Tracy Brandenburg and Sirieta Simoncini, senior lecturers of The Art of Innovation: A Hands-On Design Thinking Immersion, have always approached life differently.

Simoncini was just 28 years old when she became chief architect of a northern Italian town named Voghera, which is home to a Roman necropolis and a Renaissance castle. “I was immediately thrown into a Tower of Babel in which everybody was speaking a different language: the city accountant, the lawyers, the engineers, the politicians and the citizens. I had to learn very quickly how to bring all these voices together and facilitate the collaborative process while solving problems at a fast pace.”

Brandenburg spent 10 years living intermittently as an anthropologist among the Zapotec Indians in Oaxaca, Mexico, where she studied the life of a Zapotec artist, philosopher, activist and one-time political prisoner. “I was drawn to study the life of an indigenous intellectual who claims that his pre-Hispanic culture is alive,” says Brandenburg. “He even believes that they communicate in ways that harken back to ancient times. I went on the journey to see if it was true what he was intuiting.”

These differences are just what they want to role model for their class. Design Thinking is often considered the brainchild of leading U.S. design innovator David Kelley (he actually shares credit with other team members), focuses on cultivating empathy for the end user and takes a multi-disciplined approach to solving any type of design problem. “Design Thinking is thought...
It is my pleasure to serve as the Director of the Systems Engineering Program at this exciting time in its evolution. Many new educational opportunities have either just been implemented or are in the process of being developed.

As many of you know, this past fall our cornerstone introductory class in Systems Engineering was redesigned by David Schneider, a lecturer in our program, to include (1) model-based systems engineering; (2) the introduction of a mini Lego-based robotics project or a Kodu-based videogame project (based on student interest); as well as a (3) enabling students to apply the many systems engineering tools that are taught in the class to their specific Master of Engineering Project. All of these changes necessitated that the course become four instead of three credits. The enrollment this past fall ballooned to over 100 with classroom space limiting enrollment.

We have welcomed two new professors to our program: Tracy Brandenburg and Sirietta Simoncini. Sirietta is an architect and Tracy has a background in anthropology. Both are experts in design thinking. Systems Engineering is reaching out to incorporate design thinking into our curriculum because it is an excellent vehicle to embed innovation and it provides another mechanism to foster “T-shaped” engineers, which is the hallmark of systems engineering.

With their help we have integrated design thinking into SYSEN 5940 (Creativity and Innovation within Systems Engineering) and created two new classes in the area. The new courses (one of which was piloted last spring) have been conceived to create an environment where students from Engineering, the Johnson Graduate School of Management, Architecture, Art and Planning, CIPA, CALS and Human Ecology can learn the art of innovation. Last spring the design challenge was to re-imagine the check-in experience for JetBlue using the JetBlue terminal at JFK. This fall the design challenge is a social innovation challenge focusing on refugees settling in Syracuse, N.Y. through organization Hopeprint. A future design challenge will focus on market innovation/product design.

Finally, in the fall of 2014 we will welcome another new professor, Dr. Daniel Selva. Daniel is a recent graduate of AeroAstro at MIT with a specialization in system architecture and multidisciplinary design optimization. During the 2014-2015 school year he will lead the creation of a new course in Systems Architecture.

In later issues of this newsletter we will focus on each of these courses as well as our new class in Systems Dynamics (Professor Haiyan Deng) and in Heuristic Methods (Professor Daisy Fan), both also introduced this past year. As you can see, these are exciting times in our program and we welcome you as a part of our alumni family to reach out with your ideas as to how this program should continue to evolve.

Sincerely,

Linda Nozick
Systems Director
to bring together anthropology, design, business and engineering,” says Brandenburg. “But all disciplines are welcome to contribute as the thinking is that problems are best solved when we come together. We are most powerful and effective as a group, bringing together all of our unique skill sets.”

Brandenburg and Simoncini joined the Cornell faculty in 2012. They group their students into teams of four to six; all representing a variety of disciplines. The class is low-tech, emphasizes both right- and left-brain thinking, focuses on bringing students as close to the end-user as possible, encourages plenty of trial and error, incorporates end-user feedback throughout every stage of design and alternates its focus between corporate and social issues. The first class brainstormed ways to redesign JetBlue check-in services within Terminal 5 at the John F. Kennedy International Airport in New York.

“You can use both sides of your brain and solve any kind of problem,” says Simoncini. “Our Design Thinking classes are a place where any student can come and connect with his or her creative self.”

Students learn ethnographic techniques for building empathy in order to understand human needs and desires, how to build a design vision based on deep insights gleaned from fieldwork, effective brainstorming techniques, rapid prototyping, and how to test prototypes with real users and make multiple iterations based on user feedback. Chi Fan Johnson Cheng, who is now a second-year M.B.A. student at the Johnson Graduate School of Management at Cornell University, took the first Art of Innovation: A Hands-On Design Thinking Immersion class last year.

“The Art of Innovation class differs radically from the traditional college lecture: you’ll see post-its on the wall everywhere, hear pop music in the background as people brainstorm, and find students of various backgrounds building rough prototypes using markers, tape, and cardboard,” says Cheng, who previously worked as a Strategy and Operations consultant at Deloitte Consulting and received his undergraduate degree from Cornell University in Applied Economics and Management. “This class is full of diversity and positive energy, and provides a safe environment where wild ideas are encouraged and judgment is deferred.”

Cheng’s class worked with JetBlue to brainstorm ways to redesign the check-in experience within Terminal 5. “To tackle this problem, my team had to approach real travelers and interview them about their experiences and pain points. For example, we spoke with a stranded business traveler looking for the next flight and a couple about to have their honeymoon plans postponed. We found that unexpected stress and emotions play a large role in the check-in experience. Our team explored a wide range of possibilities for improving travelers’ check-in experiences and we voted on two to test: a crisis desk, a concierge desk that served distressed customers, and an emotions indicator; a band that used colors to represent different emotional states. We physically built a desk using cardboard and colored paper; the emotions indicators were as simple as post-its that represent different emotions.”

In Terminal 5, the students performed skits with their prototypes and gathered feedback from travelers waiting to collect their bags. “After a couple iterations, we refined our ideas and presented them to JetBlue. This project allowed us to gain hands-on experience in ‘doing’ innovation and emboldened us to exploit the creativity that we didn’t know we had.”

This autumn, The Art of Innovation: A Hands-On Design Thinking Immersion students will work with refugees in Syracuse, N.Y. “Syracuse receives thousands of refugees every year,” says Brandenburg. “Many people have waited in camps for a decade or more, hoping to come here. They come from a variety of places, like Congo and South Sudan. And what we learned through following the papers is that Syracuse is so strapped for resources that it can’t meet their needs. So we are going to work with a nonprofit called Hopeprint to address some of those issues. We are going to work directly with anthropology, design, business and engineering, and provides a safe environment where wild ideas are encouraged and judgment is deferred.”

Simoncini was just 28 years old when she became chief architect of a northern Italian town named Voghera.

Brandenburg says “Design Thinking is the study of culture, people and then doing something about it.”

Continued bottom of next page
One of the largest Systems Engineering classes graduated May 26 during Cornell’s annual Commencement ceremony at Schoellkopf Field.

The students were also honored the previous day during a ceremony at Duffield Hall, where they received a medal and had a chance to celebrate with classmates, faculty, family and friends.

Sixty-six students earn M.Eng. degree in Systems Engineering

Brandenburg says that the Zapotec artist she worked with in Mexico once said, “People come here from all over the world. They come and study our medicinal plants, they study our culture, but they don’t leave anything behind,” she says. “And I think that is why I really gravitated towards Design Thinking. Design Thinking is the study of culture, people and then doing something about it. And that really seemed like where I needed to be.”

She was inspired by a group of Stanford students who went to Nepal to study the high infant mortality rate and who ultimately produced an incubator, Embrace, costing only $25. “They turned that into a company and are saving countless lives. That was sort of my guiding light. I wanted to create future innovators who could do projects like this. That seemed so much more fulfilling. You learn how to approach real-world problems, you learn how to think and you get experience,” she says.

This spring, Brandenburg and Simoncini will debut a new iteration of the course, Design Thinking 2.0: Making Design Thinking Work, to help students learn how to apply the skill set on-the-job after they graduate from Cornell. “We realized that students need to learn how to lead the Design Thinking process in their future jobs, organizations, or as entrepreneurs, so we designed Design Thinking 2.0, which will be offered in the spring. This class will have students planning and teaching executives via one-day workshops and they will also be pairing off and offering Design Thinking training to companies and organizations.”
Mark your calendars. Cornell Cup USA, presented by Intel®, the popular college-level embedded design competition, will be held for the third time in Lake Buena Vista, Fla. This year’s competition will be held May 2-3, 2014 at the Walt Disney World® Resort.

Once again this year, the benefit to teams is two-fold. First, teams will get the experience of creating a real-world embedded technology invention, building off of an existing design or current project. Second, the cash prizes are among the highest in college-level competitions. The grand prize winner will take home $10,000, while the runner-up receives a check for $5,000. Third place is $2,500.

“Cornell Cup USA is shining a spotlight on the brilliant embedded engineering work these young people can do,” said Jim Robinson, general manager, Intel’s Intelligent Systems Group Segments and Broad Market Division, and the keynote speaker at the 2013 competition. “Embedded technologies and intelligent systems can solve big problems facing consumers, businesses and even the government today, and we believe it’s critical to foster and encourage this kind of innovation.”

Last year’s Cornell Cup USA featured 30 teams from 18 universities, and the students dedicated six months to the projects—from conception and design to construction and iterations—all while juggling school work and, in some cases, graduation preparation and job interviews. Throughout the process, the teams had access to Intel Atom® boards and input from Intel technical leaders with experience in designing and developing embedded hardware and applications.

“Students today are hungry for the opportunity to showcase what they can really do. They have tremendous innovative spirit—they don’t know if something can be done, but find a way to do it anyway,” said David Schneider, lecturer in Systems Engineering at Cornell. “Thanks to Intel this competition is an opportunity for the students to demonstrate their capabilities on a national stage.”

The University of Pennsylvania’s Titan Arm team that developed an exoskeleton prototype took first-place honors last May, taking home the $10,000 check. The Titan Arm provides an affordable, streamlined and wireless option for rehabilitation and therapeutic application.

Second place at the competition and $5,000 went to a team from Worcester Polytechnic Institute for its Cyber Physical Systems semi-autonomous wheelchair. The wheelchair is combined with a body-brain interface and uses cost-effective, modular sensor packages that can be easily mounted to a variety of commercially-available wheelchairs.

Third-place honors and $2,500 went to a team from the University of Colorado, Denver for its Intracell project. The Intracell is comprised of networked cell phone transceiver nodes that function together as a local extension to the global cellular network to provide coverage to areas normally blocked by geographical and architectural constraints.

Any company or organization interested in becoming a sponsor is encouraged to send an email to cornellcupusa@cornell.edu.
By Peter L. Jackson

Working with another faculty member, I recently completed a software development project for a European equipment sales and distribution company. Our task was to develop the forecasting and stock optimization computational engine for managing service parts. We were partnered with a supply chain management company who developed the application, including the web interface, database management, and transaction processing. It was a nice opportunity for me to observe how professionals in this area develop such applications and to practice systems engineering on my own. So far, the project has been a success on all metrics of time, cost, and performance. Most of the credit for this must go to company we worked with. Here are three reflections from that experience:

**Functional modeling is still valuable.** Working with software professionals, I expected that they would be using powerful entity-relationship models or other diagramming techniques to guide development. However, after the first day of the kick-off workshop, the team was mired in discussions that had no discernible organization. In the hotel room that night, I used Visio to create a series of IDEF0 diagrams that provided the functional architecture of the project and the major data flows. Those diagrams formed the basis of discussion for the rest of the week. Later, I developed detailed IDEF0 diagrams of the computational engine and used them to document all the data inputs and outputs to interface with the application. Our partner company liked them so much they adopted IDEF0 to manage other parts of the project as well. So, a simple 40-year-old technology still works well.

**Give them zero, one, or infinite choices?** Professor Dick Conway once said to me that in developing applications, whenever you give users a set of choices greater than one they will inevitably complain of a missing choice. For example, I am sure there are users who complain that they are limited to two address lines when filling in online forms for shipping addresses. So, if you are going to provide a number of choices beyond one, your architecture should not artificially limit the choices to any finite number. Over the years, this advice has helped me greatly in database design. On this project, however, I experienced the downside of that advice. At subsequent workshops with the client, what seemed to be new requirements surfaced and we had to adapt the design quickly to meet the requirements. My recommendations were always to treat the requirement in a generic form and prepare for infinite extendibility. For example, I was initially going to classify demand streams into only two groups: those with sufficient data for forecasting techniques and those that were unforecastable. As the project progressed, I admitted the need to open that up. My instinct was then to allow for unlimited demand stream groupings but it was too late in the project to make such architectural changes. So the end product has nine hard-coded groupings based on different levels of product age, demand velocity, and sales trending. So a prerequisite for an elegant design, which this is not, is good anticipation of future needs.

**The most important requirements are unwritten.** The contract stipulated that we develop a sales forecasting module, but it was vague as to what that module should consist of and how performance was to be measured. There was no list of forecasting techniques to be included and no criteria for judging the adequacy of a technique. The company was implicitly relying on our expertise to develop such a module and expected a “best effort.” When we delivered the first version of the module, it was clear that the methods we had coded did not work well for low demand rate parts with significant trend and seasonality.

We had omitted a well-known technique for low demand rate parts which the client now requested. So an implicit requirement was that our module should “do what the other guy’s does,” that is, it should match the capabilities of competing software. We also developed a custom technique that performed even better. For us, as consultants, the relationship was more important than narrowly constructed requirements.

All of these statements are open for debate and I would like to hear your perspective.

Peter L. Jackson is a professor in the School of Operations Research and Information Engineering and Director of Graduate Studies for the Systems Engineering Program. He conducts research in supply chain management and teaches courses in industrial systems analysis and manufacturing systems design.

Practitioner’s Corner is intended to be a shared forum in this newsletter format. Please contribute stories and reflections of your own by sending them to patgillespie@cornell.edu. Contributions will be reviewed and edited prior to publication.
Faculty Spotlight: Huseyin Topaloglu

Huseyin Topaloglu has quickly become a student favorite in the classroom.

Topaloglu is an associate professor in the School of Operations Research and Information Engineering—one of the five core fields that make up Cornell’s Systems Engineering program. After receiving his B.Sc. degree in industrial engineering from Bogazici University in Istanbul, Turkey, he completed his Ph.D. at Princeton University before coming to Ithaca to join the ORIE faculty in 2002.

Professor Topaloglu has recently been teaching courses on systems engineering, simulation modeling, and revenue management. His systems architecture, behavior and optimization course is devoted to how to model, simulate, and analyze complicated systems operating under uncertainty.

“The course that I regularly teach (SYSEN 5200) goes over crucial mathematical analysis tools that become useful in the technical design process. We cover simulation, optimization and statistical analysis techniques. What I like about the course is that not only do we cover a broad range of topics, but we also go into the depths of these topics,” Topaloglu says. “When students come out of the class I teach, I can comfortably say that they know simulation, optimization and statistical analysis to a pretty advanced level. The students in the program are strong at implementation. Every semester, we wrap up the class with a project, where students apply the tools they acquired on a larger scale.”

Topaloglu points to some unique features of the systems engineering program.

“The skills that we give to systems students are unique in the sense that they are hard to get in any one engineering discipline alone,” says Topaloglu. “We focus on the whole design process that starts with the customer and culminates on delivering and supporting a finished product. In particular, we show our students how to talk to the customer and understand what the customer wants.

“We develop a structured approach for taking the needs and wants of the customer and turning them into technical engineering requirements,” Topaloglu continues.

“Once we figure out what the customer wants, we carve out a functional design process that allows the design engineer to understand what the system should do in order to accomplish what the customer wants. This functional analysis phase is followed by structural analysis, where the design engineer architects the whole structure that will carry out the planned function.”

But the systems process does end there, says Topaloglu.

“There is a systematic thought process that goes into this basic requirement-function-structure design cycle. We talk to our students about how to go through this thought process, document the design, establish the links between different parts of the design and figure out the sources of a problem when some things do not add up. Once a system is deployed, there is, of course, the ongoing management and support phase and we try to put our students in a good position to help with the management and support phase as well.”

While the Systems student is earning their master’s degree right after a bachelor’s degree or has been working in the field for a few years and is part of the distance learning program, they can definitely benefit from Professor Topaloglu’s experience and courses.
Students learn innovative design theories.

As part of the innovative design practice, students had to interview Systems faculty and staff.

Students spend most of their time working with each other.

Students from various companies work together as a team.

At the end of the week, students make their presentations.

Professor Frank Wayno teaches both 5920 and 5940.

SYSEN 5940 Summer 2013 students take a much-needed break.
Ezra’s Round Table brings together faculty, students and practitioners whose work centers on, or involves systems. We include the natural and engineering behavior of complex systems, the design and operation of them, the societal and behavioral context in which we find such systems, as well as their local and global consequences. Each Round Table consists of a 30-minute presentation by an invited speaker, followed by a moderated discussion. We will be including topics in engineering, health, food, and others in the series. Intellectual collusions, new ideas, and prospects for further study and research come out of the audience in these Round Table discussions.

Fall 2013
Fridays at 12 p.m. in 253 Rhodes Hall or online.

September
13 Patrick Reed (Cornell)
20 Timothy Simpson (Penn State)

October
4 David Greene (Oak Ridge National Lab)
11 Larry Burns (Michigan)
18 No Seminar - Fall Break
25 Norman Uphoff (Cornell)

November
8 Jorge De La Guardia (Panama Canal)
22 Pamela Sydelko (Argonne National Lab)
29 No Seminar - Thanksgiving

December
6 Linda Nozick (Cornell)

Lunch served at 12 p.m., followed by the presentation at 12:15 p.m. If you can’t make it in person, you can watch it live or recorded at http://www.systemseng.cornell.edu.

Seminars in italics have already occurred, but can be viewed online.
By Natalie O’Toole

Imagine you are a bright young engineering student. Your cell phone rings: “Tell me, what could NASA do for you?” says a voice.

In his hypothetical “Last Lecture” April 30, David Schneider, lecturer in systems engineering, shared anecdotes like this in an overview of his career as a Disney screenwriter, teacher at Columbia and Cornell universities, an engineer for NASA, national competition founder for Intel, video game designer for the National Science Foundation and lead adviser for student project teams such as Cornell University Sustainable Design, among others.

Schneider, who wears Hawaiian shirts to be more approachable, welcomes being questioned by his students and lives by the motto, “It’s nice to be important, but it’s more important to be nice.”

He said he had a life-changing conversation with Mark León, a director at NASA’s Ames Research Center, who got Schneider in touch with David Lavery, program executive of NASA planetary solar exploration. “Yeah, the sun. He’s in charge of that,” joked Schneider. Together they created the NASA Robotics Alliance Cadets Program to modernize engineering curricula.

Schneider, M.S. ’05, Ph.D. ’07, also created an educational robot to function as a “supertextbook” for students, and his students drove one of these “ModBots” around at the lecture. He also talked about founding the G’TA task allocation algorithm, the fastest problem-solving system of its kind. “I was willing to look at new ways of using the same information,” Schneider said. “I found that to be a real source of innovation.”

As a 22-year-old, Schneider developed the most popular freshman engineering course at Columbia based around toys. Since then, he has made five sustainability-based video games that teach computer science for middle schoolers and helped found the Cornell Cup USA presented by Intel®, a national innovative embedded systems competition, now in its third year.

Schneider said carefully weighed risk-taking with back-up plans and not allowing your own inhibitions to hold you back are two traits that helped him advance his career. To prove his point, he started up a lively audience chant of “to be enthusiastic you must act enthusiastic” from the Hugh O’Brian Youth Foundation, gave a Seinfeld impersonation and even donned a flannel shirt to sing “I’m a lumberjack and I’m OK” in an English accent to the crowded lecture hall. “[This] shows how dedicated I am to wanting my students to actually learn,” he said.

“Make the most out of any opportunity that you have. Really seek to find ways that you can contribute, ways you can gain experience. Look for it; don’t expect somebody else to offer you that opportunity or let you know that the opportunity even exists. … [Also,] give every job your very best. Even if it’s demeaning, people will recognize the value in that.”

Concluding, Schneider said: “You’re the only person who holds yourself back. Look at all these different things I got to do, just because I put myself out there, you know — positive attitude each time. If you’re going to do it, give it your all.”

“Last Lectures” is a series sponsored by Mortar Board, a national senior honor society.

Natalie O’Toole ’16 is a writer intern for the Cornell Chronicle.
Systems Spotlights
Catching up with current and former Systems students

Hooman Bolandi, M.Eng. ‘13

- I have been working at Applied Materials for 16 years in new product development. I dreamed to make a bigger impact by having a more strategic role in the company. Dr. Liang Chen (one of our VPs and a Ph.D. from Cornell) suggested the Cornell Systems program might be something I need.
- The program taught me about creativity and innovation. It pushed me to think outside the box and systematically solve problems. The program also taught me about embracing challenge. One of my fears entering this distinguished program was failing since I was away from school for more than 16 years and working full time. One semester I was taking 11 credits, working full time and still earned a 4.2 GPA!
- This journey gave me an opportunity to see my potential and confidence to overcome my fears and most importantly deep understanding that if “there is a will there is a way”. Now I can say nothing is impossible; in fact to me the word “impossible” is “I’m possible”!
- The Cornell System Engineering program gave me a new start in my once staggering career. I am currently working as a member of technical staff in the office of CTO at Applied Materials. Since graduating in May 2013, my responsibility has grown tremendously. Now I manage two major programs in the office of CTO.
- Now I am dreaming bigger dreams. I plan to convert and run one of the start-up programs that I am currently working on into a multi-million dollar division at Applied Materials. Then the next step for me would be to become a CEO of a company.

Craig Brewer, M.Eng. ‘14

- Currently a captain in the United States Army, I have been given a great opportunity to further my education as an M.Eng. student in the Systems Engineering program at Cornell. After supporting me through three deployments to Iraq, my wife, Lalah, and my two dogs were also very excited to start this new chapter!
- During the past eight years in the Army, I have only served in combat arms leadership positions. Looking back, I have a great appreciation for general systems thinking when considering manning, operations, integration of assets, and optimizing training events, just to name a few.
- Also, in operational combat environments where problems are ill-defined, understanding complex systems and inter-related components becomes necessary.
- I became interested in design methodologies in conjunction with hard systems thought when searching for and solving the right problem. I was inspired by the new design thinking course, dealing with a proven, human-centered approach to solving problems. I will apply this design methodology with hard systems tools in a project with CYBEX International to explore alternative fitness equipment.
- Upon graduating from Cornell, I will fully utilize the learned analytical and soft skill sets as an officer in the Army. I am thankful to my wife, all my soldiers, the front office staff, and all of my professors and advisors.
We want to hear from you...

If you would like to share information about your current activities, please visit the Systems alumni page at http://www.systemseng.cornell.edu/alumni and go to “Submit an Alumni Note.” Feel free to include updated contact information or other items of interest, including:

- Career News
- Personal Highlights/Milestones
- Get Married? Have a Child?

In addition to publishing the alumni notes online, we’ll add Alumni Notes to future issues of Systems Update. Feel free to add a photo to your note submission.