SIXTH SYMPOSIUM ON ENGINEERING AND LIBERAL EDUCATION

7-8 JUNE 2013
UNION COLLEGE
SCHENECTADY, NEW YORK
Trolley Schedule

The trolley runs about every 10 minutes during the designated times.

Friday 7 June
4:50 to 6:30 pm  Hampton Inn to Old Chapel Circle
9:30 to 10:30 pm  Old Chapel Circle to the Hampton Inn

Saturday 8 June
7:30 to 8:30 am  Hampton Inn to Old Chapel Circle
5:30 to 6:00 pm  Reamer Campus Center Circle to Hampton Inn
6:00 to 7:00 pm  Hampton Inn to Old Chapel Circle
9:00 to 10:00 pm  Old Chapel Circle to Hampton Inn

On the cover: Scanning electron micrograph of a microcrack in equine cortical bone (photo by Barbara Garita, Ph.D.). The microcrack runs from near the (relatively) large hole at left to the hole at lower right (the smaller holes are osteocyte lacunae, voids in which cells reside that comprise the signaling network in bone). These large holes - Haversian canals - are about the diameter of a human hair and are at the center of an osteon, the remnant of remodeling activity - the internal change of architecture and composition - in this type of bone. Beams machined from the dense cortical shells of horse third metacarpals, each containing a natural hole - the primary nutrient foramen, were subjected to cyclic loading so as to generate cracks like that shown. The architecture near the foramen was shown to arrest such cracks which, if left unarrested, could potentially grow and coalesce to ultimately fracture the whole bone (see, e.g., Garita and Rapoff Exp Tech 2003).
Welcome

Welcome to the Sixth Symposium on Engineering and Liberal Education, hosted by Union College in Schenectady, New York.

We are incredibly grateful to have Dr. Jamshed Bharucha, President of the Cooper Union for the Advancement of Science and Art, with us to present the keynote address.

We have an outstanding array of papers from researchers and practitioners at the interface of engineering and the liberal arts. We have integrated these papers into an exciting program that we hope will result in you bringing home some practical applications of this work.

On behalf of the Program Committee, we welcome you to our beautiful campus and hope that you have an inspiring symposium.

Andrew Rapoff, Symposium Chair

Program Committee

Chair
Andrew J. Rapoff, Ph.D.
Director of Engineering
Associate Professor of Mechanical Engineering
Union College

Members
J. Douglass Klein, Ph.D.
Kenneth B. Sharpe Professor of Economics
Union College

Bradley G. Lewis, Ph.D.
Professor of Economics
Union College

Hans-Friederich O. Mueller, Ph.D.
Chair and William D. Williams Professor of Classics
Union College

Symposium Staff
Karen Crosby, Administrative Assistant for Academic Affairs
ACKNOWLEDGEMENT OF SUPPORT

We gratefully acknowledge the support of the Laurence W. Levine '52 and Barry Traub '53 Endowed Lecture Fund on the Liberal Arts and Engineering. This fund has helped us bring to campus a leading engineer who is also a leading proponent of the liberal arts. We further acknowledge the support of the Union College Office of Academic Affairs.

Special thanks to the Union College Facilities, Media and Dining Services staff, without whom this event would not be possible.
Friday 7 June

SYMPOSIUM PROGRAM

5:00 pm  Check-in & Reception
6:45 pm  Welcome
   Dr. Stephen C. Ainlay, President, Union College
7:00 pm  Dinner
7:45 pm  Introduction of Keynote Speaker
   Dr. Andrew J. Rapoff, Director of Engineering, Union College
   Keynote Address
   "What the Brain Tells Us About How We Learn"
   Dr. Jamshed Bharucha, President, The Cooper Union for the Advancement of Science and Art

Social Reception to follow Keynote Address

Saturday 8 June

8:00 am  Registration & Breakfast Buffet  Old Chapel

9:00 am  Symposium Kick-Off  Olin 115

9:15 am  Plenum PechaKucha  Olin 115

11:00 am  Plenum Workshop 1: The Fundamental Value of Integration  Olin 306

Smarter Curriculums: Bridging the Pedagogical Gap between Engineering and Sciences and the Liberal Arts
   Kevin Buchan, Molly Bigness

   Hands-on Education
   Heath J. Hansum

Systems Thinking: Engineering's Contribution to Liberal Arts
   John Krupczak
Where Science and Humanities Meet: Critical Importance of an Integrated Education
Cheikh Ndiaye

Problem-Solving, Representation and Ethics
Wade Robison

noon
Lunch & Poster Session Wold Atrium
United States Presidential Decision Making: Technology and Science
Maurice F. Aburdene

Teaching Entrepreneurship and Digital Media in an Engineering Context
Ashraf Ghaly

Engineers for a Sustainable World: Interdisciplinary Education through Student-Driven Sustainability Projects
Erin Lennox, Alexander Dale, Justin Hess

Program Technology and Society at Princeton University
Emily Carter, Victoria Dorman, Edward Felton, Cornelia Huellstrunk, Sanjeev Kulkarni, Sharad Malik, Stephen Schultze, Laura Strickler

Union College student posters will also be displayed.

1:30 pm
Plenum Workshop 2: The Practical Needs for Integration Olin 306
United States Presidential Decision Making: Technology and Science
Maurice F. Aburdene

Teaching Engineering Policy as the Governance of Technology
Benjamin R. Cohen

Strategic Analysis for Complex, Sociotechnical Systems
Darryl Farber

Teaching Entrepreneurship and Digital Media in an Engineering Context
Ashraf Ghaly

Engineers for a Sustainable World: Interdisciplinary Education through Student-Driven Sustainability Projects
Erin Lennox, Alexander Dale, Justin Hess
2:30 pm  **Plenum Workshop 3: Integration on the Ground**  
*Olin 306*

*From D-Lab to WE-Lab: Translating an MIT Humanitarian Engineering Curriculum for Wellesley College*  
Amy Banzaert

*Rapid Curriculum Development in Extremely Unconstrained Environments: Creating and Adapting Engineering Projects for Liberal Arts Students*  
Stephen Banzaert

*Program Technology and Society at Princeton University*  
Emily Carter, Victoria Dorman, Edward Felton, Cornelia Huellstrunk, Sanjeev Kulkarni, Sharad Malik, Stephen Schultze, Laura Strickler

*Collaboration Comes Full Circle*  
J. Douglass Klein, David Hans

*IDEAL: Integrating Engineering and the Liberal Arts through Multidisciplinary Education*  
Ed Gamber, John Nestor, Scott Hummel, Hannah Stewart-Gambino

3:30 pm  **Break**  
*Olin Rotunda*

4:00 pm  **Breakout Sessions**  
*Olin 106, Olin 211, Olin 306*

5:00 pm  **Plenum Summary Session**  
*Olin 115*

5:30 pm  **Break**  
*Olin Rotunda*

7:00 pm  **Dinner Buffet**  
*Hale House*  
**Social Reception** to follow Dinner
KEYNOTE ADDRESS

"What the Brain Tells Us About How We Learn"

Dr. Jamshed Bharucha

President of the Cooper Union
for the Advancement of Science and Art

Abstract: Curricula and methods of teaching have not kept up with our knowledge of how the brain works. In this talk, President Bharucha will discuss several principles from research in cognitive science and neuroscience that should spur us to innovate in the design of the educational process.

Biosketch: Jamshed Bharucha is the twelfth President of The Cooper Union for the Advancement of Science and Art. Prior to this position, which commenced on July 1, 2011, he served in academic leadership positions at Dartmouth College and Tufts University.

A cognitive neuroscientist, he has published extensively on the cognitive and neural underpinnings of music (using a variety of methods including perceptual experiments, computational neural net models and MRI brain scanning), has been awarded grants from NSF and NIH for his work, and has served as Editor of the interdisciplinary journal Music Perception. More recently, he has written and lectured widely on the challenges facing higher education, emphasizing the need for bold innovations in learning and global engagement.

A 1978 Phi Beta Kappa graduate of Vassar College, where he majored in biopsychology, President Bharucha received an M.A. in philosophy from Yale University (1979) and a Ph.D. in cognitive psychology from Harvard University (1983).

He was a Fellow at the Center for Advanced Study in the Behavioral Sciences at Stanford
University in 1993-94, and currently is an Honorary Fellow of the Foreign Policy Association. He received the Distinguished Achievement Award from the Alumnae & Alumni of Vassar College, and has served as a Trustee of Vassar College, where he chaired the Budget and Finance Committee. President Bharucha began his academic career at Dartmouth College, where he was named the John Wentworth Professor of Psychological and Brain Sciences and served in several leadership positions, including Associate Dean, Deputy Provost and Dean of the Faculty of Arts & Sciences. At Dartmouth he received the Huntington Teaching Award in 1987 and the Undergraduate Teaching Initiative Award in 2002, and taught in several interdisciplinary programs, including Linguistics & Cognitive Science, Cognitive Neuroscience, and Electro-Acoustic Music. A signature accomplishment of his administrative work at Dartmouth was the creation of the nation’s first brain imaging facility for the study of cognitive neuroscience outside of a clinical setting.

In 2002, Bharucha was appointed Provost and Senior Vice President of Tufts University, where he also held appointments as Professor in the Departments of Psychology, Music and Neuroscience. Under his leadership as Provost, annual sponsored research at Tufts doubled to $175 million, and revenues from the transfer of technology increased eight-fold to $8 million. He launched the Summer Scholars program, which provides summer research opportunities for undergraduate students, and the University Seminar, a course that brings together faculty and students from multiple schools to focus on issues of societal importance. He strengthened the Ph.D. programs through the Provost's Fellows program and the Graduate Competitiveness Initiative, and spurred innovation and collaboration through two competitive seed-fund programs: Tufts Innovates! and Tufts Collaborates! He elevated the role of education for global leadership and public service, and led the university’s strategic engagement with Mexico, India and China.

President Bharucha is a classically trained violinist, having received an Associate’s Diploma in Violin Performance from the Trinity College of Music, London, in 1973.

_Biosketch from cooper.edu_
ABSTRACTS

Smarter Curriculums: Bridging the Pedagogical Gap between Engineering and Sciences and the Liberal Arts

Kevin Buchan, Molly Bigness
IBM

[A liberal arts education] makes [students] more reflective about their beliefs and choices, more self-conscious and critical of their presuppositions and motivations, more creative in their problem-solving, more perceptive of the world around them, and more able to inform themselves about the issues that arise in their lives, personally, professionally, and socially.

- The Office of Admissions at Harvard College

When I’m looking to hire an engineer at IBM, I look for good examples of hands-on experience that lead me to believe they’d be successful doing a job at IBM; stories about themselves that show good teamwork and leadership; they need to be good communicators - people who can translate their technical expertise into language others can understand. Beyond that, I look for hires that can facilitate innovation that matters for our company and for the world.

- Jim Ground, Hiring Manager IBM

In this presentation, we will analyze a small group of industry leaders in engineering and technology with a corporate philosophy that emphasizes a concentration in the liberal arts to enhance traditional fundamentals in engineering. We will identify a common set of core skills and techniques that these companies have cultivated to become more successful than competitors in innovation. We will consider how students can harness these skills and use these techniques to become more effective, well-rounded employees and academics. This presentation will also discuss how these skills and techniques can be used to drive innovation. We will introduce an idea for a curriculum that produces problem solvers.

Hands-on Education

Heath J. Hansum
Bucknell University

Practical hands-on learning is a cornerstone to many forms of engineering, art and creativity. Possessing the ability to bring ideas to fruition is critical to innovation. Part of becoming a master artisan or engineer should start with solid skills involving using mechanical reasoning honed through laboratory application. These laboratories can be in a school but also in a shop, or on a farm, in a studio or on even a boat. Creative problem solving expertise is paramount for success in the workplace. We are looking to create graduates who are career agile and
forward thinking with a solid foundation of what it takes to make project successful. How do we as their instructors deal with students who haven’t ever had to worry about how to keep a wheel on a soap box racer, never built a catapult in their back yard or never had to fix their own bike? Incoming college students often encouraged to become advanced scholars at an early age but they seem to be less and less in touch with their physical universe. What it takes to keep two pieces of material mated together might be an issue that they are just learning to understand in as a sophomore in college. This essay discusses changes that seem to be evident in the modern university student scholar and what we as mentors can do to get them in touch with their practical, physical universe.

**Systems Thinking: Engineering's Contribution to Liberal Arts**

John Krupczak  
*Hope College*

This work addresses issues relevant to developing practical pedagogies for integrating engineering into the liberal arts curriculum and the creation of engineering courses appropriate to the liberal education of all majors. A discipline may claim a place in liberal education to the extent that it provides a characteristic perspective or way of thinking which is both general in application, and accessible to liberal arts students. Economics, psychology, and statistics are some examples. These subjects are accessible at the introductory level and provide capabilities that can persist for a lifetime. Engineering deserves inclusion in the liberal arts only to the extent that it can articulate a unique, productive, and transferable way of thinking. The framework used by engineering in creating technological systems could be one of engineering’s contributions to the liberal arts. All engineering disciplines utilize a systems thinking approach. Foundational principles that define the structure and function of technological systems can be acquired as part of a liberal education for all majors. A course using this approach has been developed for liberal arts students at Hope College. The course uses familiar technologies such as the automobile and home appliances as accessible examples. This approach accommodates integration of mathematics and science but, by focusing on system structure, does not trespass into physics, chemistry, or biology. Development of the function and structure of systems is linked with discussion of the engineering design process as means through which technology is created. Some examples are presented of student outcomes achieved using this approach.

**Where Science and Humanities Meet: Critical Importance of an Integrated Education**

Cheikh Ndiaye  
*Union College*

My presentation is tailored for global awareness. Part of its inspiration comes from a play I watched at an elementary school this year and a number of applications I read and reviewed as a member of the Watson fellowship Committee at Union College. These two experiences, among others, clearly speak to the notion of *border* as a concept more virtual than real
nowadays. Many writers, critics, and theorists including Gaston Bachelard in his 1957 essay, *The Poetic of space*, have for long thought through notions like *place* and *space*, yet if home was a clear project, today it has lost its clear definition. It is as never before subjected to fragmentations. Information technology, science, and human ingenuity are connecting the world at a high speed. The concepts of home, elsewhere, place, space lie at a structural juncture, for many of us operate from a *position* defined by complex local and outside constructs. Smart educational institutions including liberal arts schools understand this complexity; as a result they inspire their students to address 21st-century societal and intellectual challenges; this speaks to the need and support for an integrated ‘practical pedagogy’ and scholarly training aimed to teach students how to create and apply knowledge; science, engineering, art, music, theater, and world language are clearly part of the definition of this applied knowledge.

**Problem-Solving, Representation and Ethics**

Wade Robison  
*Rochester Institute of Technology*

The intellectual core of engineering is the solution to a certain kind of design problem. That sort of problem-solving is not unique to engineering, but is common to any endeavor which requires imagination subject to constraints: a poet finding exactly the right phrase or rhyme is doing exactly what engineers are doing. I suggest a course in how to solve problems that cuts across engineering, on the one hand, and the humanities, on the other, by focussing on the common problem of presentation and representation. How we present what we have to say -- our solution to a design problem, say -- is itself a design problem. Getting it wrong can cause great harm, and so our presentations and representations have moral weight.

A nice case study is Edward Tufte’s claim that the engineers at Morton Thiokol were morally responsible for the death of the seven Challenger astronauts because they failed to present their view in a perspicuous way. Had they done so, he says, no rational person would have agreed to a launch. He is wrong about the engineers’ presentation and wrong to judge them morally responsible for the astronauts’ deaths, but he is right to in-sist that the way we present what we propose is a skill. His presentation makes that point nicely: he failed to get the facts right and failed to represent what facts there were in a perspicuous way. Had he done so, he would not have made the moral judgment he made.

**United States Presidential Decision Making: Technology and Science**

Maurice F. Aburdene  
*Bucknell University*

We live in an explosively technical world in highly volatile times. Our leaders make critical decisions, daily, regarding security, war and peace. Presidents need to be technically savvy enough to make rapid assessments of situations and informed decisions that will ultimately determine the course of the country, and the world.
The objective of this new research project is to study the United States Presidents' involvement in decision making, with respect to innovation and to science, technology, engineering, and mathematics (STEM) based issues. The research topic is broad and it might be best to identify the most important and/or highest priority issues of each administration and to examine which of these carried over from one presidency in to the next.

In particular, some of the initial questions to be considered include:

1) What were the most significant STEM issues facing each of the Presidents from Dwight D. Eisenhower to President George W. Bush?
2) Which of these carried over from one presidency to the next?
3) What information was available to the Presidents?
4) What was the motivation for their involvement in these issues, for example, was it to stimulate the economy, aid in defense, or advance space exploration?
5) Were they reactive or proactive, with respect to innovation and technology?
6) What was their level of knowledge and understanding of the technology of their time compared to the "general public" or the electorate?
7) Was the Presidents' thinking and grasp of the importance of STEM ahead of their time?
8) How do we stimulate presidential involvement in these technological issues in the future?

Teaching Engineering Policy as the Governance of Technology

Benjamin R. Cohen
Lafayette College

We offer a course on engineering and public policy at Lafayette College. It is structured as a study of the politics and governance of technology; it is cross-listed between our engineering studies and policy studies programs; it is suited to fit a small liberal arts college integrating engineering and the liberal arts. The opportunity for that engineering/liberal arts integration plays out, first, with cross-campus enrollment in the class and, second, by understanding engineering in society as a political activity. To leverage that second opportunity, the course introduces students to three dimensions of science, technology, engineering and public policy: (1) the political character of technologies, (2) the means by which decision-makers craft policies about those technologies, and (3) the ways technologies themselves are used in that process. In this talk, I will discuss the strategies we use to develop these points, the ways we enroll concepts from Science, Technology, and Society to inform the course with cultural context, and the kinds of projects students pursue as they study the governance of technology. The overall point is that framing the course through the active and community-based notion of governance is more than a semantic move. It allows the course to emphasize the ways technologies are active, dynamic, and community-based systems while promoting debate about engineering policy as an on-going, engaged and public activity. It allows, that is, a way to teach engineering activity and the values of a liberal education together.
Strategic Analysis for Complex, Sociotechnical Systems

Darryl Farber
Pennsylvania State University

An education for understanding the problems that face civilization and strategies for addressing them requires one to understand complex, sociotechnical systems. Complex, sociotechnical systems are the relationships or interactions among technological systems, such as transportation systems, and social systems, such as legal or regulatory systems that collectively are characterized by non-linear, multiple feedback behaviors among elements and that function and change over multiple time and space scales. The interaction of the elements generates qualitatively different phenomena or emergent phenomena rather than a simple sum of the elements. The presentation describes an experimental class, “Scenario Analysis and Planning for Engineering Systems Leadership” that was coordinated with the National Intelligence Council’s Global Trends 2030 (2012) report. Global Trends 2030 is a strategic analysis that examines trends, factors, and circumstances that may influence the future and is intended to help decision and policy makers in thinking through how the many aspects – the social, political, economic, and technical – of the international system interact. The presentation also explores the use of Global Trends 2030 as a starting point for interdisciplinary discussion across a range of global challenges. The report additionally serves as a focal point to synthesize ideas and observations from multiple perspectives. The presentation suggests the metaphor of the “T” shaped engineer, one who is both deep in a field as represented by the vertical bar of the “T” and broadly educated as represented by the horizontal bar is one mindset among others that needs be cultivated so that one may understand how the parts of complex, sociotechnical systems are related to the whole.

Teaching Entrepreneurship and Digital Media in an Engineering Context

Ashraf Ghaly
Union College

Entrepreneurship and Digital Media is an interdisciplinary course that Union College offered last Fall, and was taught by several instructors with different experience and background. The writer presented the subject from an engineering viewpoint using a module specifically designed for a non-technical audience. The students registered in this course came from many majors and had a variety of interests. The intersection between entrepreneurship, digital media, and engineering was simplified using illustrative examples. The module started with defining entrepreneurship in an engineering context. This was followed with a description of the differences between digital and analog media. The characteristics of entrepreneurs were discussed in detail and this helped students answer the question: Do I pass for an entrepreneur? The answer to this question was facilitated with an extensive questionnaire that addressed the intricate components of what comprises an entrepreneurial spirit. Focus then shifted to models that demonstrated how entrepreneurship, digital media, and engineering could constitute the ingredients of a successful business formula. Many examples of companies that experienced significant growth by following such model were shown. The module then shed light on the psychological aspect of the thrill that comes from being a click away from a wanted goal, and
the desire to be in control of what one reads and views. Students were also introduced to examples of existing “almost science fiction” enterprises that work toward revolutionizing procedures and techniques that can add to the progress of mankind. As tempting as it is to make profits using entrepreneurship and digital media, examples were given of some high-impact, not-for-profit organizations that employ business-like techniques to serve worthy causes. As is the case with bright endeavors, entrepreneurship and digital media has a dark side too. Students were shown how this was exploited by criminal enterprises involved in scam, spam, phishing, hacking, and identity theft of non-suspecting digital media users. The module concluded with a detailed example of how to apply the learned principles in developing a mission statement and business plan with elements leading to success. The module was well received and students’ response was enthusiastic.

**Engineers for a Sustainable World: Interdisciplinary Education through Student-Driven Sustainability Projects**

Erin Lennox1,2, Alexander Dale1,3, Justin Hess1,4

1*Engineers for a Sustainable World, 2Rensselaer, 3University of Pittsburgh, 4Purdue University*

Engineers for a Sustainable World (ESW) is a non-profit organization with student chapters at 34 universities across the United States. Our student members design, build, and implement innovative technologies and solutions that address issues of energy and the environment on their campuses, in their local communities, and within the developing world. Through our projects and multidisciplinary courses students gain experience working in diverse teams and learn how to solve complex problems, training engineers that will be better suited to address global issues.

Here we highlight our interdisciplinary course initiative, along with two successful ongoing projects from our student chapters. First our new Wicked Problems in Sustainable Engineering course (WPSE) brings together students from multiple universities to tackle complex, unstructured environmental problems. The course will be piloted during Fall 2013 at three universities: Pitt, RIT, and Georgia Tech. Second, the University of Rochester’s campus biodiesel project showcases how students have partnered with faculty and staff to produce, test, and promote clean affordable fuel for their campus buses. Finally, Rensselaer Polytechnic Institute’s multi-year project to retrofit shipping containers to create medical and daycare facilities in Haiti shows how large initiatives can become a continuous opportunity for international experience and education. Building on these examples, we suggest ways that ESW's network and multidisciplinary approach to engineering education can be expanded.

**From D-Lab to WE-Lab: Translating an MIT Humanitarian Engineering Curriculum for Wellesley College**

Amy Banzaert

*Wellesley College*

There is growing interest in offering engineering students the opportunity to work on real-world projects, many focused in developing countries, as part of their curricular work. These projects can be highly appealing to students, motivating their learning while offering them greater
insight into the needs of particular populations, the potential efficacy and challenges in their disciplines, and the interdisciplinary nature of real problems. This particular approach seems highly relevant and appropriate in a liberal arts context; making that connection is the aim of this work.

One example of international development-oriented engineering education is the D-Lab program at the Massachusetts Institute of Technology, which has generated great enthusiasm throughout Wellesley College. The two schools – near enough that each offers cross-registration at the other – are quite distinct in terms of student body and mission: a technical institute and a liberal arts women’s college.

Given such appeal, Wellesley is currently developing and expanding its engineering curriculum to emphasize a Service-Learning approach. The college does not offer a degree in engineering and the expectation is that students who take an engineering course do so to broaden their education. Certain students take additional engineering classes at MIT or Olin College (another nearby engineering institution) with a subset intending to pursue graduate studies in engineering. In this talk, the current course offerings and examples of projects will be presented. The challenge and potential approaches to scoping projects for students who may have only basic math or science background, let alone engineering exposure, will be discussed.

Rapid Curriculum Development in Extremely Unconstrained Environments: Creating and Adapting Engineering Projects for Liberal Arts Students

Stephen Banzaert
Hampshire College, Massachusetts Institute of Technology

The academic program at Hampshire College, sometimes summarized as "no tests, no grades, no majors," presents a uniquely unconstrained environment for the development of engineering subjects. Because students at Hampshire select engineering subjects to support a course of (liberal arts) study they have independently developed, the population of a single engineering subject can contain students with widely divergent goals, expectations, and prior experience. This combination of diverse student population and unconstrained curriculum has enabled the rapid development and adaptation of engineering projects and curriculum modules.

One example of this method is a hands-on electrical project to design and build an oscillator that outputs a tone controlled by pressure on a hand-made sensor. Originally conceived as a module for teaching concepts of robustness and feedback within a fixed engineering curriculum, this project has been adapted to cover introductory electrical topics such as resistance and capacitance, while providing an opening to discuss more advanced concepts as the students encounter them.

In this talk, a series of hands-on projects, curriculum modules, and courses developed at Hampshire College over the past seven years will be presented, with particular emphasis on the process of adaptation from a highly-constrained, rigorous engineering curriculum to one better suited to a diverse Liberal Arts student population.
Program Technology and Society at Princeton University

Emily Carter, Victoria Dorman, Edward Felton, Cornelia Huellstrunk, Sanjeev Kulkarni, Shard Malik, Stephen Schultz, Laura Strickler

Princeton University

One would be hard-pressed to find any aspect of society today that is not influenced by evolving technology in a significant way. Likewise, technology does not develop in a vacuum; by virtue of its applied nature, it is shaped by the needs and desires of individuals and by the societies in which they live. Society and technology co-evolve, so that it is not possible to fully understand one without knowing something about the other. In an effort to develop leaders empowered to address challenges at the nexus of technology and society, the Keller Center at Princeton University has developed a crossdisciplinary certificate program on Technology and Society, with concentrations available along two tracks – Information Technology and Energy. This program was developed in partnership with the Center for Information Technology Policy and the Andlinger Center for Energy and the Environment at Princeton. The program is open to all students (from engineering, science, social science, and humanities), who are interested in exploring this intersection in depth, with the goal of imparting some understanding of basic technological and societal issues and the interplay between them. The hope is that graduates who earn this certificate will be more effective contributors to the creation, development, and deployment of technological solutions for the benefit of society. In this session, the presenter will not only share information on the certificate requirements, but also will share the impetus behind the creation of the program and discuss the program’s success to date since its inception.

Collaboration Comes Full Circle

J. Douglass Klein\textsuperscript{1}, David Hans\textsuperscript{2}
\textsuperscript{1}Union College, \textsuperscript{2}IBM

Increasing the scope of client engagements, developing a strong professional skill base, integrating and building new skill sets while sharing valuable technical and business expertise are key goals for IBMers in 2013. Continuing to explore how data and analytics help bridge the arts and sciences is the goal of the Union College Smarter Planet research program. Working with Union College through the IBM Shared University Research (SUR) program has provided both Union College and IBM the opportunity to explore common ground in sharing their respective goals.

Over the past year, IBM continued to participate in the Union College Smarter Planet Sophomore and Scholars Research Seminars. In the spring 2013 seminar, Improving Union College’s Energy Efficiency we strengthened a truly collaborative and mutually beneficial partnership. IBM provided respected guest speakers to help complement the seminar's syllabus. The IBM speakers provided students with a unique view into the impact of data on the business and commercial aspects of a Smarter Planet. Using these lessons, students investigated critical campus wide energy issues, collecting and evaluating various types of key data. Students translated their data-driven findings into marketable business solutions.
Finally, many early tenure IBM employees were able to listen in on the final class project reviews, giving the employees a glimpse into the views and ideas of some future members of the Smarter Planet community.

This paper will explore how both IBM and Union College leveraged this ten week seminar to meet critical business and career goals. We created an atmosphere where both Union College and IBM shared valuable insight, learned more about each other's client expectations, and helped grow the respective professional skill bases.

**IDEAL: Integrating Engineering and the Liberal Arts through Multidisciplinary Education**

Ed Gamber, John Nestor, Scott Hummel, Hannah Stewart-Gambino
*Lafayette College*

Lafayette College is creating a new center for Innovation, Design, Entrepreneurship, and Leadership (IDEAL) that will provide students with multidisciplinary educational experiences that integrate engineering and liberal education. The center coordinates and supports campus-wide opportunities for students in all disciplines to learn and apply the skills, perspectives, and attributes of creative leaders in business, non-profit, and governmental sectors.

The center offers three major components: multidisciplinary projects, co-curricular experiences, and certificate programs.

The multidisciplinary project component allows students from different majors to work together in cross-disciplinary teams with faculty and external partners. Projects will address a range of challenges including new products, applied research, design competitions, entrepreneurial development, and community engagement.

The co-curricular experience component provides training for specific skills such as business and entrepreneurship, community leadership, and engineering methods for non-engineering students. For example, a "Business Link" co-curricular experience is currently under development that focuses on entrepreneurship skills.

The curricular component allows students to choose from a range of multidisciplinary projects and co-curricular activities. For students who desire deeper engagement, the center is developing certificate programs centered around specific themes such as entrepreneurship and innovation that combine course work with multidisciplinary project and co-curricular experiences.

The five-year goal of the IDEAL Center is to build a physical and institutional infrastructure that supports and sustains a culture of multidisciplinary collaboration. The common thread across the three components is the application of liberal arts and engineering to address complex multidisciplinary problems. Once it is fully operational, we expect roughly half of the student body to participate in IDEAL center activities.
## REGISTERED PARTICIPANTS

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REDEFINING LIBERAL EDUCATION FOR
THE 21ST CENTURY

At Union College, we are guided by innovation and inspired by tradition.

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On the back cover: The Union College Logo (top) and Seal of Minerva (bottom). The adoption of the Seal of Minerva at the College's founding was a radical innovation in that it incorporated a French motto: "Sous le lois de Minerve nous devenons tous freres"—"We all become brothers under the laws of Minerva".
SIXTH SYMPOSIUM ON ENGINEERING AND LIBERAL EDUCATION

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