Research Papers*, 1(1), pp. 1-5), the students at Leeds perform research *through*

design, *into* design, and *for* design. Their experience includes working on a global product design team in conjunction with students around the world, including the InnovationSpace program at Arizona State University.

According to Mark Henderson, professor of engineering at ASU’s Polytechnic Campus, InnovationSpace provides “a transdisciplinary education and research lab to teach students how to develop products that create market value while serving real individual and societal needs and minimizing impacts on the environment.” A recent outgrowth of the program has been Global Resolve, where ASU and Leeds have partnered with Kwame Nkrumah University of Science and Technology in Ghana to create multinational teams to work on multi-disciplinary projects for developing countries.

‘T-SHAPED PEOPLE’

As globalization moves engineering, business, and design closer together, many argued that interdisciplinary graduate design programs are the future for the U.S. to maintain its position in product leadership. As Spencer Magleby, associate dean and professor of mechanical engineering at Brigham Young University, noted early in the workshop, “Undergraduate programs are full. Much of this will need to occur at the graduate level.”

The ensuing discussion focused on creating “T-shaped people,” as advocated by Tim Brown, CEO and president of IDEO, a world-renowned design firm headquartered in Palo Alto, Calif. As reflected in this model, designers should be deep in one disciplinary area (e.g., industrial design or mechanical engineering), but with broad knowledge of all aspects of design activity.

Many workshop participants felt that the undergraduate degree provides the stem of the T, while a graduate degree in interdisciplinary design provides the broad exposure to all aspects of design to form the top of the T—the assumption being that students need to be grounded in a specific discipline before they can become interdisciplinary. Others thought that the undergraduate degree might, in fact, be the breadth, and that a deep knowledge of the design discipline at the graduate level might make

to learn more

The list of participants, workshop schedule, copies of the presentations, and workshop report can all be found online at: http://www.design.psu.edu/NSF/workshop_May08/. The site also includes the participants’ e-mail contacts and a page for contributions from visitors. Readers interested in contacting the group or individual participants are invited to do so.

The workshop was an interdisciplinary effort, organized by faculty from Penn State University in fields as diverse as engineering, architecture, psychology, and business. The authors—Simpson, Barton, and Celento—were joined by John Messner, associate professor of architectural engineering; Matt Parkinson and Cari Bryant-Arnold, as-

sistant professors of engineering design; and Sam Hunter, assistant professor of industrial-organization psychology, in the planning and execution of the workshop.

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Innovative design to benefit developing countries is the subject of an article, “Design that Solves Problems for the World’s Poor,” by D. G. McNeil Jr. in *The New York Times*, May 29, 2007. It is available online: <http://www.nytimes.com/2007/05/29/science/29cheap.html>.

the stem. This issue remains unresolved and is worthy of further exploration.

Throughout the workshop, industry practitioners from companies both small and large encouraged faculty to focus on the designer that comes from these programs: Is the goal to create “design-sensitive engineers” or “engineering-conversant designers” or “design leaders” or “entrepreneurs” or some new breed of designer? What should their role in an organization be? Once the goal is identified, the direction that the graduate programs should take will be clearer, easier to assess, and lead to consensus about degrees to be offered and organizational structure.

One of the industry participants, Chris Kasabach, co-founder of BodyMedia Inc., was clear on the abilities of people whom the company wants to hire. “We need designers who can convince the strategy team to put a solution on the roadmap and then shepherd the idea through development,” Kasabach said.

There was considerable discussion about the type of degree best suited for such individuals. Of the programs discussed at the workshop, degrees ranged from B.S., B.A., and B.F.A. (Bachelor of Fine Arts), to M.S., M.F.A., and M.P.D. (Master of Product Development) in

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design and design-related fields. The newest addition is a Ph.D. in Design Science at the University of Michigan. When explaining the program, Panos Y. Papalambros, the Donald C. Graham Professor of Engineering, said: “Traditional sciences study the world as we found it. Design science studies the world as we make it!”

Even with the range of degrees, Spencer Magleby of Brigham Young University, commented, “We need better ways to appreciate design as an academic product.”

Don Norman, the Allen K. and Johnnie Cordell Breed Senior Professor in Design and co-director of the Segal Design Institute at Northwestern University, said that the low prestige of design at universities—like many companies—arises primarily from their reward structures, which assign merit based on the ability to bring in grant money, publish research findings in peer-reviewed journals, or to achieve a financial target. Since designers tend to be generalists, the traditional academic reward structure fails to recognize successes for those having a very broad (but shallow) base of knowledge rather than

The Same Three Words

Mark Henderson, a professor of engineering at Arizona State University’s Polytechnic Campus, presented this amusing and pointed exercise to the group.

Global Product Development	Global Product Development	Global Product Development
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“It’s the same three words, but each representation connotes something very different,” Henderson said.

becoming an in-depth expert in a particular field.

The disciplinary breadth (vs. depth) of the design function is often underappreciated in corporate settings as well. For companies focused on traditional “stage/gate” processes, the reward structure can often mean that deliberative design decisions made early in the process may initially cause budgets and deadlines to be overshot but later result in significant savings in time and money during manufacturing or increased sales due to product desirability. However, protracted design efforts are often not recognized as beneficial or rewarded, and may instead be punished.

In terms of valuing design, Dean Nieuwsma, assistant professor of science, technology, and society at Rensselaer Polytechnic Institute, stressed the importance of recognizing and understanding how power is manifested through disciplinary when planning interdisciplinary endeavors. Since different knowledge domains grant different levels of authority to the various approaches to design, we must recognize and confront problems that can arise when striving for equal partnerships with disciplines where design is more marginalized (i.e., has less authority). Not surprisingly, everyone was quickly able to cite examples of disciplines with “lower status” at their respective universities where this was indeed the case.

THE NEXT STEPS

We are making plans for a Design Workshop Series that will occur in the coming year, with different universities taking turns organizing and hosting workshops. Led by the Penn State team, faculty involved with the graduate design programs at the University of Michigan (fall 2008), Northwestern University (spring 2009), and Stanford University (summer 2009) plan to participate. We are seeking NSF funding to support the effort.

The purpose of the Design Workshop Series is twofold: (1) to explore design as an instructional discipline by investigating existing programs while shaping emerging ones, and (2) to broaden and focus the discussions while involving the larger design community. Our goal: to further legitimize the art and science of design. Everyone is welcome to participate, so join us. ■