NSF Workshop on Sustainable Manufacturing: Urgent Research Needs and Multidisciplinary Collaboration

The National Science Foundation
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Organized by the NSF RCN-SEES Sustainable Manufacturing Advances in Research and Technology (SMART) Coordination Network

BIOGRAPHICAL SKETCHES

NSF OFFICERS

JoAnn S. Lighty
Director, Division of Chemical, Bioengineering, Environmental, and Transport Systems (CBET)
National Science Foundation
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JoAnn S. Lighty, director of the Division of Chemical, Bioengineering, Environmental, and Transport Systems (CBET) in the Directorate for Engineering (ENG), is also professor and former chair of the department of chemical engineering at the University of Utah. She joined the National Science Foundation (NSF) in October 2013. The division supports fundamental engineering research, in areas such as advanced biomanufacturing, clean energy, sustainability, transport and reaction fundamentals, synthetic biology, and neuroengineering, with an annual budget of approximately $175M. At the University of Utah, Lighty served in a variety of leadership capacities. She led the department of chemical engineering from 2007 to 2013 and served as associate dean for academic affairs for the College of Engineering from 1997 to 2004. During the intervening years, Lighty directed the Institute for Combustion and Energy Studies (now the Institute for Clean and Secure Energy).Lighty's research has focused on the formation of fine particulate matter from combustion systems; the fate of mercury in fossil fuel combustion; carbon capture technologies; and on the formation and oxidation of soot. She received her Ph.D. and B.S. in chemical engineering from the University of Utah. Lighty has authored or co-authored more than 60 publications and 6 book chapters based on her research and expertise. While serving on committees for the Environmental Protection Agency and the National Research Council, she contributed to reports on important national issues including air

quality, hazardous waste management, and water quality. Lighty has received numerous honors and recognitions, including educator awards from the Society of Women Engineers and the Utah Engineering Council, and election to Fellow by the American Institute of Chemical Engineers.

George Hazelrigg
Deputy Director, Division of Civil, Mechanical and Manufacturing Innovation (CMMI)
National Science Foundation
Arlington, VA 22230

George Hazelrigg enjoyed designing and building things when he was young, so he decided to go to college to study engineering. He obtained a BS in mechanical engineering from Newark College of Engineering (now New Jersey Institute of Technology) and went to work for Curtiss-Wright. There, he found that his education had utterly destroyed his abilities to do engineering design. So he felt it necessary to get a master's degree. He completed an MS in mechanical engineering, also from NCE, but still hadn't regained his design abilities. While getting his MS, however, he did some teaching and liked it. So he figured that, if he couldn't do design, the next best thing would be to teach it. Five years later, he had obtained MA, MSE, and PhD degrees in aerospace engineering from Princeton University. Now, in addition to not knowing how to do design, he couldn't teach it either. For the next 25 years, he roamed industry and academe in an attempt to understand the theory of engineering design, including time spent at the Jet Propulsion Laboratory, General Dynamics, Princeton University and a consulting firm of which he was a co-founder. He also spent a year in Korea helping to found the Systems Engineering Department of Ajou University. He joined the National Science Foundation in 1982 and, in 1996, became program director for the Engineering Design program where, for eight years, he provided support to others in the field. In January, 1996, he did a stint as Station Science Leader of the U.S. South Pole station. In 2004, he became Program Director for the Manufacturing Machines and Equipment program and, since the formation of the CMMI Division, he has been Deputy Division Director. More recently, he becomes Program Director of the Sensors and Sensing Systems program. For relaxation, he spends his weekends soaring over the Shenandoah Valley, and he is a certified flight instructor in gliders (CFI-G) with about 1,800 total flying hours.

Bruce Hamilton
Director, Environmental Sustainability Program, CBET
National Science Foundation
Arlington, VA 22230

Bruce Hamilton is a program director at the National Science Foundation. Among various activities at NSF, he is program director for Environmental Sustainability in the CBET Division of NSF's ENG directorate, and a member of the cross-NSF Working Groups for both INFEWS (Innovations at the Nexus of Food-Energy-Water Systems) and CRISP (Critical Resilient Infrastructure Systems and Processes). Additionally, he a program manager for the RCN-SEES grant on sustainable manufacturing. He is also a program director for CyberSEES, Cyber-Physical Systems (CPS), and the Engineering Research Center (ERC) program. In 2012, he received the NSF Director's Award for Meritorious Service in the area of sustainability. Before joining NSF 18 years ago, Bruce held R&D management positions in the chemical and biotechnology industries for 20 years. He has a B.S. in Chemical Engineering and a Ph.D. in Biochemical Engineering, both from MIT.

Khershed Cooper
Director, Nanomanufacturing Program, CMMI
National Science Foundation
Arlington, VA 22230

Dr. Khershed Cooper is Program Director for the Nanomanufacturing and Scalable Nanomanufacturing Programs at NSF. He is also a PD for the Center for Hierarchical Manufacturing NSEC and a co-PD for the NASCENT NERC. He is a SME for the NNMIIs (National Network for Manufacturing Innovation Institutes) and is a member of NSTC's NSET sub-committee and co-chair of its NICE working group. Prior to joining NSF, Dr. Cooper was Program Officer at ONR and Senior Research Scientist at NRL. While at ONR he managed the Manufacturing Science Core Program, and MURI, YIP, STTR/SBIR and ManTech projects in various areas of manufacturing primarily additive manufacturing and nanomanufacturing. His research work at NRL was in the areas of materials science and processing, specifically metallic and nanostructures. Prior to joining NRL, he worked as a scientist in an industrial research laboratory performing corporate-sponsored research. Dr. Cooper received his BTech from IIT-Mumbai, his MS and PhD from the University of Wisconsin-Madison. He is an advisor to the SFF Symposium, the Nanotechnology for Defense Conference, and the SPIE Nanomanufacturing Instrumentation, Measurement and Standards Symposium. He serves on the editorial boards of the Rapid Prototyping and Additive Manufacturing/3D Printing Journals. He has nearly 150 publications, over 150 invited talks, 70 contributed presentations, one book and one patent. He has organized and participated in several symposia and workshops in additive and nanomanufacturing. He is a Fellow of ASM International and a recipient of its prestigious Burgess Memorial Award. He has also received Best Paper and other awards.

Zhijian Pei
Director, Manufacturing Machines and Equipment Program, CMMI
National Science Foundation
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ZJ Pei is the program director of the Manufacturing Machines and Equipment program at NSF. He is also a professor in the Department of Industrial and Manufacturing Systems Engineering at Kansas State University (KSU). He received his Ph.D. in Mechanical Engineering from University of Illinois at Urbana- Champaign and has four years of industrial experience. He is an ASME Fellow and has received NSF CAREER award (2004), Commerce Bank Distinguished Graduate Faculty Award (2011, KSU), Iman Outstanding Faculty Award for Research (2013, KSU Alumni Association), Frankenhoff Outstanding Research Award (2008, KSU College of Engineering), and Outstanding Senior Scientist Award (2010, KSU Chapter of Sigma Xi). He serves or has served as an associate editor for three journals (Journal of Manufacturing Science and Engineering, Machining Science and Technology, and Journal of Manufacturing Processes) and an editorial board member for seven journals (including International Journal of Machine Tools and Manufacture). He has published more than 140 journal papers, 140 conference papers, three patents, and eight book chapters. He has graduated 12 Ph.D. students with six of them working in academia and the rest in industry.

Chris Paredis
Director, Programs of Engineering and Systems Design (ESD) and
Systems Science (SYS), CMMI
National Science Foundation
Arlington, VA 22230

Dr. Chris Paredis is Program Director for the Engineering and Systems Design (ESD) and Systems Science (SYS) programs at the National Science Foundation. He is also Professor of Mechanical Engineering in the G.W. Woodruff School of Mechanical Engineering, and in the H.M. Stewart School of Industrial and Systems Engineering at Georgia Tech, Atlanta, USA. He is a Woodruff Faculty Fellow and Director of the Model-Based System Engineering Center. He holds graduate degrees in Mechanical Engineering from the Catholic University of Leuven (Belgium) and in Electrical and Computer Engineering from Carnegie Mellon University. Dr. Paredis' research focuses on Model-Based Systems Engineering, combining aspects of decision theory, information technology, simulation, and systems theory to support the design of complex mechatronic systems. He is past Chair of the ASME Computers and Information in Engineering division, and has served as Conference Chair for the 2013 Conference on Systems Engineering Research (CSER'13) and the 2007 Computers and Information in Engineering Conference (CIE'07). Dr. Paredis has served as Associate Editor for the SAE Journal of Commercial

Vehicles and the ASME Journal of Mechanical Design. He currently serves as co-Editor of the ASME book series, "Advances in Computers and Information in Engineering Research." He received the 2007 CETL/BP Junior Faculty Teaching Excellence Award, the 2007 SAE Ralph R. Teetor Educational Award, and the 2011 ASME CIE Excellence in Research Award.

DOE AND DOC OFFICERS

Mark Johnson
Director, Advanced Manufacturing Office (AMO)
Office of Energy Efficiency and Renewable Energy (EERE)
U.S. Department of Energy
Washington DC 20585

Mark Johnson, Ph.D., serves as the Director of the Advanced Manufacturing Office (AMO) in the Office of Energy Efficiency and Renewable Energy (EERE). AMO is focused on creating a fertile innovation environment for advanced manufacturing, enabling vigorous domestic development of new energy-efficient manufacturing processes and materials technologies to reduce the energy intensity and life-cycle energy consumption of manufactured products.

Previously, Mark served as a Program Director in the Advanced Research Projects Agency–Energy (ARPA-E) where he had the longest tenure in that post—from ARPA-E's formation in 2010 to mid-2013. At ARPA-E, Mark led initiatives to advance energy storage and critical materials, as well as projects in small business, advanced semiconductor, novel wind architectures, superconductors and electric machines.

He also served as the Industry and Innovation Program Director for the Future Renewable Electric Energy Delivery and Management (FREEDM) Systems Center. This is a National Science Foundation Gen-111 Engineering Research Center targeting the convergence of power electronics, energy storage, renewable resource integration and information technology for electric power systems.

Mark joins EERE on assignment from North Carolina State University, where he is an Associate Professor of Materials Science and Engineering. His research has focused on crystal growth and device fabrication of compound semiconductor materials with electronic and photonic applications. Mark also taught in the Technology, Entrepreneurship and Commercialization program jointly between the NC State Colleges of Management and Engineering. In addition to his academic career, Mark is an entrepreneur and early stage leader in Quantum Epitaxial Designs (now International Quantum Epitaxy), EPI Systems (now Veeco) and Nitronex (now GaAs Labs).

Mark has a bachelor's degree from MIT and a Ph.D., from NC State, both in Materials Science and Engineering.

Michael F. Molnar
Director, Advanced Manufacturing National Program Office
National Institute of Standards and Technology
U.S. Department of Commerce
Gaithersburg, MD 20899

Mike Molnar is the founding director of the interagency Advanced Manufacturing National Program Office (AMNPO), with a mission to foster industry-led partnerships and to form a "whole of government" approach to strengthen competitiveness and innovation in U.S. manufacturing. This interagency team is responsible for designing and establishing the National Network for Manufacturing Innovation (NNMI), a Presidential and Congressionally authorized initiative with now nine institutes under formation.

Mike likes to be known simply as "a manufacturing guy from industry" with 30 years of industry experience in advanced manufacturing and technology development. His engineering passion is with "designing and building things" – with a career in creating flexible automation, assembly and test systems and launching state-of-the-art manufacturing plants. His corporate career in manufacturing research emphasized industry consortia and partnering with academia and federal agencies. He has served as a federal fellow in the White House Office of Science and Technology Policy, and was elected a fellow of both the American Society of Mechanical Engineers (ASME) and the Society of Manufacturing Engineers (SME). Mike holds an executive MBA from Notre Dame, and a BS-Mechanical and MS-Manufacturing Systems degrees from the University of Wisconsin – where he was recently recognized with the University's Outstanding Engineering Alumni Award. He's very active in professional societies with over 30 years of leadership roles with ASME and SME – most recently as the 2014 president of SME.

WORKSHOP ATTENDEES

Luke E. K. Achenie
Professor
Department of Chemical Engineering
Virginia Polytechnic Institute and State University
Blacksburg, VA 24061

Dr. Luke E.K. Achenie is a Professor of Chemical Engineering at Virginia Polytechnic and State University. He holds a joint appointment as Professor of Health Sciences at the Virginia Tech Faculty of Health Sciences. Dr. Achenie is a member of several major professional societies and has served on several federal peer-review panels. He served as the Program

Director of the Reaction and Engineering Program within the NSF Division of the National Science Foundation in the 2012 calendar year.

Dr. Achenie's work is in several different interdisciplinary fields including process design, molecular modeling, multi-scale modeling, bioinformatics, drug-delivery and uncertainty analysis. He is a pioneer in molecular design, a subset of computer aided product design. This is an advanced simulation model that addresses the systematic design of chemical compounds with desired physical and chemical properties, with the goal of producing computer based "designer" compounds. Molecular design is a valuable tool used to aid bench chemists in narrowing down the range of compounds to synthesize for particular applications. Dr. Achenie has also worked to develop new formulations for flexibility analysis that takes into account accuracy of uncertain parameters in physical models. This theory has been applied to the analysis of the direct methanol Proton Exchange Membrane (PEM) fuel cell, an area that has attracted a lot of research interest over the last decade for its use in portable electronics, as well as in stationary and mobile power generators and electric vehicles.

His current research effort is in molecular dynamics (MD) modeling, computational modeling of fast pyrolysis of biomass and systems biology. In systems biology he has collaborative efforts in (1) modeling of oral drug delivery, (2) modeling of drug transport across the blood-brain-barrier, and (3) machine learning algorithms for early diagnosis of autism in little children.

Dr. Achenie is honored by (1) induction into Connecticut Academy of Engineering (2007), (2) Board Member, Scientific Journals International (SJI) (2008 to present), (3) Board Member, AIChE Board of Trustees (2009 to present), (4) AIChE Award for Excellence & Service as Minority Affairs Committee Chair (2004), and (5) The Rogers Outstanding Teaching Award (1992, 1997).

Miguel Bagajewicz
Sam Wilson Professor
Department of Chemical, Biological and Materials Engineering
University of Oklahoma
Norman, OK 73072

Dr. Bagajewicz is the Sam Wilson Professor at the University of Oklahoma. He has a bachelor in Chemical Engineering from Argentina and a Master of Science and Ph.D. from the California Institute of Technology, USA. In Argentina, he was a member of the staff of the National Research Council and an associate professor in the University.

He worked at Simulation Science (California), where among other duties he participated in the development of a data reconciliation software (Datacon), being responsible for one of its releases. While at Simsci, Dr. Bagajewicz participated in onsite training and problem solving of data reconciliation as well as several other duties related to Simsci's process simulator. He is the

author of several publications on data reconciliation and gross error detection as well as in instrumentation network design and upgrade. On this last subject, he is the author of a book that reviews the field and presents the cost-optimal paradigm. In the area of sensor network design he has developed one of the first cost models, has offered new definitions for software accuracy, has shown how to calculate the value of information and has recently proposed a new paradigm in sensor network design consisting of maximizing an unconstrained objective (value-cost). In his second book, he reviews the old and new paradigms.

Dr. Bagajewicz is also active in the field of heat integration, with the development of new methodologies. He has introduced new concepts in the field of heat integration among many plants, with illustration on real systems. He has also developed new techniques to schedule heat exchanger network cleaning and throughput de-bottlenecking process through proper cleaning schedules. Dr. Bagajewicz has also contributed to the field of water management in process plants. He developed several methods and proposed computationally advantageous properties of these systems. He is the author of a review paper in the area (CCE, 2000). Dr. Bagajewicz has also made contributions to the field of crude fractionation, revitalizing the design concepts in the subject. He showed the relationships between column design and operations and heat recovery (these are energy intense units), and holds a patent for a method that increases the yield of distillates in these columns at no extra energy expenditure. He is also the inventor of the Acoustic Mass Pump, a device that promises high energy savings in difficult chemical species separations. A recent area of research is product design, where he has proposed the merging with microeconomics with traditional product design. Finally, in the field of process design and capacity planning Dr. Bagajewicz has developed new techniques for financial risk management with applications to heat exchanger networks, water systems, investment planning and a few others.

He has more than 205 publications and has served as member of various scientific committees of international conferences and has served as coordinator of AICHE area 10c. He is the member of the advisory boards of IECR and Recent Patents on Engineering.
His full vita is available at http://www.ou.edu/class/che-design/

Bhavik R. Bakshi
Professor
Lowrie Department of Chemical and Biomolecular Engineering
The Ohio State University
Columbus, OH 43210

Bhavik R. Bakshi is a Professor of Chemical and Biomolecular Engineering at The Ohio State University. He also holds appointments in Civil, Environmental and Geodetic Engineering at OSU and as a Visiting Professor at the Indian Institute of Technology in Mumbai, India. His research is motivated by the need for a sustainable engineering that stays within nature's capacity

to supply needed goods and services, and prevents unintended harm to society and the environment. Such an engineering must also enhance human well-being and be socially acceptable. His work is developing systematic and scientifically rigorous methods for understanding the interaction between engineering and the environment and for developing decisions and designs toward sustainability. This includes methods for analyzing the life cycle of existing and emerging technologies, and for designing synergistic networks of technological and ecological systems. He has published extensively, is on the editorial boards of various academic journals, and teaches short courses to practicing professionals on various aspects of sustainability. His work has been recognized through awards from the American Institute of Chemical Engineers, the U.S. National Science Foundation, and several best paper awards at various conferences. Prof. Bakshi received his Bachelor of Chemical Engineering degree from the University of Bombay, MS in Chemical Engineering Practice and Ph.D. in Chemical Engineering from the Massachusetts Institute of Technology. While in graduate school, he also completed a minor in Technology and Environmental Policy and conducted research at Harvard's Kennedy School of Government.

John Bradburn
Global Manager of Waste Reduction
General Motors
Detroit, MI

John is manager of global waste reduction at General Motors. In this role, he leads the company's landfill-free initiative, which has resulted in an industry leading 122 GM operations around the world that reuse, recycle, and convert to energy all waste from daily operations. John is an expert in waste reduction and recycling, and is dubbed GM's MacGyver for devising unconventional uses for everyday waste. He frequently mentors other companies pursuing zero-waste goals.

John's responsibilities also include directing GM's design-for-the-environment program, implementing sustainable processes and technologies that reduce environmental impact and costs. He collaborates with suppliers, product and manufacturing engineers, and external stakeholder groups.

Under John's leadership, GM recycled or reused 84 percent of its manufacturing waste generated globally through various resource conservation efforts in 2013. Between 2000 and 2010, the company reduced non-recycled manufacturing waste by 73 percent.

John frequently speaks at various sustainability-focused events and has been recognized by the Society of Automotive Engineers with four Environmental Excellence in Transportation awards for material development and reuse and recycling projects. In 2015, John received the Presidential Lifetime Service Award from the Office of the President of the United States for sustainability services to youth.

John serves as the materials efficiency work group chairman for the Suppliers Partnership for the Environment, a forum GM helped found where suppliers share environmental best practices and sustainability initiatives. He is the executive advisory committee chairman for the U.S. Business Council for Sustainable Development. He volunteers regularly to the Boy Scouts of America, mentoring youth in sustainability efforts for 25 years running.

John has worked for GM for more than 35 years. He earned a Master of Science degree in hazardous waste management from Wayne State University in Detroit in 1995 and a Bachelor of Science degree in conservation from Northern Michigan University in 1978. He is a Certified Hazardous Materials Manager and a member of the Society of Automotive Engineers.

Jose Bravo
Chief Scientist, Thermodynamics and Physics Separations
Department of Chemistry and Catalysis
Shell International Exploration & Production
Shell Technology Center Houston
Houston, TX 77082

José Bravo is Chief Scientist Separations and General Manager Chemistry and Catalysis in Emerging Technologies. He obtained a graduate degree in Chemical Engineering from the University of Texas at Austin after undergraduate studies at the Universidad Iberoamericana, Mexico City. He has worked as an academic in charge of the Separations Research Program at UT Austin and as an independent consultant in the area of Separations, Process Development and Design. He is a Member of the Executive Committee and VP of Fractionation Research Inc. He joined Shell in 1995 and has had several assignments, e.g. Distillation Specialist, Manager of Separations Research and Account Executive for the Americas. He currently works on Hydrocarbon Recovery and Sustainability for Oil Sands, CCS and Recycle and Thermodynamics of High Pressure Sour Gases.

Prodromos Daoutidis
Professor and Executive Officer
Chemical Engineering and Materials Science
University of Minnesota
Minneapolis, MN 55455

Prodromos Daoutidis is Professor and Executive Officer in the Department of Chemical Engineering and Materials Science at the University of Minnesota. He received aDiploma degree in Chemical Engineering (1987) from the Aristotle University of Thessaloniki, M.S.E. degrees in

Chemical Engineering (1988) and Electrical Engineering: Systems (1991) from the University of Michigan, and a Ph.D. degree in Chemical Engineering (1991) from the University of Michigan. He has been on the faculty at Minnesota since 1992, having served as Director of Graduate Studies in Chemical Engineering (1998-2004) and Chair of the Physical Sciences Policy and Review Council (2000-03), while he has also held a position as Professor at the Aristotle University of Thessaloniki (2004-06). He is the recipient of several research and teaching awards and recognitions, including the NSF CAREER Award, the PSE Model Based Innovation Prize, the Ted Peterson Award of the CAST Division of AIChE, the George Taylor Career Development Award, the McKnight Land Grant Professorship, the Ray D. Johnson / Mayon Plastics Professorship and the Shell Chair at the University of Minnesota. He has also been a Humphrey Institute Policy Fellow. He has served as Program Coordinator in Areas 10B and 10D of the CAST Division of AIChE, and as AIChE Director in AACC. He is the Associate Editor for Process Systems Engineering in the AIChE Journal. He has co-authored four books, over 200 refereed papers, and has supervised 33 graduate students and post-docs, 7 of which currently hold academic positions. His research interests are in design and control of energy systems, process and plant-wide control, control of nonlinear and distributed parameter systems, model reduction, dynamics and control of chemical and biological systems, and control of advanced materials processing.

Cliff I. Davidson
Thomas and Colleen Wilmot Professor of Engineering
Program Director, Environmental Engineering
Department of Civil and Environmental Engineering and
Syracuse Center of Excellence in Environ. & Energy Sys.
Syracuse University
Syracuse, NY 13244

Dr. Davidson received his B.S. in Electrical Engineering from Carnegie Mellon University, and his M.S. and Ph.D. degrees in Environmental Engineering Science from California Institute of Technology. Following his PhD, he joined the Carnegie Mellon faculty in the Department of Civil and Environmental Engineering and the Department of Engineering and Public Policy where he served for 33 years. He joined Syracuse University in 2010. His areas of research include modeling and measurement of airborne particles, removal processes for airborne particles from the atmosphere, historical air pollution trends, contamination of water by air pollutants, characterization and use of green infrastructure for urban stormwater management, and methods for improving engineering education. Most recently, he has studied lay people's perceptions of technology and their understanding of the environmental impact of their daily activities. He has written and edited a number of books and has over 100 articles in refereed journals. He is the Founding Director of the Center for Sustainable Engineering, a partnership

among several universities led by Syracuse University. He is active in several professional societies, including service on committees of the American Association for Aerosol Research (AAAR), the Association of Environmental Engineering and Science Professors (AEESP), the American Society of Civil Engineers (ASCE), and the American Association for Engineering Education (ASEE). He served as President of the AAAR during 1999-2000. He has received awards for outstanding teaching at Carnegie Mellon and Syracuse University and research awards from several organizations, and he is a Fellow of the AAAR and the AEESP.

Bryony DuPont
Assistant Professor
School of Mechanical, Industrial, and Manufacturing Engineering
Oregon State University
Corvallis, OR 97331

Bryony DuPont is an Assistant Professor in the School of Mechanical, Industrial, and Manufacturing Engineering at Oregon State University (Corvallis, Oregon, USA). Dr. DuPont's research focuses on the development and application of computational design tools for solving real-world sustainability issues. Tackling these challenges computationally - like the need for renewable energy systems optimization, collaborative energy systems design, and sustainable product development - can help in breaking down barriers to implementation and boost the acceptance of sustainable design by providing an accurate picture of the behavior of the system prior to its development. Dr. DuPont's work is primarily focused on creating advances in design automation that help product developers better understand life-cycle impact the early design phase, enabling product developers to make substantive sustainable design decisions as part of the traditional design process. She completed her BS in Mechanical Engineering from Case Western Reserve Univeristy (2008), and her MS and PhD in Mechanical Engineering as part of the Integrated Design Innovation Group at Carnegie Mellon University (2010 and 2013, respectively).

Matthew Eckelman
Assistant Professor
Department of Civil and Environmental Engineering
Northeastern University
Boston, MA 02115

Matthew Eckelman is an Assistant Professor at Northeastern University in Civil and Environmental Engineering, with secondary appointments in Chemical Engineering and Public Policy. His research focuses on large-scale modeling of industrial resource use and emissions

and the environmental impacts and benefits of novel materials and products. Manufacturing research includes the application of emissions modeling and life cycle assessment in the metals, chemicals, energy, and water sectors. Dr. Eckelman consults regularly on sustainability-related projects with a range of businesses, non-profit institutions, and government agencies, and has served on panels at the National Academies and the National Institute for Standards and Technology on sustainable construction and manufacturing issues. He is the Chief Technical Officer of Sustainability A to Z, LLC, a green engineering firm focused on sustainable manufacturing, and sits on the Advisory Board of the Resources Optimization Initiative in India. Dr. Eckelman previously worked as an engineer with the Massachusetts Executive Office of Environmental Affairs and with Design that Matters, a Boston-area product design company. Dr. Eckelman was a co-recipient of the Laudise Prize in Industrial Ecology in 2013 and awarded an NSF CAREER award in environmental sustainability in 2015. He holds a B.A. in Physics and Mathematics from Amherst College and a doctorate in Chemical and Environmental Engineering from Yale, where he was affiliated with the Center for Industrial Ecology and the Center for Green Chemistry and Engineering.

Dr. Mario Richard Eden
Department Chair
Joe T. & Billie Carole McMillan Professor
Director, NSF-IGERT on Integrated Biorefining
Acting Director, Alabama Center for Paper and Bioresource Engineering
Department of Chemical Engineering
Auburn University, AL 36849

Dr. Mario Eden is the Department Chair and Joe T. & Billie Carole McMillan Professor in the Department of Chemical Engineering at Auburn University. Dr. Eden is also the Director of an NSF-IGERT Program on Integrated Biorefining and the Acting Director of the Alabama Center for Paper and Bioresource Engineering. His main areas of expertise include process design, integration and optimization, as well as molecular synthesis and product design. His group focuses on the development of systematic methodologies for process and product synthesis, design, integration, and optimization.

Dr. Eden's research has generated 1 edited book, 100 refereed papers/book chapters and resulted in over 300 presentations at national/international meetings, including more than 40 invited lectures, e.g. the 2006 Danish Chemical Engineering Conference, the 2006 and 2012 AIChE Annual Meetings, the 2009 Process Systems Engineering Conference, the 2010 Mississippi State University Biofuels Conference, the 2013 International Symposium on Sustainable Chemical Product and Process Engineering, the 2013 World Congress of Chemical Engineering, and the 24th and 25th European Symposium on Computer Aided Chemical Engineering. To support his research and educational activities, Dr. Eden has successfully

secured over $6.75M in extramural funding as PI, and an additional $10.7M as co-PI from the National Science Foundation (NSF), Department of Energy (DOE), Department of Defense (DOD), Department of Education (DOEd), Environmental Protection Agency (EPA), Department of Agriculture (USDA), and industrial sponsors like Evonik-Degussa and Masada Resource Group.

Dr. Eden is the recipient of the National Science Foundation CAREER award (2006), the Auburn Engineering Alumni Council Junior Faculty Research Award (2006), the William F. Walker Superior Teaching Award (2007), the Fred H. Pumphrey Teaching Award for Excellence (2009 and 2011), the SGA Award for Outstanding Faculty Member in the Samuel Ginn College of Engineering (2009 and 2011), the Outstanding Faculty Member in the Department of Chemical Engineering (2009, 2011, 2013, and 2014), the Auburn Engineering Alumni Council Senior Faculty Research Award (2012), and the William F. Walker Merit Teaching Award (2014). As one of the founding members of Auburn University's Center for Bioenergy and Bioproducts, Dr. Eden and his collaborators received the AU President's Outstanding Collaborative Units Award (2012). At the 2009 Foundations of Computer Aided Process Design (FOCAPD), he was honored with the Best Faculty Contribution Award. Dr. Eden was selected to participate in the 2010 National Academy of Engineering Frontiers of Engineering Education Symposium. He was awarded the 2014 AIChE Computing and Systems Technology (CAST) Division Outstanding Young Researcher Award and is recipient of the 2015 Auburn University Creative Research and Scholarship Award (the highest recognition for research at Auburn University).

Dr. Eden received his M.Sc. (1999) and Ph.D. (2003) degrees from the Technical University of Denmark, both in Chemical Engineering. He has been an active member of the process systems engineering community for almost 15 years. Dr. Eden was recently elected Director of the CAST Division of AIChE and a Board of Trustee Member of Computer Aids for Chemical Engineering (CACHE) Corporation. Dr. Eden was also selected to co-chair the 2014 Foundations of Computer Aided Process Design (FOCAPD) conference. He serves on the editorial boards for Clean Technologies & Environmental Policy, Chemical Process & Product Modeling, and the Journal of Engineering; the International Peer Review College for the Danish Council for Strategic Research; the advisory board for the Computer Aided Process Engineering Center (CAPEC-PROCESS), and is a member of the International Energy Agency Annex IX on Energy Efficient Separation Systems.

Tom F. Edgar
Director, The University of Texas at Austin Energy Institute
George T. and Gladys H. Abell Chair in Engineering and
Jack S. Josey Professorship in Energy Studies
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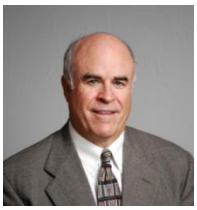

Thomas F. Edgar is Professor of Chemical Engineering at the University of Texas at Austin and Director of the UT Energy Institute. Dr. Edgar received his B.S. degree in chemical engineering from the University of Kansas and a Ph.D. from Princeton University. For the past 40 years, he has concentrated his academic work in process modeling, control, and optimization, with over 450 articles and book chapters. Edgar has co-authored two leading textbooks: Optimization of Chemical Processes (McGraw-Hill, 2001) and Process Dynamics and Control (Wiley, 2010) and has received major awards from ASEE, AACC, and AIChE, including the 2013 AIChE Sustainable Engineering Award and the 2015 AACC Bellman Control Heritage Award. Tom Edgar is co-founder of the Smart Manufacturing Leadership Coalition (SMLC; https://smart-process-manufacturing.ucla.edu/), which develops software tools for saving energy in industrial plants. Dr. Edgar is a member of the National Academy of Engineering.

Mahmoud M. El-Halwagi
Professor and Holder of the McFerrin Professorship
Artie McFerrin Department of Chemical Engineering
Managing Director of TEES Gas and Fuels Research Center
Texas A&M University
College Station, TX, 77843

Dr. Mahmoud El-Halwagi is the McFerrin Professor at Artie McFerrin Department of Chemical Engineering, Texas A&M University and the Managing Director of the Texas A&M Engineering Experiment Station's Gas and Fuel Research Center. Dr. El-Halwagi's main areas of expertise are process integration, synthesis, design, operation, and optimization. Specifically, Dr. El-Halwagi's research focuses on sustainable design. In addition to the theoretical foundations he helped lay down in these areas, he has been active in education, technology transfer, and industrial applications. He has served as a consultant to a wide variety of chemical, petrochemical, petroleum, gas processing, pharmaceutical and metal finishing industries. He is the coauthor of more than 250 papers and book chapters, the co-editor of five books, and the author of three textbooks. Dr. El-Halwagi is the recipient of several awards including the American Institute of Chemical Engineers Sustainable Engineering Forum (AIChE SEF) Research Excellence Award, the National Science Foundation's National Young Investigator Award, the Lockheed Martin Excellence in Engineering Teaching Award, the Celanese Excellence in Teaching Award, and the Fluor Distinguished Teaching Award. Dr. El-Halwagi received his Ph.D. in Chemical Engineering from the University of California, Los Angeles and his M.S. and B.S. from Cairo University.

Renée D. Elms
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Renée Elms is a Senior Consulting Engineer at Bryan Research & Engineering (BR&E), where she has provided high level engineering, consulting, and technical support for leading operating and engineering companies in the Oil and Gas and Chemical Industries since 2010. Her consultation activities include feasibility, design, operation, and optimization of new and existing facilities related to oil, natural gas, refining, energy, alternative energy, carbon capture, and chemical production. In addition, she conducts independent research in system/process synthesis, design, analysis, economics, integration, optimization, and simulation of natural gas, petroleum and bio-fuels; sustainable design and sustainability. In a global context, her research interests pertain to process design and integration for sustainability, with specific focus in topics related to the oil and gas industry, computer-aided design, biorefineries/biofuels, water management, and sustainability/sustainable design. Prior to joining BR&E, Dr. Elms obtained research and engineering experience in various academic, government, and private sector projects at NASA, NIST, Henkel AG & Co. KGaA, the Mary Kay O'Connor Process Safety Center, and Texas A&M University. Dr. Elms holds B.S. degrees in Biochemistry and Genetics and M.S. and Ph.D. (2009) degrees in Chemical Engineering, all from Texas A&M University. A recipient of various honors, Dr. Elms was a NASA Harriett Jenkins Pre-doctoral Fellow, National Science Scholar, and Robert Byrd Honors Scholar. She also has a strong interest in STEM education and serves as a regular Guest Lecturer for multiple classes in the Texas A&M University Department of Chemical Engineering.

Ignacio E. Grossmann
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Ignacio E. Grossmann is the R. R. Dean University Professor of Chemical Engineering, and former Department Head at Carnegie Mellon University. He obtained his B.S. degree at the Universidad Iberoamericana, Mexico City, in 1974, and his M.S. and Ph.D. at Imperial College in 1975 and 1977, respectively. He is a member of the "Center for Advanced Process Decision-making," an industrial consortium that involves about 20 petroleum, chemical, engineering and software companies. He is a member of the National Academy of Engineering, and associate editor of AIChE Journal. Major awards include the 1994 Computing in Chemical Engineering

Award, the 1997 William H. Walker Award for Excellence in Contributions to Chemical Engineering Literature and the 2011 Research Excellence in Sustainable Engineering Award, all from AIChE. He has honorary doctorates from Åbo Akademi in Finland, University of Maribor in Slovenia, and University of Dortmund in Germany. He was named as one of the "One Hundred Engineers of the Modern Era" by AIChE in 2008. He also received the Warren K. Lewis Award for Chemical Engineering Education, AIChE, 2009, was named along with Larry Biegler, Discrete Optimization Top Cited Article in 2005-2010, and Thomson Reuters Highly Cited Researcher in 2014. He was recently named the first recipient of the Medal Sargent by the Institution of Chemical Engineers in the UK. The research interests of Ignacio Grossmann are in the areas of process synthesis, energy integration, process flexibility, planning and scheduling of batch and continuous processes, enterprise-wide optimization, mixed-integer and logic-based optimization, and stochastic programming. He has authored more than 500 papers, several monographs on design cases studies, and the textbook "Systematic Methods of Chemical Process Design," which he co-authored with Larry Biegler and Art Westerberg. He has also organized the Virtual Library on Process Systems Engineering. Professor Grossmann has graduated 52 Ph.D. and 8 M.S. students.

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Timothy G. Gutowski is a Professor of Mechanical Engineering at the Massachusetts Institute of Technology (MIT), Cambridge, MA, USA. His research interests focus on the relationship between manufacturing and sustainability at various scales. His recent work looks at global manufacturing and its economic benefits as well as energy/carbon challenges.

He was the Director of MIT's Laboratory for Manufacturing and Productivity (1994-2004), and the Associate Department Head for Mechanical Engineering (2001-2005). From 1999 to 2001 he was the chairman of the National Science Foundation and Department of Energy panel on Environmentally Benign Manufacturing. He has over 150 technical publications, two books and seven patents and patent applications. He received his Ph.D. in Mechanical Engineering from MIT in 1981, an M.S. in Theoretical & Applied Mechanics from University of Illinois in 1968, and a B.S. in Mathematics from University of Wisconsin in 1967,

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Karl R. Haapala is an Associate Professor in the School of Mechanical, Industrial, and Manufacturing Engineering at Oregon State University, where he directs the Industrial Sustainability Laboratory and serves as Assistant Director of the OSU Industrial Assessment Center. He received his B.S. (2001) and M.S. (2003) degrees in Mechanical Engineering, and his Ph.D. in Mechanical Engineering-Engineering Mechanics as an NSF IGERT trainee (2004-2008), all from Michigan Technological University. He has served in a variety of capacities within ASME, IIE, and SME, and has been inducted into the honor societies of Pi Tau Sigma, Phi Kappa Phi, and Sigma Xi. In 2014, he received the Outstanding Young Manufacturing Engineer Award from SME. His research addresses sustainable manufacturing challenges, including life cycle engineering methods, manufacturing process performance modeling, and sustainable engineering education. He has participated in over $5M in research from the Army, DOE, NIST, NSF, the Pacific Northwest National Laboratory, Oregon BEST, the Oregon Metals Initiative, and industry, including Boeing, Blount International, and Sheldon Manufacturing. His work has appeared in more than 75 peer-reviewed proceedings and journal articles.

Richard Helling
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Dr. Rich Helling leads the Sustainable Chemistry expert community at Dow, which supports Dow businesses on the use of Life Cycle Assessment (LCA), the Sustainable Chemistry Index (SCI) and related tools to identify opportunities for innovation, differentiating products in the marketplace, and creating sustainable value for Dow. He is a member of the State of Michigan's Green Chemistry Roundtable, and active in working groups of The Sustainability Consortium. Rich joined Dow in 1987 and has held a variety of roles in process research, development and manufacturing. He developed and improved technologies at Dow's Pittsburg, California, manufacturing site for waste reduction, reaction selectivity and purification of chlorinated pyridines that are used in a broad range of Dow AgroSciences products, becoming the leader for Process & Environmental Technology in Pittsburg. He led the process development for SiLK™ dielectric materials in Midland, Michigan, and was the Dow AgroSciences European contract synthesis leader and fungicides technology leader when based in Drusenheim, France. Rich returned to Midland in 2003, when he began his use of LCA to

complement economic evaluations of new technologies, especially the use of renewable feedstocks for chemical production, becoming an Associate R&D Director. Rich holds a bachelors' degree from Harvey Mudd College with majors in Engineering and History, a masters' degree in Chemical Engineering Practice from MIT, and a doctorate in Chemical Engineering, also from MIT. He was an Assistant Professor with the MIT Chemical Engineering Practice School prior to joining Dow. He is an author of 23 papers, holds 2 patents, is a registered Professional Engineer in Michigan, and is a LCA Certified Professional. Rich and his wife, Denise, have two adult sons. Rich is a dedicated musician, playing trumpet, singing tenor, ringing handbells, and is a cantor at his church. He is the board secretary of the Midland County Emergency Food Pantry Network. During the non-freezing half of the year in Michigan, he enjoys commuting on his bicycle.

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Yinlun Huang is Professor of Chemical Engineering and Materials Science at Wayne State University, where he has directed the Laboratory for Multiscale Complex Systems Science and Engineering. His research has been mainly focused on the fundamental study of multiscale complex systems science and sustainability science, with applied studies on engineering sustainability, including sustainable (nano)material development, integrated design of sustainable product and process systems, manufacturing sustainability, and sustainability assessment and decision making under uncertainty. He has published widely in these areas. Dr. Huang is currently directing the NSF funded Sustainable Manufacturing Advances in Research and Technology Coordination Network (SMART CN), which involves 13 domestic universities, seven foreign universities in six countries, and 11 national organizations and university centers. In August 2013, he chaired the SMART CN's Sustainable Manufacturing Roadmap Development Workshop in Cincinnati, OH. Dr. Huang was Chair of AIChE Sustainable Engineering Forum (SEF) in 2008-09 and ACS Green Chemistry and Green Engineering Subdivision in 2010. Currently, he is Technical Advisor of the AIChE-SEF. Among many honors, Dr. Huang was a recipient of the Michigan Green Chemistry Governor's Award in 2009, the AIChE SEF Research Excellence in Sustainable Engineering Award in 2010, and the NASF Scientific Achievement Award in 2013. Dr. Huang holds a B.S. degree from Zhejiang University, China, and a M.S. and a Ph.D. degree from Kansas State University, all in chemical engineering. He was a postdoctoral fellow at the University of Texas at Austin before joining Wayne State University in 1993.

Jacqueline A Isaacs
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Jacqueline A. Isaacs is a professor in the Department of Mechanical and Industrial Engineering with a secondary appointment in the School of Public Policy and Urban Affairs at Northeastern University, where she is an associate director of the NSF Nanoscale Science and Engineering Center for High-rate Nanomanufacturing (CHN). Her research interests include assessment of the regulatory, economic, environmental and ethical issues facing the development of nanomanufacturing and other emerging technologies. Dr Isaacs' research group works on various aspects of life cycle assessment and to assess and compare processes or products alternatives with respect to materials and design choices. Her 1998 NSF Career Award, one of the first that focused on environmentally benign manufacturing, had a powder metallurgy theme. Dr. Isaacs also guides research on development and assessment of educational computer games that aim to offer students an exploration of environmentally benign processes and supply chains in manufacturing. She received a B.S. from Carnegi e Mellon University and S.M and Sc.D. degrees in Materials Science and Engineering from the Massachusetts Institute of Technology. Dr. Isaacs has been recognized by Northeastern University, receiving the President's Aspiration Award in 2005 and a University-wide Excellence in Teaching Award in 2000. She is also a 2013 ELATE Fellow. Dr. Isaacs co-chaired the Sustainable Nanotechnology Organization's Annual Conference in 2014, and was one of the plenary speakers at the 2015 Gordon Research Conference on Environmental Nanotechnology.

I. S. Jawahir
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Dr. I.S. Jawahir received his Ph.D. from the University of New South Wales (Sydney, Australia) in 1986. His current research interests are in sustainable manufacturing, focusing on developing predictive performance models for products, processes and systems. He has produced over 320 technical research papers, including 130 refereed journal papers, and has been awarded with 4 U.S. patents. He has directed the research of 32 PhD and over 80 MS graduates. He has

delivered 40+ keynote papers in major international conferences and over 150 invited presentations in 32 countries.

Professor Jawahir has received significant research funding from U.S. Federal Agencies, including NSF, NIST and DoD, and from industry groups such as General Motors, Ford, Toyota and General Electric – Aviation. He is a Fellow of three major professional societies: CIRP, ASME, and SME. He is the *Founding Editor-in-Chief of the International Journal of Sustainable Manufacturing*, and the *Technical Editor of the Journal of Machining Science and Technology*. He was also a Member of the ASME Board for Research and Technology Development (BRTD) for over a decade, and in 2005, he founded the ASME *Research Committee on "Sustainable Products and Processes"* and served as the *Chairman* of this committee for six years (2005-11). In 1998, he founded the CIRP international conference series on *Modeling of Machining Operations.* This series still continues with the 15th conference recently held in Karlstruhe, Germany in June 2015. He also founded and served as the *Chairman* of the CIRP's International Collaborative Research Group on *"Surface Integrity and Functional Performance of Components"* (2007-11). Professor Jawahir received the *2013 ASME Milton C. Shaw Manufacturing Research Medal* for his outstanding contributions to manufacturing research.

Nancy Kralik
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Nancy Kralik is a licensed civil and environmental engineer with over 30 years of experience in the development and application of HSE and sustainability practices globally. Nancy has served as HSE project manager on onshore and offshore facilities, refineries, and chemical plants for major oil and gas companies, conducted field investigations in the U.S. and international locations, and managed global HSE regulatory issues. At Fluor, Nancy led the corporate initiative to integrate HSE activities and is engaged in sustainability and HSE engineering and field issues in a corporate role. She serves as the chair of Fluor's executive-level Sustainability Committee.

Nancy holds P.E. licenses in Texas and Ohio, with M.S. degrees in civil/environmental engineering and fisheries biology and a B.S. in biology. She is a LEED (Leadership in Energy and Environmental Design) Accredited Professional and Envision Sustainability Professional. She is a member of ASCE's Committee on Sustainability and its education subcommittee and led an Engineers Without Borders team on an El Salvadoran water project. Nancy chaired the Construction Industry Institute's two-year research dealing with sustainability during construction, with the research team's results presented in mid-2014.

Manish Mehta
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Dr. Manish Mehta is Founder/President of M-Tech International LLC, an Ann Arbor-based global consultancy in strategic planning, manufacturing and sustainability research management, and philanthropic ventures development that incorporates life cycle thinking approaches to achieve the triple-bottom-line with new technologies. He has 25 years' experience in organizing and managing federally-funded, multi-partner technology ventures and cross-industry collaborations in areas such as lightweight materials, nanotechnology, design/CAE tools, net-shape manufacturing, automation, alternative energy, workforce training and sustainable manufacturing.

Previously, he was Director of Strategic Projects and Sustainability at the National Center for Manufacturing Sciences (2000-15), and Executive Director of NCMS' for-profit subsidiary Technologies Research Corporation, as well as Principal Technical Staff at Environmental Research Institute of Michigan (1991-2000), where he led the industrialization of several remote sensing and imaging technologies, and implementation of total quality management on advanced research projects. His experience includes organizing and managing sponsored research and standardization projects in metals and composites with sponsors such as DOE, EPA, DoD, DOC-NIST and NSF and the United States Council for Automotive Research (USCAR). He was principal investigator and author of four largest NSF-sponsored studies (2003, 2006, 2009 and 2014) to assess the commercial impact of the National Nanotechnology Initiative on US manufacturers and industrial sectors.

Manish obtained his BS (Mechanical Engineering) from Bangalore University, India and MS and Ph.D. degrees in industrial engineering from University of Cincinnati, and completed the Executive Program at University of Michigan's Ross Business School in 2001. He has over 70 publications and is a Fellow of the Engineering Society of Detroit, Past Chair of the Detroit Chapter of ASM International, and served two terms on the National Academies Board on Manufacturing and Engineering Design (2002-07), and on two National Research Council committees to recommend lightweight materials (2003) and lightweighting best practices for land, sea and air military platforms (2012). He has served on peer review panels for the US EPA, DOE, NSF and state-sponsored innovation programs such as Michigan's 21st Century Jobs Fund, Ohio's Third Frontier Fund, and Singapore SPRING business plan competitions. He is a member and past-President of the Rotary Club of Ann Arbor North, where he organized or participated in over 10 Rotary Foundation-sponsored humanitarian Global Grant projects in Bangladesh, Brazil, India, Nepal, Nigeria and Uruguay for polio eradication, tuberculosis treatment, intra-ocular lens, clean water, rural sanitation, healthcare equipment and pacemaker reuse, and microfinance. He is a member of the Governing Board of International School of Jain Studies at Claremont Lincoln University.

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Partha P. Mukherjee is currently an Assistant Professor of Mechanical Engineering at Texas A&M University (TAMU). Before joining TAMU in 2012, he worked for four years in the U.S. Department of Energy Labs; as a staff scientist (2009-2011) at Oak Ridge National Laboratory and as a Director's research fellow (2008-2009) at Los Alamos National Laboratory. He received his Ph.D. in Mechanical Engineering from the Pennsylvania State University. Prior to PhD studies, he worked as a consulting engineer for four years at Fluent India Pvt. Ltd, a fully-owned subsidiary of Fluent Inc., currently Ansys Inc. His research interests include transport, materials and manufacturing aspects in energy storage and conversion (e.g., batteries and fuel cells). He has more than ten years of research experience in batteries and fuel cells. He is known for his highly cited work on mesoscale electrode physics and stochastics. He is a PI for multiple projects on batteries from NSF, DOE, NASA and industry, and has been an invited speaker at premier international conferences, e.g. the Electrochemical Society, American Chemical Society, TMS, American Ceramic Society, and American Society for Mechanical Engineers.

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Kimberly Ogden is a professor of chemical and environmental engineering at the University of Arizona. She received her BS degree from the University of Pennsylvania and her MS and PhD degrees from the University of Colorado. Prior to joining the UA in the fall of 1992 she was a postdoctoral fellow at Los Alamos National Laboratory. She is currently on the managing board of SBE and recently completed her term as the secretary of AIChE. Kim's research focus includes bioreactor design for production of alternative fuels from algae and sweet sorghum and microbiological water quality. She is the engineering technical lead for the National Alliance for Advanced Biofuels and Bioproducts or NAABB. As the final report is being written for the NAABB consortium, her research in algae to biofuel continues through a Regional Algal Feedstock Test bed program funded by the Department of Energy. The goal of this 4 year project is to obtain long term outdoor algal cultivation data that will be available to the public for use in modeling and other research efforts, and demonstrate the feasibility of year

round cultivation. Furthermore, industrial and other universities will be able to use the test beds to test new technologies such as novel harvesting and extraction systems.

Kim is also involved in teacher outreach programs. She has run a NSF Research Experiences for Teachers Program for over ten years, where teams of teachers spend 5 to 6 weeks in the summer doing research in the UA laboratories and transfer what they learn directly to the K-12 classroom through relevant lesson plans. She is also the principal investigator for a NSF GK-12 engineering program. The focus of the GK12 is water and energy sustainability. Graduate students from 7 different engineering disciplines have been GK12 fellows and worked in junior high and high school classrooms in the Tucson area. Some of these school districts have up to 90% of their student population from diverse backgrounds and have 70 to 80% of the students receiving free or reduced meals.

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Elsa Olivetti is the Thomas Lord Assistant Professor of Materials Science and Engineering at the Massachusetts Institute of Technology. Her research focuses on improving the environmental and economic sustainability of materials in the context of rapid-expanding global demand. Dr. Olivetti received her B.S. degree in Engineering Science from the University of Virginia and her Ph.D. in Materials Science Engineering from MIT. She also did post-doc work in Engineering Systems at MIT.

Cristina Piluso
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Cristina Piluso joined BASF as a Sustainability Specialist in the EHS Product Stewardship Sustainability Programs Group in Florham Park, NJ. Her main responsibilities included supporting the group with the completion of Eco-efficiency Analysis studies, which quantify the sustainability of products over the entire product life-cycle, as well as interacting with and presenting results to customers. Cristina was also involved in the methodology enhancement of a Risk Characterization tool. She also has a background in supply chain optimization and new business development for the Polyurethanes division. She is currently a Manufacturing Technical Leader, responsible for operational excellence, lean manufacturing,

and capital planning for the North American Polyurethanes Systems production locations. Cristina also holds a part-time faculty position in Wayne State University's Department of Chemical Engineering and Materials Science department.

Cristina earned her Ph.D. in Chemical Engineering (*Industrial Sustainability Analysis and Decision-Making under Uncertainty: A System Approach*), with a minor in Business Administration, from Wayne State University. She has additional EHS experience with Marathon Ashland Petroleum, LLC as well as research experience at Dow Automotive. She has also served as the editor of the American Institute of Chemical Engineers (AIChE) Sustainable Engineering Forum (SEF) newsletter from 2007 – 2009, Programming Chair from 2009 – 2011, and Treasurer from 2011 – present.

Sudarsan Rachuri
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Dr. Sudarsan Rachuri is the Associate Program Manager for Smart Manufacturing Design and Analysis program at NIST. He also managed Sustainable Manufacturing program earlier. Before joining NIST, he was a research professor at George Washington University. His primary research objectives are to develop and transfer knowledge to industry about information models for sustainable manufacturing, green products, assembly representation, system level analysis, and tolerance representation. Specific focus is on identifying integration and technology issues that promote industry acceptance of information models, and standards, that will enable designers to develop products that are sustainable and manufactured in a distributed and collaborative environment. Dr. Rachuri's primary areas of interest are smart and sustainable manufacturing, scientific computing, CAD/CAM/CAE, design for sustainability, data analytics, and ontology. Dr. Rachuri is an ASME Fellow, having been elected in 2012 for his significant contributions in the areas of information and semantic modeling of product life cycle management, and the application of measurement science for sustainable manufacturing.

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Gintaras.V. (Rex) Reklaitis is Burton and Kathryn Gedge Distinguished Professor of Chemical Engineering at Purdue University (USA) and deputy director of the NSF Engineering

Research Center on Structured Organic Particulate Systems. At Purdue he has served as the Head of the School of Chemical Engineering and Director of the Computer Integrated Process Operations Center. His expertise lies in process systems engineering, the application of information and computing technologies to process and product design, process operations and supply chain management. Current research interests include applications of process systems methodology to improve pharmaceutical product design, development, manufacture and administration as well as systems studies of integrated energy networks and supply chains. He was educated at the Illinois Institute of Technology (BS ChE), received MS and PhD degrees from Stanford University, has held an NSF Postdoctoral fellowship (Zurich, Switzerland) and a Senior Fulbright Lectureship (Vilnius, Lithuania). He is a member of the US National Academy of Engineering, fellow of AIChE, and past Editor-in-Chief of *Computers & Chemical Engineering*. Among the recognitions he has received are the Computing in Chemical Engineering Award (AICHE), the ChE Lectureship Award (ASEE), the George Lappin (AIChE) and Van Antwerpen Awards (AIChE) , the Long Term Achievements in Computer Aided Process Engineering Award of the EFChE. And the Pruitt Award (CCR). He has served on the Board of Directors of AICHE, the Council for Chemical Research and the CACHE Corporation and continues to serve on the editorial boards of several journals. He has published over 250 papers and book chapters and edited/authored eight books

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Jeremy Rickli is an Assistant Professor in the Industrial and Systems Engineering Department at Wayne State University, where he has created the Manufacturing and Remanufacturing Systems Laboratory (MaRSLab). His research program addresses fundamental and applied problems in manufacturing and remanufacturing process/systems while boosting considerations for sustainability and life-cycle thinking in design, manufacturing, use, and recovery. Specific research thrusts include: (1) transforming manufacturing quality monitoring and remanufacturing core condition assessment via automated laser line scanning systems, (2) remanufacturing core management considering uncertain core quality, quantity, and timing, and (3) integrating design for disassembly and remanufacturing into CAD/CAM tools. He has been active in the sustainability and manufacturing areas, getting his start as an NSF IGERT trainee in the Sustainable Futures Institute at Michigan Technological University. He has presented at the 4th International Forum on Sustainable Manufacturing, attended the Pan-American Studies Institute on Manufacturing Innovation through Sustainable Design, and developed a Fundamentals of Sustainable Manufacturing undergraduate and graduate course at Wayne State

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Alan Rossiter is president of Rossiter & Associates, a consulting company based in Bellaire, TX, specializing in industrial energy efficiency. He has more than 30 years of experience in process engineering and management. Alan was born in Southern Rhodesia (now Zimbabwe), and was educated there through high school. He then moved to England to attend the University of Cambridge, where received his BA, MA, MEng and PhD, all in Chemical Engineering. After graduating he worked with ICI (Imperial Chemical Industries) for nine years in process design, technical support and research, before joining Linnhoff March (energy efficiency consultants), where he carried out consulting projects for eight years and ultimately became president. He left Linnhoff March to become an independent consultant, and founded Rossiter and Associates in 1997. In this capacity he has carried out pinch analysis and energy efficiency projects, including PFD reviews, operational assessments and energy workshops, both on existing plants and grassroots designs, for a wide range of industrial clients, including LyondellBasell, Sasol, ConocoPhillips/Phillips66, Hess, Ergon Refining, Albemarle and ExxonMobil. He has more than 70 publications including four books. His fourth book, 'Energy Management and Efficiency for the Process Industries,' was published in April 2015 by John Wiley & Sons, Inc. He is a chartered engineer (UK) and a registered professional engineer (Texas). He was the 2010 Chair of the South Texas Section of the American Institute of Chemical Engineers, and currently serves as the Chair of the AIChE Southwest Process Technology Conference and a member of the AIChE Career and Education Operating Council.

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Dr. Jeffrey Seay is Associate Professor of Chemical and Materials Engineering at the University of Kentucky College of Engineering Paducah Extended Campus Program. Dr. Seay

joined the University of Kentucky in 2008 after a 12 year career as a process engineer in the chemical industry. His research interests include the integration of sustainable biomass supply chains with thermochemical modeling of biomass utilization processes as well as the application of appropriate technology to the production of biofuels in underdeveloped regions. Dr. Seay is the current Chair of the American Institute of Chemical Engineers (AIChE) Sustainable Engineering Forum (SEF) and past Vice-Chair and Education Committee Chair for the SEF. In the last several years he has served on the organizing committee for several international sustainability focused conferences.

Dr. Seay leads the University of Kentucky Appropriate Technology and Sustainability (UKATS) research group at the University of Kentucky Paducah Extended Campus. UKATS is focused on developing sustainable, renewable energy solutions for underdeveloped regions, particularly sub-Saharan Africa. His group has collaborated with the African Center for Renewable Energy and Sustainable Technology (ACREST) in Cameroon and the Organization of Development Action and Maintenance (ODAM) in India to develop a sustainable process for producing biofuel from locally available resources. In addition his group is working to develop metrics for evaluating the impacts for renewable energy processes in developing regions. Dr. Seay is a past faculty advisor to two US EPA funded People, Prosperity and the Planet projects focused on sustainable biofuel. Dr. Seay's outreach activities include hosting local high school students who are interested in participating in sustainability focused research projects. Over 20 students from 5 area high schools have participated over the last 5 years.

Dr. Seay is the inaugural recipient of the AIChE SEF Sustainability Education Award (2013) and has been awarded the Outstanding Teaching Award in Chemical Engineering (2013) and the Dean's Award for Service (2014) at the University of Kentucky (2013). Dr. Seay has a BS from Auburn University (1996), an MS from the University of South Alabama (2005) and a PhD from Auburn University, all in chemical engineering.

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Dusan P. Sekulic is Professor of Mechanical Engineering at the University of Kentucky and Distinguished 1000 Plan Foreign Expert Professor at the Harbin Institute of Technology, Harbin, China. Dr. Sekulic directs the Brazing and Heat Exchanger Design Laboratory at the Institute of Sustainable Manufacturing at the College of Engineering, University of Kentucky. Dr. Sekulic is Fellow of ASME. His research has been mainly focused on the fundamental study of transport phenomena and involves high temperature liquid metal capillary flows, design of compact heat exchangers and thermodynamics for resources (materials and energy) for

sustainable manufacturing processes and systems. Dr. Sekulic is currently directing two NSF funded projects in the fields of the kinetics of capillary flow in brazing and systems thinking for sustainability, respectively. Dr. Sekulic has published three books with more than dozen editions in multiple languages: Fundamentals of Heat Exchanger Design (with R.K. Shah), Wiley, Hoboken, NJ, 2003; Thermodynamics and Destruction of Resources (with B. Bakshi and T. Gutowski), The Cambridge University Press, Cambridge, UK, 2011; Advances in Brazing: Science, Technology and Applications, Woodhead, Cambridge, UK, 2013. Dr. Sekulic research work has been funded by US NSF, DOE, DoD, NASA, German DAAD, Yugoslav NSF, China NSF and numerous industrial corporations in US and abroad. In addition to the academic positions in USA and China, Dr. Sekulic is currently appointed visiting professor at the University of Belgrade, and the Key Laboratory of Soldering & Brazing Materials and Technology" Hangzhou, China.

Debalina Sengupta
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Debalina Sengupta obtained a Bachelor of Engineering degree in Chemical Engineering from Jadavpur University, Calcutta, India, in 2003. In 2010, she earned the Doctor of Philosophy degree in chemical engineering from the Department of Chemical Engineering at Louisiana State University, Baton Rouge, Louisiana. Her research was on the optimization of industrial complexes and sustainability analysis using Total Cost Assessment Methodology. Following this, her first book titled "Chemicals from biomass: integrating bioprocesses into chemical production complexes for sustainable development" was published by CRC Press in the Green Chemistry and Chemical Engineering Series in 2012. After her PhD, she worked at the National Risk Management Research Laboratory of the United States Environmental Protection Agency, Cincinnati, OH as an ORISE Post Doctoral Fellow in the Sustainable Technology Division. Her research at the EPA was focused on Sustainable Supply Chain Design of Biofuels and Consumer Products, and decision-making in Sustainability using metrics and indicators. Currently, she is working at Artie McFerrin Department of Chemical Engineering at Texas A&M University as a postdoctoral research associate where she is developing educational modules for sustainable manufacturing for the NSF sponsored project on Sustainable Manufacturing Advances in Research and Technology (SMART). She is also co-authoring her second book titled "Measuring Progress towards Sustainability". Dr. Sengupta has served on multiple NSF panels and enjoys teaching and mentoring students. She has served as the Director of Environmental Division AIChE and currently is the Chair for Programming for the Environmental Division. She is also an active member of the Sustainable Engineering Forum at the AIChE.

Raymond Smith
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Ray Smith has been a Chemical Engineer in the U.S. Environmental Protection Agency's Office of Research & Development for over 15 years, after earning his PhD in Chemical Engineering from the University of Massachusetts, Amherst. During his tenure with EPA, Ray has established an expertise in sustainability by performing research and publishing in the areas of life cycle assessment, biofuels, industrial ecology, process design, sustainability indicators, optimization, and decision making. As a Principal Investigator, Ray's research on method development for solving sustainability problems describes often overlooked details of seemingly simple systems and shows how to obtain appropriately simplified solutions to complex problems. Over the course of his career he has also been employed in industry and collaborated with domestic and international academic, industrial, and consultant groups. He is currently a lead for the Rapid Estimation of Life Cycle Inventory team and is co-inventor and developer of the GREENSCOPE process sustainability methodology and tool. Ray has volunteered his time to the American Institute of Chemical Engineers, serving as the first Chair of both the Environmental Division and (in 2016) the Sustainable Engineering Forum.

Thomas L. Theis
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Professor Theis is Director of the Institute for Environmental Science and Policy (IESP) at the University of Illinois at Chicago (UIC). IESP focuses on the development of new cross-disciplinary research initiatives in the sustainability area. Professor Theis received his doctoral degree in environmental engineering, with a specialization in environmental chemistry, from the University of Notre Dame. He has published widely on life cycle assessment, systems analysis, industrial ecology, industrial pollution prevention, and environmental chemistry, and is the co-author of the online text *Sustainability: A Comprehensive Foundation*. He is also a past editor of the *Journal of Environmental Engineering*.
From 2003 to 2009 Professor Theis was a member of the USEPA Chartered Science Advisory Board where he chaired the review of the Multimedia, Multipathway, and Multireceptor Risk Assessment (3MRA) Model, and co-chaired the Committee on Integrated Nitrogen Management. From 1980-1985 he was the co-director of the Industrial Waste Elimination Research Center (a

collaboration of Illinois Institute of Technology and University of Notre Dame), one of the first Centers of Excellence established by the USEPA. In 1989 he was an invited participant on the United Nations' Scientific Committee on Problems in the Environment (SCOPE) Workshop on Groundwater Contamination; in 1998 he was invited to by the World Bank to assist in the development of the first environmental engineering program in Argentina; in January, 2009 he delivered the keynote address at the NitroEurope Conference in Gothenburg, Sweden, and in October 2009 he was a member of the US delegation to the US-Japan Workshop on Life Cycle Assessment and Infrastructure Materials in Sapporo, Japan. He is currently principal investigator for UIC's initiative on Building Urban Resilience and Sustainability (BURST), and is co-investigator for the USEPA-funded center on Life Cycle of Nanomaterials.

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Graham Thorsteinson graduated top of his class with a Bachelor's and Master's degree in Chemical and Biomolecular Engineering from the Georgia Institute of Technology in 2007. As the first plant based energy engineer at General Mills, Graham delivered a total of $5,000,000 in energy savings at one General Mills cereal plant including a 29% BTU per pound of product reduction (BTU/lb). Graham influenced senior leadership to create additional plant based energy engineer jobs in the larger plants. He then created a CI energy process for them to follow. He now leads this energy engineering team in cereal, snacks, meals, and international divisions. His process and leadership have resulted in almost $10,000,000 in additional savings in the last three years (12% BTU/lb reduction) with a plan to deliver similar savings over the next 3 years.

Paul Witherell
Mechanical Engineer/ Associate Program Manager
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Dr. Paul Witherell is a Mechanical Engineer in the Life Cycle Engineering Group of the Systems Integration Division of the Engineering Laboratory at the National Institute of Standards and Technology (NIST). Dr. Witherell's primary research interests are Additive Manufacturing, Design for Sustainability, Sustainable Manufacturing, Knowledge Representation in Product Development, Design Optimization, and Ontology and Semantic Relatedness for Manufacturing.

Paul served as co-PI for the Material Information Model for Sustainability project under a previous Sustainable Manufacturing Program at NIST. Paul is actively involved with the ASTM E60 standards committee on Sustainability. He serves as the Task Chair for the recently approved and designated ASTM E60 E2986 – 15, "Guide for the Evaluation of Manufacturing Processes for Sustainable Improvement." This will be the first standard published under ASTM's E60.13 designation for Sustainable Manufacturing. Paul currently serves as the Associate Program Manager of the Measurement Science for Additive Manufacturing program in NIST's Engineering Lab. Within this program, Paul manages a project on Systems Integration for Additive Manufacturing. Paul received the ASME CIE Young Engineer award in 2014. A Ph.D. recipient from the Department of Mechanical and Industrial Engineering at the University of Massachusetts Amherst, Dr. Witherell received his BS and MS degrees in Mechanical Engineering from the University of Massachusetts Amherst in 2004 and 2006, respectively. Paul joined NIST upon receiving an NRC Postdoctoral Fellowship in 2009.

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Fengqi You is an Assistant Professor of Chemical and Biological Engineering at Northwestern University. He received his PhD from Carnegie Mellon University and worked at Argonne National Laboratory as Argonne Scholar, before joining the faculty of Northwestern University. He has published 75 peer-reviewed journal articles, some of which have been editorially highlighted in *Nature*, featured on journal covers (e.g. *Energy & Environmental Science*), and covered by media (e.g. *New York Times*, *BBC*, *BusinessWeek*, and *National Geographic*). He has received several competitive awards, including W. David Smith, Jr. Graduate Publication Award from the CAST Division of AIChE, Director's Fellowship from Argonne National Laboratory, and the 2013 Northwestern-Argonne Early Career Investigator Award. His research focuses on the development of novel computational models, optimization algorithms, and systems analysis tools for process engineering, energy systems and sustainability. More information can be found from his group website: <http://you.mccormick.northwestern.edu>.

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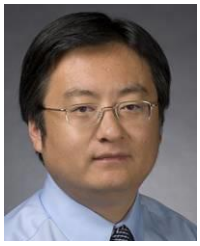

Chris Yuan is an Associate Professor of Mechanical Engineering at University of Wisconsin, Milwaukee, where he is the Director of the Laboratory for Sustainable and Nano-Manufacturing and also the Director of the DOE Industrial Assessment Center at the University of Wisconsin, Milwaukee, working with dozens of manufacturing companies on sustainable manufacturing research and practices. Currently he is the Chair of ASME Life Cycle Engineering Technical Committee, and also a subject editor for International Journal of Life Cycle Assessment. He is a recipient of the 2014 National Science Foundation Career Award, the 2014 State of Wisconsin "Citation of Commendation" Award, the 2013 Gustav Olling Outstanding Young Manufacturing Engineer Award from the Society of Manufacturing Engineers (SME), as well as the LEO Best Paper Award from the 2013 CIRP International Conference on Life Cycle Engineering. He is the Conference Program Co-Chair of the International Symposium on Sustainable Systems and Technology (ISSST) during 2012-2015, and also a Symposium Chair for ASME Manufacturing Science and Engineering Conference (MSEC) during 2011-2015. He is a member of the American Society of Mechanical Engineers (ASME), and a senior member of the Society of Manufacturing Engineers (SME). He received his Ph.D. in Mechanical Engineering from University of California Berkeley in 2009, M.S. degree in Industrial Engineering from Texas Tech University in 2005 and B.S. degree in Mechanical Engineering from China University of Petroleum in 1999.

Michael Zentner
Entrepreneur in Residence, Purdue Foundry
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As an Entrepreneur in Residence, Michael helps Purdue faculty and students during the commercialization of their innovations. As a senior research scientist and assessment team lead, his research focuses on studying data driven user behavior patterns on nanoHUB to determine the impact of nanoHUB on the international community in education and in advancing science, as well as on developing visualizations to illustrate this impact. Michael is also currently the CEO of SPEAK MODalities, a Purdue startup with software that helps children with autism develop language skills. Prior to joining Purdue, Michael was founder/senior team member of several information technology startup companies, where he created innovative solutions for extracting patterns from data, collaboration, and constrained optimization. Michael has consulted with many Fortune 500 companies to apply these technologies for solving business problems including operations scheduling, strategic capital investment, process improvement, and new product innovation and creation. Michael holds a BS in Chemical Engineering from the

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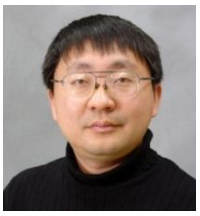

Fu Zhao is Associate Professor of Mechanical Engineering and Environmental and Ecological Engineering at Purdue University. His research is mainly focused on sustainable design and manufacturing, with particular interests in conceptual design, manufacturing process characterization, process planning, energy-efficient scheduling, and product end-of-life management. He also conducts research on advancing life cycle analysis for sustainability assessment and policy development related to renewable energy systems. He has published more than 100 peer-reviewed journal papers and conference proceedings on these topics, and is a receipt of the outstanding paper award at the 43rd SME North American Manufacturing Research Conference. Dr. Zhao's research has been supported by NSF, DOE, EPA, and industries. Dr. Zhao was Co-Chair and Chair of Life Cycle Engineering Technical Committee of ASME's Manufacturing Engineering Division from 2006 to 2008 and from 2008 to 2010. He is now Co-Chair of the Design for Manufacturing and Life Cycle Technical Committee of ASME's Design Engineering Division. Dr. Zhao holds two B.S. degrees (one in thermal engineering and the other in environmental engineering) and an M.S. degree (in thermal engineering) from Tsinghua University. He received his second M.S. degree in electrical engineering and his Ph.D. degree in mechanical engineering from the University of Michigan. He was a postdoctoral fellow in the Department of Civil and Environmental Engineering at the University of Michigan before joining Purdue University in 2007.