EVOLUTION AND INNOVATION BY DESIGN

AFTER NEARLY TWO DECADES, ENGINEERING FIRST® AND THE LEGACY OF DESIGN THINKING CONTINUE TO TRANSFORM THE MCCORMICK EXPERIENCE
Only this conversation took a pointed turn, one that changed the future of McCormick and reshaped the entire concept of undergraduate engineering education. Carr, now senior associate dean, recalls, “We said to ourselves, we need something that will prepare our students for careers in the 21st century because it’s going to be altogether different from anything seen over the last century. We knew that sooner rather than later, just simply getting an engineering degree where you learn about technologies would be disappointing and inadequate. It was going to be a brave new world. We needed to find a way to use the freshman year to make the education that our students get altogether different and much more relevant to the changing world.”

Knowing that the time was right for a new entry point into the field, the faculty and administration at McCormick School of Engineering took on the ambitious task of creating an entirely new approach, one that would equip and inspire undergraduates to become the kind of engineering leaders that the 21st century would require.

They created Engineering First®, a visionary curriculum that combines engineering analysis with design and communication and engages students in engineering concepts from the start. This groundbreaking foray into design thinking created a unifying McCormick experience that continues to evolve today.

**TWO DECADES AGO**

as the world entered an era of unprecedented technological advancement and rapid globalization, the standard approach to teaching first-year mathematics and engineering sciences was beginning to hold little appeal for students who longed for dynamic engineering experiences from day one.

REINVENTING ENGINEERING EDUCATION

It was a conversation Stephen Carr has never forgotten. He remembers the weather (hot) and the building (silent) on that summer day about 20 years ago when then-dean Jerome Cohen drifted into Carr’s office, put his feet up, and prepared to launch into one of the duo’s usual philosophical discussions.

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“Evolution and Innovation by Design”

Carr says Dean Cohen asked him to form a faculty committee in 1995 to collaborate on how to use the first year as a springboard to something big. “We knew we had to prepare our students to be leaders in engineering, not just practitioners,” he notes. “It was also an empowerment of the faculty that if they had bright ideas for ambitious changes in the curriculum, we would stand behind them.”
COMMUNICATION AS THE CORNERSTONE

The result was the Engineering First program. Envisioned as an ambitious two-part sequence of engineering analysis and design courses for first-year students, the plan introduced a new pedagogy for engineering education.

The Engineering Analysis (EA) program covered linear algebra, differential equations, Newtonian mechanics, computer proficiency, and engineering statistics and dynamics in combination to show students how analysis serves as the foundation for thorough and accurate engineering. It became a new way to teach the basics of engineering and was typically a student’s first experience with learning multiple subjects in an integrated fashion.

Charged with heading up a design component to complement the EA experience, J. Edward Colgate, the Allen K. and Johnnie Cordell Breed Senior Professor in Design, soon realized that incorporating faculty from the Writing Program at the Weinberg College of Arts and Sciences into the process was critical. “Experience with my students showed me that understanding one’s work deeply is part and parcel of being able to communicate it well,” he says.

Colgate put together a faculty team that included Professors David Kelso and Greg Olson on the engineering side and Professors Penny Hirsch and Barbara Shwom and Lecturer John Anderson on the writing side. The team decided to combine the design course with the first-year writing requirement to create an integrated, project-based, human-centered design and communication program.

“We thought of design as a creative problem-solving process and realized that the writing process is also creative problem-solving,” Hirsch remembers. “The similarity could be used to help engineering students better understand communication.”

Another key program innovation involved incorporating teamwork as a central component. Students would work in teams of four with courses team-taught by engineering and communication faculty and experts from the field. Pilot versions of the courses, known then as Engineering Design and Communication (EDC), were tested, refined, and fully integrated into the McCormick curriculum between 1997 and 2000.

Colgate says: “There was nothing out there that combined design and communication like this—certainly nothing that had the scope of what we were doing.”

REAL PROJECTS, REAL CLIENTS, REAL SOLUTIONS

EDC put first-year students to work immediately on real design problems submitted by individuals, non-profits, entrepreneurs, and industry members. In the two-quarter course, teams of students interviewed clients, brainstormed ideas, and built, tested, and rebuilt prototypes until they got them right. They then presented their solutions to clients through written reports and a final presentation.

Thanks to partnerships with organizations such as the Rehabilitation Institute of Chicago, Shedd Aquarium, Kids in Danger, and Misericordia, the program’s projects allowed students to design solutions that improved people’s lives. Ultimately, the course introduced students to human-centered design: the ability to find the real problem behind the perceived problem.

“We’ve always believed the human side is very important,” Colgate says. “You have to know for whom the solution is being created and what the client’s needs are, so we embrace softer social skills to understand people better as part of this approach.”

A LEGACY OF LEARNING

EDC proved that through real design projects, first-year engineering students can learn the skills of design thinking and develop the prerequisites for leadership. This new approach transformed the McCormick culture with the strong belief that leadership and design thinking can—and must—be developed from day one.

One of the greatest legacies to come out of EDC and the design education evolution it inspired is the six-story, 84,000-square-foot Ford Motor Company Engineering Design Center. Opened in 2005, the center houses faculty and student offices, classroom space, laboratories, research rooms, and a prototyping facility.

As word of McCormick’s design curriculum spread, Ford Motor Company wanted to help create a space to foster innovation. The center provides students with a collaborative environment where the exchange of ideas and group work can flourish. It also inspired McCormick to expand design thinking beyond the first year.

“We thought that if we’re going to have a whole building for design, we need to do more than one course,” Colgate remembers.

INNOVATION OVER TIME.

DESIGN THINKING AT MCCORMICK.

| SUMMER 1995 |
| Faculty committee explores creating a new first-year program |

| WINTER 1995 |
| Concept created that will become Engineering First® |

| 1996 |
| Resources gathered to support the program |

| 1997 |
| Engineering First launched |

| 1997–2000 |
| Engineering Design and Communication pilot programs tested, refined, and fully integrated into the McCormick curriculum |

| 2001 |
| The Ford Motor Company Engineering Design Center funded with a $10 million gift from the Ford Motor Company |
In 2007, the Ford Center became home to the Segal Design Institute, which has as its mission to educate innovators and design thinkers while expanding the research frontiers of human-centered design. Crate and Barrel co-founders Gordon and Carole Segal endowed the institute and enabled McCormick to significantly expand its undergraduate design curriculum, develop new graduate degree programs, and fund additional design research.

Now, undergraduate students can take a variety of upper-level courses that tackle everything from industrial design to intellectual property—and, with enough courses, can achieve the Segal Design Certificate. Segal is home to several graduate programs in design and product development and also houses a PhD design cluster, which brings together faculty and graduate students from across Northwestern University to conduct design research.

THE FUTURE OF INNOVATION AT MCCORMICK

The cornerstone of design education, EDC, continued to evolve through expanding partnerships across the University. In 2012, the course was renamed Design Thinking and Communication (DTC) to reflect this growth.

One recent innovation, an entrepreneurial Design Thinking and Communication course called eDTC, is taught in conjunction with the Farley Center for Entrepreneurship and Innovation, also housed in the Ford Center. The course is designed for first-year students interested in moving products into markets. Projects in its first offering addressed technologies targeting a specific market as well as unmet needs seeking a solution. These included video eyewear for medical markets and enhanced battery capacity for wearable devices.

DTC has also partnered with the University’s Center for Leadership to more fully integrate leadership assessments within teams. The Center worked closely with DTC faculty to develop software that helps DTC teams communicate more effectively and ultimately reach their goals. Early in the quarter, each team must develop a charter that lays out its mission, goals, and ground rules. At midterms, the team uses an online survey to assess its own work and that of its members. That way, any problems that may arise within the group can be solved in a timely manner. This communication-intensive teamwork approach has permeated the design curriculum, which is now open to students from across the University.

“Bringing in different points of view allows a team to be more balanced than any one individual ever could be,” explains Bruce E. Ankenman, co-director of the Segal Design Institute. “We also have a class called Human-Centered Service Design. Students in journalism and psychology can imagine themselves designing a service and understand that it’s the same design process.”

Segal also brings diverse viewpoints together through Design for America (DFA). Founded at Northwestern in 2009 by undergraduate students and Liz Gerber, Breed Junior Chair in Design, DFA is an award-winning nationwide network of interdisciplinary student teams and community members who use design to create local and social impact.

DFA drives a lot of the new innovation at Segal, according to Ankenman. “It’s also led to a lot of thinking about the pedagogy and whether it’s better for students to learn on their own and be self-driven,” he shares. “We now have PhD students and faculty members whose main research focus is the design process.”

STANDING THE TEST OF TIME

Often imitated, never replicated, McCormick’s Engineering First program created a legacy of design thinking and innovation that has stood the test of time. Carr notes, “To this day, 20 years or so later, most of the major engineering schools in the United States now have their version of DTC. But the magic sauce for why Design Thinking and Communication is very widely imitated but never copied successfully is that all projects have real clients with real needs, it is required of all engineering students, and it’s truly 50 percent communication.”

This design approach to education has diffused throughout the curricula over the past two decades, becoming the embodiment of McCormick’s whole-brain engineering philosophy. “It’s the idea that students don’t just do the calculations,” Ankenman says. “This balance between being able to understand the mechanics as well as the emotions of people and the way society works underpins our philosophy. Clearly, design is the one place this all comes together.”

SARA LANGEN