Educating Engineers to Meet the Grand Challenges

Workshop Book

April 30-May 1, 2014
National Academy of Engineering
Washington, D.C.
Meeting Information

April 29, 2014
National Academy of Sciences building
2101 Constitution Avenue, N.W., Washington, D.C.
Reception: 7:00 p.m. to 9:00 p.m.

April 30, 2014
National Academy of Sciences building
2101 Constitution Avenue, N.W., Washington, D.C.
9:00 a.m. to 5:15 p.m.
Lunch included.

May 1, 2014
National Academy of Sciences building
2101 Constitution Avenue, N.W., Washington, D.C.
9:00 a.m. to 12:30 p.m.
Lunch included.

Contact Information
Cathy Leslie: 303-718-1614
Robin Matsumoto: 703-967-4046
Educating Engineers to Meet the Grand Challenges

The Grand Challenges: In 2007, the National Academy of Engineering (NAE) convened a group of leading technological thinkers and doers to consider the NAE Grand Challenges for Engineering for the 21st Century. They identified 14 remarkable goals. Taken together, these objectives reflect the way engineers enable sustainability, health, security and joy of living. Moreover, they underscore how engineering plays a role in addressing all of the Challenges, while making clear that technology alone cannot solve them. Skillsets beyond engineering fundamentals will be necessary, as well as the context of tackling major issues at a global level.

Programs such as EWB-USA, EPICS, EpiCenter and the Grand Challenge Scholars Program, when taken together, provide just such a background -- incorporating entrepreneurship, service learning, hands-on and global experiences as well as perspectives on culture, behavior and policy. The goal of this workshop is to bring those groups together, along with industry, the startup community, and academia, to strengthen each organization and to integrate them into a whole that is greater than the parts. The resulting consortium of engineering schools will commit to incenting students to integrate several curricular and co-curricular experiences in a way that prepares them for taking on the NAE Grand Challenges for Engineering.

Synergy with other reports and initiatives: The President's Council on Jobs and Competitiveness declared a national goal of graduating 10,000 more engineers a year to meet the needs of US industry and to maintain national economic competitiveness. While industry is asking for more engineers, they are also asking for different kinds of engineers that possess both strong technical skills and a broader set of capabilities that allow them to lead innovation, work across disciplines, and thrive on multi-cultural teams. The NAE described these skills in their report the Engineer of 2020 (NAE, 2004). These characteristics include robust communication, teamwork and leadership skills, along with well-developed social and cultural competencies. Moreover, the scale and timeframe of the NAE Grand Challenges suggest that one cannot expect to know all that is needed over the course of a degree program; rather as suggested in a 2012 UIUC/NAE report, it requires the commitment to and ability for lifelong learning. The American Association of Engineering Societies (AAES) believes that this type of education happens over a lifetime and is making efforts to address some of these same issues.

Presidential support for Grand Challenges: The White House has shown extraordinary support for engineering education and, along with it, Grand Challenge initiatives in such areas as reverse engineering the brain. Tom Kalil, deputy director of the White House Office of Science & Technology Policy, has challenged engineering educators to prepare grand challenge scholars – engineers uniquely prepared with the skillset and mindset to address grand challenges over the course of their careers. In reference to the NAE Grand Challenge Scholars Program, Kalil said “America needs thousands of students participating in this program.” It is recognized that this kind of integrative preparation is extremely demanding and will not be achievable by every engineering student. Nonetheless, a cadre of specially trained and motivated engineers can be transformative for both global society and the American economy. The goal is for x schools to commit to train y students/year over the next 10 years with x and y on the order of 50 and 20.

It became apparent to the leaders of the programs described above that their efforts needed to be combined in order to respond to the presidential imperative of educating students to address Grand Challenges.
The workshop will bring together leaders from academia, associations, startup communities, learning through service organizations, and industry to identify best practices for preparing students to address Grand Challenges.

The intended result will be a consortium of engineering schools committed to shared practices for providing their students/members with an engineering education that includes elements such as learning through service, global perspectives, practical applications, entrepreneurship, and aspects of policy and human behavior.

This commitment to shared practices will be shared with other STEM educators who provide engineering and lifelong learning opportunities.

**April 30, 2014**

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
</tr>
</thead>
<tbody>
<tr>
<td>9:00 – 9:20</td>
<td>Welcome – C.D. Mote, Jr., President, National Academy of Engineering</td>
</tr>
<tr>
<td>9:20 – 9:45</td>
<td><strong>Keynote:</strong> Tom Kalil, Deputy Director for Technology and Innovation White House Office of Science &amp; Technology Policy: The power of educating engineers to meet the Grand Challenges, and the Imperative for Them to Do so.</td>
</tr>
<tr>
<td>9:45 – 10:45</td>
<td><strong>Innovative Experiences:</strong> Students involved with EPICS, Epicenter, EWB-USA, and the Grand Challenges Scholars Programs</td>
</tr>
<tr>
<td></td>
<td>• Epicenter: Karuna Relwani, University of Pittsburgh</td>
</tr>
<tr>
<td></td>
<td>• EPICS: Chris Bosma, Purdue University</td>
</tr>
<tr>
<td></td>
<td>• EWB-USA: Vivaswath Kumar, Rice University</td>
</tr>
<tr>
<td></td>
<td>• NAE Grand Challenge Scholars Program: Daria Nesterovich, Duke University</td>
</tr>
<tr>
<td>10:45 – 11:15</td>
<td>Break</td>
</tr>
<tr>
<td>11:15 – 12:30</td>
<td><strong>Key Factors for Success</strong> - Pillars, Similarities and Differences in Current Programs</td>
</tr>
<tr>
<td></td>
<td>• Bernard Amadei, Founder, Engineers Without Borders-USA</td>
</tr>
<tr>
<td></td>
<td>• Tom Byers, Director, Principal Investigator, Epicenter, Stanford</td>
</tr>
<tr>
<td></td>
<td>• Jenna Carpenter, Chair, NAE Grand Challenge Scholar Program</td>
</tr>
<tr>
<td></td>
<td>• Chad Holliday, Chair, National Academy of Engineering</td>
</tr>
<tr>
<td></td>
<td>• Leah Jamieson, Co-founder, EPICS, Purdue University</td>
</tr>
<tr>
<td></td>
<td>• Kristina Johnson, CEO, Enduring Hydro, LLC</td>
</tr>
<tr>
<td></td>
<td>• MaryBeth Oyer, Director, Engineering Operations, Lockheed Martin</td>
</tr>
<tr>
<td>12:30 – 1:30</td>
<td>Lunch</td>
</tr>
<tr>
<td>1:30 – 2:00</td>
<td>Presentation of Survey Results of Shared Practices</td>
</tr>
<tr>
<td>2:00 – 4:00</td>
<td><strong>Brainstorming of a Shared Vision for the Core Elements of an Academic Program to Educate Engineers to Meet the Grand Challenges</strong></td>
</tr>
<tr>
<td>4:00 – 4:15</td>
<td>Break</td>
</tr>
<tr>
<td>4:15 – 5:15</td>
<td><strong>Summary of Breakouts and Next Steps for Tomorrow</strong></td>
</tr>
</tbody>
</table>
**May 1, 2014**

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>9:00 – 9:15</td>
<td><strong>Welcome</strong> – the Vision of Success – Bernard Amadei, Founder, Engineers Without Border-USA</td>
</tr>
<tr>
<td>9:15 – 10:30</td>
<td><strong>Commit to Act</strong> – What are the shared practices and core elements?</td>
</tr>
<tr>
<td>10:30 – 11:00</td>
<td>Break</td>
</tr>
<tr>
<td>11:00 – 12:30</td>
<td><strong>Commit to Act</strong> – Beyond the MOU – Next Steps as a Community</td>
</tr>
</tbody>
</table>
Participant Bios

Bernard Amadei, Founder, Engineers Without Borders-USA
Dr. Amadei is Professor of Civil Engineering at the University of Colorado at Boulder. He received his PhD in 1982 from the University of California at Berkeley. Dr. Amadei holds the Mortenson Endowed Chair in Global Engineering and served as Faculty Director of the Mortenson Center in Engineering for Developing Communities from 2009-2012. He is also the Founding President of Engineers Without Borders - USA and the co-founder of the Engineers Without Borders-International network. Among other distinctions, Dr. Amadei is the 2007 co-recipient of the Heinz Award for the Environment; the recipient of the 2008 ENR Award of Excellence; an elected member of the U.S. National Academy of Engineering and National Academy of Construction; and an elected Senior Knight-Ashoka Fellow. He holds four honorary doctoral degrees. In 2012, Dr. Amadei was appointed as a Science Envoy by the U.S. Department of State.

Chris Bosma, Purdue University
Chris Bosma is a Beering Scholar and will receive his BS from Purdue in May 2014 in Multidisciplinary Engineering with a focus in Global Humanitarian Aid, a major designed in preparation to meet the Global Challenges in Engineering by combining understandings of relevant technologies and cultural applications. In pursuit of this end, Chris has interned for nine months over three summers in Chambrun, Haiti working for an NGO providing basic needs to impoverished areas in the country. He has been part of EPICS for three years including for his capstone design experience where he led a team to design a model that creates sized solar panel systems for application in rural energy grids. He was a project leader for EPICS teams working in Haiti and Colombia. Next year, he will begin medical school and a Masters in Public Health program in order to better understand systems of healthcare.

Tom Byers, Director, Principal Investigator, Epicenter, Stanford University
At Stanford University since 1995, Professor Tom Byers focuses on education regarding high-growth entrepreneurship and technology innovation. He is the first holder of the Entrepreneurship Professorship endowed chair in the School of Engineering, and is also a Bass University Fellow in Undergraduate Education. He has been a faculty director since the inception of the Stanford Technology Ventures Program (STVP), which serves as the entrepreneurship center for the engineering school. STVP includes the Mayfield Fellows work/study program for undergraduates, the Accel Innovation Scholars for PhD students, and the Entrepreneurship Corner (ECorner) collection of thought leader videos. He is a principal investigator and the director of the Epicenter, which is funded by the National Science Foundation to stimulate entrepreneurship education at all USA engineering and science colleges. He is the co-author of a textbook called Technology Ventures: From Idea to Enterprise that is published by McGraw-Hill.

He is a past recipient of the prestigious Gordon Prize by the National Academy of Engineering in the USA and Stanford University's Gores Award, which is its highest honor for excellence in teaching. He has been a member of advisory boards at Harvard Business School, UC Berkeley, World Economic Forum, Conservation International, and several private enterprises. Tom was executive vice president and general manager of Symantec Corporation during its formation, and started his business career at Accenture. Tom holds a BS in Industrial Engineering and Operations Research and an MBA from UC Berkeley. He also earned a PhD in Business Administration (Management Science) at UC Berkeley.

Jenna P. Carpenter, Chair, National Academy of Engineering Grand Challenge Scholars Program
Dr. Jenna P. Carpenter is the Associate Dean for Undergraduate Studies in the College of Engineering and Science at Louisiana Tech University, where she also directs the Office for Women in Science and Engineering. Dr. Carpenter is PI of Louisiana Tech’s NSF ADVANCE grant and previously served as co-PI on the NSF-funded Women in Engineering ProActive Network (WEPAN) Knowledge Center Project. She also served as Vice President for Professional Interest Councils on the Board of Directors for the American Society for Engineering Education (ASEE) and as Director-at-Large for the ASEE Women in
Engineering Division. Dr. Carpenter currently advises on diversity and mentoring programs for a variety of NSF-funded programs and women-serving STEM organizations. She is an ABET Program Evaluator and is the Chair of the Steering Committee for the National Academy of Engineering Grand Challenge Scholars Program. She is the President-Elect of WEPAN and First Vice-President of the Mathematical Association of America.

Charles O. Holliday, Jr., Chair, National Academy of Engineering

Charles O. (Chad) Holliday, Jr. is the retired Chair of the board of directors and Chief Executive Officer of DuPont, positions he held for 11 years. Under his direction, DuPont established it mission to achieve sustainable growth: increasing shareholder and societal value while decreasing the company’s environmental footprint. DuPont transitioned from a chemical company to a science company incorporating biotechnology with chemistry to solve complex problems in agriculture and materials science.

He serves as a member of the board of directors of Deere & Co., Royal Dutch Shell, CH2MHILL and Bank of America, where he is board Chair. He is Chair of the National Academy of Engineering, an honorary organization of over 2,000 of the most outstanding engineers in America. He is Chair of the Executive Committee of Sustainable Energy for All (SE4ALL), a joint effort of the United Nations and The World Bank to provide more efficient and renewable energy to the world with a focus on the 1.3 billion people without energy access today. Chad is Managing Director at East Meets West Solutions LLC (EMWS), a problem solving company. The unique approach of EMWS is utilizing the power of people that currently exists inside an organization.

Chad is Chairman Emeritus of the board of the U.S. Council on Competitiveness, a nonpartisan, nongovernmental organization working to ensure U.S. prosperity. He chaired the National Academies study at the request of the U.S. Congress: “Research Universities and the Future of America: Ten Breakthrough Actions Vital to our Nation’s Prosperity and Security”. He is a founding member of the International Business Council. He also previously served as Chairman of the following organizations: Catalyst, an organization supporting women’s advancement in leadership positions; The Business Council; Society of Chemical Industry, American Section; and World Business Council for Sustainable Development (WBCSD).

Awards include:
- Conservationist of the Year, National Wildlife Federation, 2013
- Bridge Builders Award, Partners for Livable Communities, 2010
- Nathan W. Dougherty Award, University of Tennessee, College of Engineering, 2009
- George Washington Carver Award, Biotechnology Industry Organization, 2009
- Distinguished Service Award, WBCSD, 2009
- Medal for the Advancement of Research for Visionary Leadership, ASM International, 2004
- International Leadership Award, U.S. Council for International Business, 2003

He received a bachelor’s degree in industrial engineering from University of Tennessee and honorary doctorate from Polytechnic University in Brooklyn, New York, The University of Tennessee and from Washington College. He is a licensed professional engineer (PE).

Leah Jamieson, Co-founder, EPICS, Purdue University

Leah H. Jamieson is the John A. Edwardson Dean of the College of Engineering at Purdue University, Ransburg Distinguished Professor of Electrical and Computer Engineering, and holds a courtesy appointment in Purdue’s School of Engineering Education. She served as 2007 President and CEO of the IEEE and was co-founder and past director of the EPICS – Engineering Projects in Community Service – program.
With colleagues Edward Coyle and William Oakes, Jamieson was awarded the 2005 NAE Bernard M. Gordon Prize for Innovation in Engineering and Technology Education for the creation and dissemination of EPICS and was elected to the U.S. National Academy of Engineering "for innovations in integrating engineering education and community service." She was an inaugural recipient of the National Science Foundation Director's Award for Distinguished Teaching Scholars and has been recognized with the IEEE Education Society’s 2000 Harriet B. Rigas “Outstanding Woman Engineering Educator” Award, the Anita Borg Institute’s 2007 “Women of Vision Award for Social Impact,” the IEEE Richard M. Emberson Award, and the Simon Bolivar medal from the National Ministry of Education of Colombia. She is a member of the American Academy of Arts and Sciences, a Fellow of the IEEE and the American Society for Engineering Education, an Eminent Member of IEEE-Eta Kappa Nu, and an Honorary Member of Tau Beta Pi.

Jamieson's research has focused on speech analysis and recognition; the design and analysis of parallel processing algorithms; and the application of parallel processing to digital speech, image, and signal processing. She has authored over 175 journal papers, conference papers, and book chapters and has co-edited books on Algorithmically Specialized Parallel Computers (Academic Press, 1985) and The Characteristics of Parallel Algorithms (M.I.T. Press, 1987). She has served on editorial boards for the IEEE Transactions on Acoustics, Speech, and Signal Processing, the IEEE Transactions on Parallel and Distributed Systems, and the Proceedings of the IEEE, and is on the Advisory Board of the Journal of Engineering Education.

Jamieson served on the steering committee for the report Changing the Conversation: Developing Effective Messages for Improving Public Understanding of Engineering (NAE, 2008), was co-chair of the American Society for Engineering Education report Innovation with Impact: Creating a Culture for Scholarly and Systematic Innovation in Engineering Education (ASEE, 2012), was a member of the planning committee for the report Advancing Research in Science and Engineering (ARISE-II): Unleashing America’s Research & Innovation Enterprise (American Academy of Arts & Sciences, 2013), and is a member of the study committee for the NRC report on Barriers and Opportunities in Completing 2- and 4-Year STEM Degrees. She is currently President of the IEEE Foundation Board and chairs the Board of Trustees for the Anita Borg Institute. Jamieson received her S.B. in Mathematics from MIT and her PhD in Electrical Engineering and Computer Science from Princeton University. She joined the faculty at Purdue in 1976.

**Kristina M. Johnson, CEO, Enduring Hydro, LLC**

Dr. Johnson served as undersecretary at the Department of Energy in Washington, D.C. from May 2009 until October 2010. Prior to her appointment as undersecretary, Dr. Johnson was provost and senior vice president for Academic Affairs at the Johns Hopkins University (September 2007 to April 2009), and dean of the Pratt School of Engineering at Duke University from July 1999 until September of 2007. She received her BS (with distinction), MS, and PhD in electrical engineering from Stanford University. After a NATO post-doctoral fellowship at Trinity College, Dublin, Ireland, she joined the University of Colorado-Boulder’s faculty in 1985 as an assistant professor and was promoted to full professor in 1994. From 1994 to 1999 Dr. Johnson directed the NSF/ERC for Optoelectronics Computing Systems Center at the University of Colorado and Colorado State University.

Named an NSF Presidential Young Investigator in 1985 and a Fulbright Faculty Scholar in 1991, Dr. Johnson’s academic awards include the Dennis Gabor Prize for creativity and innovation in modern optics (1993) and the John Fritz Medal (2008), widely considered the highest award in the engineering profession. Previous recipients of the Fritz Medal include Alexander Graham Bell, Thomas Edison and Orville Wright. Dr. Johnson was inducted into the Women in Technology International Hall of Fame (2003), and received the Society of Women Engineers Lifetime Achievement Award (2004), the ARCS Foundation Eagle Award for science and education (2009), and the Woman of Vision Award for Leadership by the Anita Borg Institute for Women and Technology (2010).

Dr. Johnson has published 142 refereed papers and proceedings and holds 45 U.S. patents (129 U.S. and international patents) and patents pending, and has received honorary degrees from University of Alabama at Huntsville, Tufts University and Trinity College, Dublin, Ireland.
Recognized for her work in technology transfer and entrepreneurship by the States of Colorado and North Carolina (1997, 2001); she received the 2010 Milton Steward Award from the Small Business Technology Council (SBTC), and is a fellow of the Optical Society of America, International Electronics and Electrical Engineering (IEEE), SPIE, the International Society for Optical Engineering (former board member) and the American Association for the Advancement of Science (AAAS). She also co-founded several companies, including SouthEast Technventures, and ColorLink, Inc., which was sold to RealD, and is responsible for 3D effects in movies such as Avatar, Monster House, Chicken Little, Meet the Robinson’s, Hannah Montana and others.

Dr. Johnson also serves on the board of directors of Boston Scientific Corporation, American Wildlife Foundation, Rocky Mountain Institute, AES Corporation and Cisco Systems.

**Tom Kalil, Deputy Director, Technology and Innovation, White House OSTP**

Tom Kalil is the Deputy Director for Technology and Innovation for the White House Office of Science and Technology Policy and Senior Advisor for Science, Technology and Innovation for the National Economic Council. In this role, Tom serves as a senior White House staffer charged with coordinating the government’s technology and innovation agenda. Prior to serving in the Obama Administration, Tom was Special Assistant to the Chancellor for Science and Technology at the University of California, Berkeley. In 2007 and 2008, Tom was Chair of the Global Health Working Group for the Clinton Global Initiative. Previously, Tom served for 8 years in the Clinton White House, ultimately as the Deputy Assistant to the President for Technology and Economic Policy, and the Deputy Director of the National Economic Council. Tom received a B.A. from the University of Wisconsin at Madison, and completed graduate work at Tufts University’s Fletcher School.

**Vivaswath Kumar, Rice University**

Vivas Kumar is a senior electrical engineering student at Rice University in Houston, Texas. He co-founded with a multi-disciplinary team of students the OwlSpark Accelerator, Rice University’s Entrepreneurship Accelerator program. The program launched during Summer 2013 with a class of 9 industry-diverse companies, and continues as a student-run and operationally sustainable organization. Vivas also has served for several years with the Engineers Without Borders-USA (EWB-USA), beginning as a Project Leader with the Rice University chapter. He currently sits on the Board of Directors of EWB-USA as the Student Representative, and upon graduation will be the Special Assistant to the Executive Director. He has represented the organization in various national and international capacities including speaking engagements and collaborative problem solving with EWB leaders worldwide. Vivas will be starting as a Business Analyst with McKinsey & Company in the Houston Office in Spring 2015.

**C. D. Mote, Jr., President, National Academy of Engineering**

Dr. Mote is a native Californian who earned his BS, MS, and PhD degrees at the University of California, Berkeley in mechanical engineering between 1959 and 1963. After a postdoctoral year in England and three years as an assistant professor at the Carnegie Institute of Technology in Pittsburgh, he returned to Berkeley to join the faculty in mechanical engineering for the next 31 years. He and his students investigated the dynamics, stability, and control of high-speed rotating and translating continua (e.g., disks, webs, tapes, and cables) as well as biomechanical problems emanating from snow skiing. He coined the area called “dynamics of axially moving materials” encompassing these systems. Fifty-eight PhD students earned their degrees under his mentorship.

At Berkeley, he held an endowed chair in mechanical systems and served as chair of the mechanical engineering department from 1987 to 1991 when the National Research Council (NRC) ranked its graduate program effectiveness highest nationally. Because of his success at raising funds for mechanical engineering, in 1991 he was appointed vice chancellor at Berkeley expressly to create and lead a $1 billion capital campaign for the campus that ultimately reached $1.4 billion.
In 1998, Dr. Mote was recruited to the presidency of the University of Maryland, College Park, a position he held until 2010 when he was appointed Regents Professor. His goal for the university was to elevate its self-expectation of achievement and its national and global position through proactive initiatives. During his tenure the number of Academy members among the faculty tripled, three Nobel laureates were recognized, and an accredited school of public health and a new department of bioengineering were created. He also founded a 130-acre research park next to the campus, faculty research funds increased by 150%, and partnerships with surrounding federal agencies and with international organizations expanded greatly. The number of students studying abroad tripled, and he created an annual open house day that has attracted over 100,000 visitors on that day, founded a charitable foundation for the campus whose board of trustees launched a $1 billion capital campaign that reached its goal, and took every student to lunch that wanted to go. The Academic Ranking of World Universities ranked the campus #36 in 2010 and its Engineering School #13 globally.

The NAE elected him to membership in 1988, and to the positions of Councillor (2002-2008), Treasurer (2009-2013), and President for six years beginning July 1, 2013. He has served on the NRC Governing Board Executive Committee since 2009. He chaired the NRC Committee on Global Science and Technology Strategies and Their Effects on US National Security (2009-2010), cochaired the National Academies Government-University-Industry Research Roundtable (2007-2013), and cochaired the Committee on Science, Technology, Engineering, and Mathematics Workforce Needs for the US Department of Defense and the US Industrial Base (2011-2012). He was vice chair of the NRC Committee on the Department of Defense Basic Research (2004) and served on the NRC committee authoring the Rising Above the Gathering Storm reports of 2005 and 2010. He was also a founding member of the FBI’s National Security Higher Education Advisory Board (2005-2010).

Dr. Mote’s recognitions include the NAE Founders Award, the American Society of Mechanical Engineers Medal, and the Humboldt Prize of the Federal Republic of Germany. At the University of California, Berkeley, he was honored with the Distinguished Teaching Award, Distinguished Engineering Alumnus Award, Berkeley Citation, and Excellence in Achievement Award. He is an Honorary Fellow of the American Society of Mechanical Engineers, and Fellow of the American Academy of Arts and Sciences, the American Academy of Mechanics, the Acoustical Society of America and the American Association for the Advancement of Science. He holds three honorary doctorates and two honorary professorships.

Daria Nesterovich, Duke University

Daria Nesterovich is a senior at Duke University majoring in Biomedical Engineering and minoring in Neuroscience. Daria is a 2014 NAE Grand Challenge Scholar at Duke University, as well as a Pratt Engineering Undergraduate Research Fellow. Her primary research interest is neural engineering applied to neural prosthetics. Her research involves quantifying the temporal response of Parkinsonian Limb Rigidity to Deep Brain Stimulation (DBS), with the ultimate goal of formulating an algorithm that will guide the selection of optimal DBS parameters. Upon graduation, she plans to pursue a Ph.D. in Biomedical Engineering and continue working with neural prosthetics. She spent her last two summers in Tanzania with Engineering World Health repairing medical equipment in local hospitals.

MaryBeth Oyer, Director, Engineering Strategy and Operations, Lockheed Martin Corporation

MaryBeth Oyer is the Corporate Director of Engineering Strategy and Operations for Lockheed Martin Corporation in Bethesda, Maryland. In this position, Ms. Oyer is responsible for leading the development, implementation, and execution of the Lockheed Martin Engineering collaboration infrastructure to facilitate communication and information sharing across the 58,000 engineers and technologists throughout the Corporation's business areas.

She also directs Lockheed Martin Engineering's outreach strategy, investment and execution to industry associations, academic institutions, and standards bodies. This includes cultivating the next generation of technical workforce talent through Science, Technology, Engineering, and Mathematics (STEM) education initiatives for the Corporate Engineering & Technology organization, and providing
development resources for the technical workforce that support professional development and encourage career advancement and exploration.

Prior to joining Corporate Engineering, she was the lead for the Mission Systems and Sensors (MS2) software enterprise improvement activities, where she led development of the MS2 Lead SW Engineer and SW Architect Development programs. During a 26-year career with General Electric, Martin Marietta, and Lockheed Martin, Ms. Oyer has held numerous positions of increasing responsibility beginning with her career as a software engineer, spanning engineering development, project leadership, and functional management.

Ms. Oyer holds a Bachelor of Science degree in Computer and Systems Engineering from Rensselaer Polytechnic Institute.

Karuna Relwani, University of Pittsburgh
Karuna Relwani is a senior at Pitt who developed a new offering on that campus called Engineers for Sustainable Medical Development to provide students of all years and majors with practical medical device development experience by shadowing physicians at the world-class University of Pittsburgh Medical Center. Last year alone, 70 students formed 5 teams out of which came 4 patents... one of which the physician refused to return back to the team because he needs it for surgery.
In 2007 the National Academy of Engineering (NAE), with support from the National Science Foundation, convened a panel of leading thinkers from academia, policy, and business with the charge of identifying grand challenges for engineering in the 21st century. Their extraordinary list of 14 challenges (www.engineeringchallenges.org) spans the themes of sustainability, health, security, and joy of living. The challenges are remarkable because they convey, in very human terms, what engineering is and will be about while clearly tapping into social consciousness, showing that these concerns are global, and connecting to behavior, policy, and business. We view the NAE Grand Challenges as a call to action for the profession and, more specifically to this workshop, for engineering education.

The NAE Grand Challenge Scholars Program (www.grandchallengescholars.org) is designed to prepare engineering undergraduates with the skills and mindset to tackle the challenges over the course of their careers. It is now under way at 15 leading universities and many more are developing programs.

In addition to the engineering requirements for their degree, students who complete the program create a portfolio with the following five components: (1) Global education experience; (2) Service learning; (3) Entrepreneurship; (4) Broad general education, including behavior, economics, and policy; (5) Hands-on research or a project related to one of the Grand Challenges.

Upon completion, participating students receive the designation of NAE Grand Challenge Scholar on the transcript from their home institution with the imprimatur of the NAE.

The NAE Grand Challenge Scholars Program leverages and complements existing research and programs in modern engineering education pedagogy. Indeed, most top engineering schools already offer some or all of the five components listed in some form or another. The Grand Challenge Scholars Program encourages students to stretch to do all five rather than a few of the components. Second, it is one of the few programs that recognizes in the transcript the value (demonstrated through research and experience) of out-of-classroom learning. More significantly, overwhelming feedback makes it evident that the process of creating their portfolio, as much as the experiences themselves, helps students appreciate how everything they have been doing in their undergraduate work comes together to prepare them for their careers and to take on important societal challenges. It is also a powerful tool for attracting and retaining a diverse talent pool to the field. Through a national network of Grand Challenge Scholars Programs, we hope to create a community of particularly capable and motivated engineers who will make a difference.

In 2009, the professional survey firm Peter Hart and Associates conducted a survey that measured response of several demographics to questions about the importance of engineering relative to medicine, business and law, before and after respondents heard a brief description of the NAE Grand Challenges for Engineering. The results were dramatic. After hearing just a short description, the respondents who rated engineering as more important/more interesting increased from 40% to 54%. The number who rated engineering as much more important/interesting increased from 18% to 27%. The increases were largest among women and underrepresented groups. The Grand Challenges Scholars Program further taps into that interest once the students are on a college campus. (The complete survey can be found here: http://summit-grand-challenges.pratt.duke.edu/national-survey)

The NAE Grand Challenges for Engineering are more than a list. They are a powerful framing of what the field of engineering is and will become, that excites and engages young people and the public alike. Today’s generation of students is more motivated than ever to change the world and help people. The Grand Challenges provide an opportunity to “change the conversation” about engineering and to enhance engineering education in ways that give students at all levels the skills and mindset to solve them.
About Engineers Without Borders USA (EWB-USA)

Engineers Without Borders USA (EWB-USA) is a nonprofit humanitarian organization established to support community-driven development programs worldwide through partnerships that design and implement sustainable engineering projects.

EWB-USA’s vision is a world in which the communities they serve have the capacity to sustainably meet their basic human needs. Today, more than two billion people lack access to the most basic things—clean drinking water, adequate sanitation, reliable passage to local markets and more.

At its core, EWB-USA’s model is rooted in practical and sustainable engineering solutions. In order to be successful, EWB-USA considers the socio-cultural dimensions of the community, local project ownership and other requirements for long-term sustainability. EWB-USA programs are full partnerships with a host community and one or more local non-governmental organizations (NGOs). EWB-USA members work alongside local community members to successfully build, maintain and monitor each project.

EWB-USA members are in remote corners of the world right now working hard to make EWB-USA’s vision a reality. As a result of EWB-USA’s ongoing projects, children can cross sturdy bridges to attend school, local clinics have consistent supplies of electricity, and accessing clean water isn’t a full-day chore for families.

EWB-USA’s vision is ambitious but achievable and everyone has an important role to play—including you. Every contribution to their cause helps EWB-USA engineer a better world. Visit www.ewb-usa.org to learn more and get involved.

Fast Facts:

- EWB-USA was founded in 2002 at the University of Colorado - Boulder
- Ten years later, EWB-USA currently has more than 13,800 members
- EWB-USA has 303 student and professional chapters across the United States
- EWB-USA has impacted more than 2,332,290 lives through EWB-USA projects
- In 2012, 1,420 EWB-USA members traveled to 35 countries.
- Project areas include water, energy, agriculture, civil works, structures, sanitation and information systems
- Since 2002, EWB-USA has worked in more than 47 countries around the world
- EWB-USA’s Executive Director is Cathy Leslie, P.E., F. ASCE
University Innovation Fellows

The University Innovation Fellows are part of a national movement to ensure that students gain the necessary attitudes, skills and knowledge required for them to compete in the economy of the future. These student leaders from schools around the country work with their peers on campus to increase student engagement with entrepreneurship, innovation, creativity, design thinking and venture activity. The program is run by the National Center for Engineering Pathways to Innovation (Epicenter), funded by the National Science Foundation and directed by Stanford University and the National Collegiate Inventors and Innovators Alliance (NCIIA).

WHY STUDENTS BECOME UNIVERSITY INNOVATION FELLOWS

Fellows realize that the pursuit of an entrepreneurial mindset is not something that should be viewed as optional; all students must acquire these skills in order to achieve their full potential. Fellows are working to create opportunities at their schools and motivate peers to engage in experiential and project-based learning to help them pursue promising career paths and serve as agents of change in all their endeavors.

CURRENT FELLOWS

The majority of our 110 Fellows are undergraduate engineering majors. As interdisciplinary collaboration is vital, we also have students pursuing graduate degrees and undergraduates majoring in fields such as biotechnology, biochemistry, business, entrepreneurship and child psychology. In the 2012-2013 academic year, the Fellows hosted 124 events and activities, reaching more than 9,000 students and faculty. Fellows have founded entrepreneurship clubs, hosted speakers, created maker spaces, collaborated with faculty on new classes, started student-led venture funds, and organized competitions.

PARTNERING

The training that students receive focuses on their current campus ecosystem, the assets within the ecosystem and the gaps they should work to solve. Students are trained to collaborate with others student leaders and faculty who have shared interests, including NAE Grand Challenge Scholars, Engineers Without Borders (EWB) and Engineering Practices Introductory Course Sequence (EPICS).

LEARN MORE

Visit dreamdesigndeliver.org to find out how students can apply, and how faculty and administrators can sponsor students. Email Humera Fasihuddin at humera@nciiia.org for more information.
EPICS Program

Engineering Projects in Community Service (EPICS) is an engineering-based design program that operates in a service-learning context. In EPICS, students earn academic credit for their participation in multidisciplinary design teams that solve technology-based problems for not-for-profit organizations in the local and global community. The student’s learning objectives can be summarized as equipping students with the broad set of skills needed for leadership in today’s global economy. These skills include technical skills, such as understanding and applying the design process, as well as the broad set of professional skills, including oral and written communication, teamwork and leadership, understanding of ethical issues, and an awareness of social and cultural issues and contexts.

EPICS students experience the entire design process, from needs assessment and problem identification to delivery, service, and potentially redesign in a real world setting. The goal is that all EPICS projects will be fielded and used by their non-profit community partners. The fact that the designs will be used in the community creates the real world environment where the designs must not only work, but be durable, easy to maintain, and accompanied by appropriate manuals and documentation. To create this authentic experience, the EPICS curricular structure breaks the traditional semester barriers and supports designs over several semesters. Students may register for EPICS for multiple semesters and often do so for multiple years. EPICS uses an experiential learning approach with students as the leaders of the design teams and the faculty, instructors, and industry volunteers as advisors. The teams are large, from 8-20, offering many opportunities for students to assume leadership positions. The students create and manage project plans, budgets, the design and development process, and the relationship with their community partner. This structure requires students to communicate frequently with a wide range of audiences.

EPICS was one of the first curricular engineering service-learning programs. It pioneered the long-term engagement with community partners and long-term student design experience. The community context offers a wealth of opportunities for students to explore ethical and social context issues related to their designs as well as being a tool to attract and retain students who are underrepresented within engineering. Since its inception, educational research has emerged which supports the educational principles and practices on which it is based. Research efforts conducted in EPICS have included impact on alumni after they enter the workforce, fundamental research into the development of human centered design skills, retention and motivation among diverse students, development of professional skills, and ethical reasoning.

EPICS has disseminated the model to other institutions through workshops and shared curricular materials. There are 21 active EPICS programs within the U.S. and abroad. EPICS has adapted the model to pre-university education through EPICS High with 50 active EPICS High schools in 11 states within the U.S. engaging more than 2200 students in community-based designs. 44% of the students are female and more than 50% from traditionally underrepresented populations. IEEE has adapted EPICS to global projects with more than 50 pre-university and university projects active or completed globally with support from IEEE volunteers.
At the AAES Board meeting November 29, 2012, Dr. Debasish Dutta, Associate Provost and Dean of the Graduate College, University of Illinois at Urbana-Champaign (UIUC), provided an overview of a 2012 NSF supported study on lifelong learning for engineering professionals, an outgrowth of a June 2009 National Academy of Engineering (NAE) workshop in Washington, DC. In his forward to the report, NAE President, Charles Vest, suggested that the United States is facing a crisis in its engineering workforce just as global competition is becoming very intense. Our nation's competitiveness and growth in a global economy hinge fundamentally on its ability to keep its STEM workforce at the technological forefront. Given the decentralization of American academic and governmental institutions, broad partnerships among leaders in industry and academia, federal and state-level policymakers, and engineering organizations could produce a US-based version of the infrastructure that's needed. Such partnerships, precisely because they are not necessarily tied to long-term, centralized efforts to formalize training, would be effectively responsive to the rapidly (and unpredictably) changing marketplace that the 21st century engineer will increasingly face.

The NAE report calls for a coordinated effort between industry, academia, professional societies, and policymakers to develop a national framework for lifelong learning in engineering ASAP. Specifically, the report relayed a call to action for professional societies to lead the way. Considering the report and presentation, the AAES Board came to consensus that it could begin to affect change in this area by forming a task group and the Lifelong Learning Task Group was born.

The task group is now an official working group within AAES with EWB-USA as the lead society to serve as a forum to share best practices and data and discuss issues and opportunities related to the activities of the member societies to enhance the quality of lifelong programs in the United States. Participating societies include AIME (and its Member Societies, SME and SPE), ASCE, ASEE, NCEES, NSPE, SAME, SWE. For more information, contact Cathy Leslie, Executive Director, EWB-USA, at cathy.leslie@ewb-usa.org and 1-720-204-3204.