Stuck on the Verge or Perpetually Reinventing? What Papers from the 2018 Annual Conference Tell Us about Change and Continuity in Liberal Education for Engineers

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Stuck on the Verge or in the Midst of a Sea Change?  
What Papers from the 2018 Annual Conference Tell Us About Liberal Education for Engineers

*Full fathom five thy father lies; Of his bones are coral made: Those are pearls that were his eyes: Nothing of him that doth fade, But doth suffer a sea-change Into something rich and strange*

--Shakespeare, *The Tempest* (1611), Act 1, Scene 2

In their editors’ preface, “A Sea Change in Engineering Education,” Ollis, Neeley, and Luegenbiehl (2004) argued that ABET had “freed undergraduate curricula from their disciplinary fetters” and faculty from “our disciplinary blinders” by replacing a system based on quantification of inputs with “an utterly open-ended set of student outcomes. . . . nearly half of which relate to elements found within liberal education in general” (p. xiii-xiv). The selection of the phrase “sea change” invokes the context of *The Tempest* (1611), a play that opens with a storm at sea and unfolds a cascade of magical transformation from something ordinary “into something rich and strange.” The use of the term “sea change” in connection with the volume’s larger theme (and title), *Liberal Education in Twenty-First Century Engineering*, implies that the transformation of liberal education for engineering could lead to a complete transformation of engineering education as a whole and, perhaps eventually, transform engineering practice.

While the volume is aspirational in its intent, the editors recognize that transformation was not a certainty. “A decade from now,” they continued, “we will know if this freedom brought either invention by and integration of faculty, or simply curricular anarchy and loss of a unique opportunity to bridge ‘the two cultures’ of C.P. Snow” (p. xiii). The analysis presented in this paper takes the corpus of work published and sponsored by the Liberal Education/Engineering and Society (LEES) Division of ASEE at the 2018 Annual Meeting as a “snapshot,” that is, an isolated but authentic observation of scholarship and practice in liberal education for engineers. While it would be useful to have a narrative review of literature that establishes the state-of-the-art in liberal education for engineers, the aims of the research and analysis presented here are more modest: to provide an initial sketch of the intellectual common ground of LEES and to assess the extent to which the fears and aspirations outlined above have been realized.

After describing the approach used to analyze the corpus of work presented at the 2018 Annual Conference, this paper identifies 4 themes that constitute the intellectual common ground of and possible future directions for research in LEES: (1) integration, (2) diversity and inclusion, (3) communication, and (4) the LEES-STS-engineering ethics relationship. Because these themes overlap, a final section of the paper is devoted to papers that demonstrate the ways that these four threads are interwoven and interdependent.

**Research Approach:** Systematic, Qualitative Analysis

The biggest challenge of the research design for this project was the size and diversity of the LEES program in 2018: 13 technical sessions, 46 papers, 5 workshops and panels, and 2 distinguished lectures. The complete program appears in Appendix A. The technical sessions served as the primary unit of analysis, which made the work more manageable but also required reading all of the papers associated with each session to discern each session’s unifying themes.
To capture at least some of what transpired in the discussions that followed the presentations of papers, I drew on notes that I took or, for the sessions I was not able to attend, obtained from the moderator or organizer (or both). Using this method, I created discussion notes for all technical sessions. Each set of notes begins with a brief synopsis of the general theme(s) of that session. Most of the content of the notes is questions posed by the papers and discussion that might be the subject of further research in the broad range of areas addressed within LEES scholarship. Notes for all 13 sessions appear as appendices to this paper. Figure 1 below provides illustrative excerpts from the discussion notes for session U434B: Diversity and Inclusion: Concepts, Mental Models, and Interventions.

U434B: Diversity and Inclusion: Concepts, Mental Models, and Interventions

Discussion Notes

The four papers in this session illuminated the variety and creativity of approaches to promoting diversity and inclusion in both the curricular and extracurricular experiences of undergraduate engineering students. The papers also problematized diversity and inclusion in a number of ways, including (1) the disparity between the intent and impact of diversity interventions, (2) the tension between exploring cultural differences in group work (for educational purposes) and minimizing differences to “get the work done,” and (3) the incompatibility between engineering faculty expertise and the requirements of preparing students to function well in diverse settings and promote inclusive practices.

Possible Topics for Future Papers/Collaborations

- Given that engaged reflection is essential for students to optimize their learning from intercultural interactions and other diversity interventions, what are the most effective pedagogical strategies for getting students to engage in meaningful reflection? How can we structure reflection assignments so that they are optimally timed, efficient, and focused while still allowing space for individualized learning?
- How can we get beyond addressing the diversity challenge in terms of numbers (as important as that is) and create the intellectual and institutional spaces that allow for the expression of multiple viewpoints and perspectives? How does intellectual diversity relate to demographic diversity?
- In what ways do notions of rigor create barriers to intercultural learning? Are these barriers more significant in highly selective institutions than elsewhere? What are the most effective strategies for helping engineering faculty recognize the unintended negative consequences of traditional notions of rigor?
- How does theater function as a space in which difficult subjects can be safely explored? What are the similarities between laboratories and theaters as educational spaces? How might the educational experience in laboratories be enhanced by exploiting the parallels between labs and theaters?

Figure 1. Excerpts from the Discussion Notes Created for Session U434B.

After completing the notes for all technical sessions, I synthesized a necessarily impressionistic summary of 14 common and emergent themes from the 2018 LEES program. This summary appears in Appendix B. Based on this input, I hypothesized that the four themes mentioned in the introduction to this paper were the most prominent overall.

To determine whether the actual content of the program was accommodated by the four themes, I determined whether the sessions, workshops, panels, and distinguished lectures seemed to
logically fall into one of the four themes. Nine of the sessions did fit reasonably well, but there were four sessions that did not. After careful examination, I determined that these sessions, rather than suggesting a fifth or sixth additional category, demonstrated the ways in which the four themes are interwoven. The results of this analysis and classification are summarized in Figure 2 below.

I. **Integration**
   T434: Engineering Education as a Dynamic System
   W334B: Undergraduate Peer Educators: Mentoring, Observing, Learning
   W334C: Embedding Sociotechnical Systems Thinking I
   W534: Embedding Sociotechnical Systems Thinking II

II. **Diversity and Inclusion**
    U434B: Diversity and Inclusion: Concepts, Mental Models, and Interventions
    M5112A: Impacts of Sexual Harassment in Academic Science, Engineering, and Medicine (Panel Discussion)
    W1112A: Revealing the Invisible: Engineering Course Activities That Address Privilege, -isms, and Power Relations (Interactive Session with a Single Paper Published in the Proceedings)
    W2112: A Voice for Change—Building an Inclusive Future with Local Policy and Engineers (Distinguished Lecture)

III. **Communication**
    U534B: Design, Assessment, and Redesign of Writing Instruction for Engineers
    M434: Embedding Writing in Experiential Learning
    W434: Maps, Metaphors, Tweets, and Drafts

IV. **The LEES-STS-Ethics Relationship**
    U434A: Learning How to Be Socially Responsible Engineers—A Comparison of Methods and Lessons Learned (Panel Session)
    M334: Ethical Awareness and Social Responsibility in a Corporate/Team Context
    T534: Imagining Others, Defining Self Through Consideration of Ethical and Social Implications
    W220: It Takes More than Good Intentions—Do Engineers Have Responsibility for Social In/Justice? (Distinguished Lecture)

V. **Interweaving All Four Themes**
    U434C: Learning Outcomes and Pedagogical Strategies: Problems of Alignment
    US34A: Communicating Across Cultural and Epistemological Boundaries
    M534: Who’s in the Driver’s Seat of Engineering Education? (Interdivisional Town Hall Meeting)
    W134: Seeking Resilience and Learning to Thrive Through Engineering

Figure 2. Sessions, Panels, Workshops, and Distinguished Lectures By Category. U=Sunday, M=Monday, T=Tuesday, W=Wednesday.

The sections that follow develop the five themes listed above and provide some examples of particular sessions or papers that exemplify the theme. The treatments of each theme are necessarily selective and provide only a glimpse of the richness and nuance of the work presented in our division. At a minimum, however, they form a rough draft of the intellectual
common ground, current state, and future directions of research in LEES. Like any rough draft, the one presented here is ripe with opportunities for revision.

I. Invention and Integration: Integrative Intellectual Frameworks, Increasing Scale and Diversity of Interdisciplinary Teams, and A Growing Cadre of Interdisciplinary Faculty

T434: Engineering Education as a Dynamic System
W334B: Undergraduate Peer Educators: Mentoring, Observing, Learning
W334C: Embedding Sociotechnical Systems Thinking I
W534: Embedding Sociotechnical Systems Thinking II

The sessions developing this theme demonstrate that many of the hopes for inventive integration of technical and non-technical dimensions of engineering education that Ollis, Luegenbiehl, and I envisioned have been realized among a growing group of interdisciplinary individuals and teams. The papers demonstrate the progress made in creating integrative frameworks, applying them in various contexts, and assessing their effectiveness. Sociotechnical systems thinking (STST) (sometimes called “sociotechnical thinking”) emerges as the dominant intellectual framework for achieving integration. The authorship of the papers reflects both increasing scale and diversity of interdisciplinary research teams, and a growing cadre of interdisciplinary individuals who bridge the gap between the “two cultures” in their personal expertise and within their own scholarly work. In the rest of the discussion, we will refer to both the teams and the individuals as “integrative” (rather than interdisciplinary) because the combination seems transformative rather than just additive (as in simply increasing the numbers of disciplines represented). Integrative individuals and teams were not limited to the sessions that developed this theme but were, rather, pervasive throughout the program.

Both sessions on embedding STST emphasized the advantages and challenges of integrating and applying diverse areas of experience to create high-impact learning opportunities for student. They also highlighted the ways in which participating on an integrative team or educational experience required the faculty involved to grow, learn, and get out of their comfort zones. Session I was primarily concerned with integration within engineering curricula, while the second session was primarily concerned with integration that occurred in particular courses or other educational experiences.

Although the papers in all of the sessions reflected significant progress and accomplishment in integration, “Measuring Change Over Time in Sociotechnical Thinking: A Survey/Validation Model for Sociotechnical Habits of Mind” by Leydens, Johnson, Claussen, Blacklock, Moskal, and Cordova provides the most fully realized account of sociotechnical integration, which the authors implicitly define as highlighting “the interplay between relevant social and technical factors in the problem to be solved” (p. 1). Most of the paper details “the development of [an] assessment instrument;” however, the parts of the paper that are most relevant to our purposes here are the introduction and literature review (“Theoretical Background on Sociotechnical Integration”), which provide a concise and well-documented synthesis of research that establishes both the need for sociotechnical integration and the obstacles to achieving it within engineering courses and curricula. Perhaps the biggest of the obstacles they identify is the “mismatch between how future engineers are taught and the decisions they will make as professionals” (p. 1). These first two sections of the paper provide a good foundation for creating
an authoritative review of literature on sociotechnical integration, an asset that would be of great value to engineering education generally and LEES in particular.

Like Leydens, Johnson, Claussen, Blacklock, Moskal, and Cordova, Andrade and Tomblin’s “Engineering and Sustainability: The Challenge of Integrating Social and Technical Issues into a Technical Course” and Waugaman, Tsai, and Zarske’s “Connection with First-Year Engineering Students’ Interest in Social Justice” exemplify the increasingly sophisticated assessment instruments that are being developed and used to assess whether various interventions to encourage sociotechnical integration are indeed achieving their objectives.

All of the papers in session T434: Imagining and Reimagining Engineering Education as a Dynamic System were focused in one way or another on why engineering education is so resistant to change. In “The Distributed System of Governance in Engineering Education,” Akera, Riley, Cheville, Karlin, and DePree report on research to increase understanding and awareness of “just how complex the U.S. system for engineering education is” and “how the structural conditions of engineering education define and limit the engineers’ diverse approach to educational innovation and reform.” They see “the epistemic habits of the engineers themselves—what engineers regard to be knowledge, and how they are trained to habitually act on that knowledge” as a major factor in the engineering education system. Like Leydens, Johnson, Claussen, Blacklock, Moskal, and Cordova, they provide a concise but information-rich summary of the background research they conducted for their study, background that should prove useful to people who want to better understand the dynamics that governed how we got where we are today in engineering education.

II. Diversity and Inclusion: Leveraging STS Research to Make Meaningful Change in Courses and Curricula and Illuminate the Connections Between Demographic Diversity and Intellectual Diversity

U434B: Diversity and Inclusion: Concepts, Mental Models, and Interventions
M5112A: Impacts of Sexual Harassment in Academic Science, Engineering, and Medicine (Panel Discussion)
W1112A: Revealing the Invisible: Engineering Course Activities That Address Privilege, -isms, and Power Relations (Interactive Session with a Single Paper Published in the Proceedings)
W2112: A Voice for Change—Building an Inclusive Future with Local Policy and Engineers (Distinguished Lecture)

Session U434B: “Diversity and Inclusion: Concepts, Mental Models” was the technical session most clearly focused on diversity and inclusion as broad categories. The four papers in this session illuminated the variety and creativity of approaches to promoting diversity and inclusion in both the curricular and extracurricular experience of undergraduate engineering students. The papers also problematized diversity and inclusion in a number of ways, including (1) the disparity between the intent and impact of diversity interventions and (2) the tension between exploring cultural differences in group work (for educational purposes) and minimizing differences to “get the work done.” We seem to have an emerging consensus that engaged reflection is essential for students to optimize their learning from intercultural interactions and other diversity interventions, but we have not yet determined what the most effective pedagogical strategies are for getting students to engage in meaningful reflection.
Two specific papers illustrate the ways in which the diversity and inclusion theme was developed. The first was the LEES nominee for Best Diversity Paper, and was selected as a finalist for Best Diversity Paper for the conference as a whole. The paper, titled “Diversity and Inclusion in Engineering: Students’ Perceptions of Learning and Engaging with Difference,” (Eddington, Zoltowski, Brightman, Joshi, Buzzanell, and Torres) was written by an integrative team of six people with diverse backgrounds and departmental affiliations, spanning a school of communication, electrical and computer engineering, and biomedical engineering. Each of the six authors is an example of an integrative individual. All have well-developed interests in engineering education in addition to at least one other distinct area of research. The authors describe their work as “qualitative analysis of interview data to explore the undergraduate students’ perceptions of diversity and inclusion within the School of Electrical and Computer Engineering (ECE) at Purdue University” but also see it as part of a “broader research project that is examining the seemingly intractable problems of diversity and inclusion that emerge from the converging threads of formation of professional identity and culture of engineering disciplines” (p. 1.) Among their many interesting findings were these: (1) “there were often inconsistencies between intent and impact of the ECE School’s efforts to incorporate D&I within the curriculum” (p. 4) and (2) “the transformational nature that reflection plays within establishing ways of viewing complex social problems” (p. 1)

The second paper illustrating the strength of the diversity discourse within LEES and ASEE provided the foundation for a workshop that we co-sponsored. Entitled “Revealing the Invisible: Conversations about –isms and Power Relations in Engineering Courses,” it illustrates a creative interdisciplinary approach. All four of the faculty are integrative individuals teaching in an innovative program, General Engineering at the University of San Diego. As part of an NSF Revolutionizing Engineering and Computer Science Departments (RED) grant, the authors describe themselves as “moving from teaching engineering as a purely technical endeavor to a sociotechnical endeavor” and recognizing that “discussing the social and ethical implications of engineering and technology is often a daunting task for both engineering students and instructors” (p. 1). They suggest “using engineering as a vehicle for inclusion and social justice rather than superficially accepting diversity” (p. 8) and provide numerous specific examples of how such an approach can be implemented in two specific courses: “Engineering and Social Justice” and “User-Centered Design.”

We also appear to agree on the need to get beyond addressing the diversity challenge in terms of numbers (as important as that is) and create the intellectual and institutional spaces that allow for the expression of multiple viewpoints and perspectives. One of the first steps toward creating those spaces is understanding the often implicit but nonetheless powerful ideas and values that constitute the culture of engineering. For example, it seems that particular notions of rigor in engineering create barriers to intercultural learning and and may have a particularly destructive effect in highly selective institutions.

III. Communication: Student Motivation, Embedded Instruction, and the Quest for Efficiency

U534B: Design, Assessment, and Redesign of Writing Instruction for Engineers
M434: Embedding Writing in Experiential Learning
W434: Maps, Metaphors, Tweets, and Drafts
Improving the communication competencies of engineers has been a dynamic, long-standing interest in ASEE generally and of LEES and its predecessors (Gianniny, 1995). The material presented at the 2018 conference featured strategies for achieving three interrelated goals: (1) increasing student motivation (changing the way students think about writing so that they will put forth more effort on writing tasks or in writing courses, example: Pulford, Tran, Gonzales, and Modell); (2) embedded instruction (integrating writing into educational experiences that are not entirely focused on developing writing ability, example: Bercich, Summers, Cornwell, and Mayhew); and (3) achieving greater efficiency (especially by developing shared resources and disseminating lessons derived from writing studies that allow instructors to break out of dysfunctional, labor-intensive traditional practices, example: Yoritomo, Turnipseed, Cooper, Elliott, Gallagher, Popovics, Prior, and Ziles).

“Embedding Writing in Experiential Learning” (Corneal, Morrow, Volz, Saterbak, Conrad, Pfeiffer, Lamb, and Kitch) addresses means of achieving all three of the interrelated goals and provides a good overview of the diversity of approaches used to integrate technical writing into experiential learning of various forms (co-op experiences, design courses, collaboration with practitioners, and throughout an engineering curriculum). A common theme in all of these interventions is improving student motivation and the efficacy of writing instruction by focusing on the kinds of communication that are actually used in engineering workplaces and practice. All three sessions demonstrated ways in which engineering faculty and practitioners have become engaged in helping students develop their communication abilities.

The papers presented in “Maps, Metaphors, and Tweets” shared the goal of making implicit aspects of learning and communication explicit, both to improve communication and to increase awareness of the representation-communication-learning relationship. The genres that the papers dealt with varied widely and included concept maps (Ferguson, Foley, Eshirow, and Pollack), product pitches/demonstrations (Randi, Harichandran, Levert, and Karimi), metaphors in presenting prototypes (Berezin), and political tweets (Carvill and Watt). All of the papers in this session were concerned with the social, cognitive, and transactional dimensions of communication.

Some of the most provocative questions raised in these papers related to linking writing to engineering identity, since it seems increasingly likely that the context in which students encounter writing shapes their perception of the role of writing in engineering.

**IV. The LEES-STS-Engineering Ethics Relationship: Common Interests, Complementary Roles, and Collaborative Possibilities**

- **U434A: Learning How to Be Socially Responsible Engineers—A Comparison of Methods and Lessons Learned (Panel Session)**
- **M334: Ethical Awareness and Social Responsibility in a Corporate/Team Context**
- **T534: Imagining Others, Defining Self Through Consideration of Ethical and Social Implications**
- **W220: It Takes More than Good Intentions—Do Engineers Have Responsibility for Social In/Justice? (Distinguished Lecture)**

The papers in session T334: Ethical Awareness and Social Responsibility in a Corporate/Team Context shared a macro-ethical perspective and focused on strategies for increasing student motivation for studying ethics, as well as the structural conditions that discourage and encourage
ethical awareness and social responsibility in corporate and team contexts. Like several other sessions at this year’s conference, the papers emphasized the importance of students learning to read and analyze the complex structures in which people act. Foreshadowing Deborah Johnson’s distinguished lecture, the presentations and discussion examined moral accountability as a social process, as an aspirational ideal, and as a set of skills (as opposed to just being opinions). They also explored the connection between engineering ethics and social justice.

The papers in session T534: Imagining Others, Defining Self Through Consideration of Ethical and Social Implications dealt with the need for and challenges of integrating ethical and social considerations (ESI) into engineering education and practice. A distinctive strength of these papers was their description of research approaches that can be used to discover and articulate the mental models used by engineering students, faculty, and practitioners to locate their enterprises within larger social contexts. The LEES nominee for PIC 3 Best Paper, “Examining the Relationships Between How Students Construct Stakeholders and the Ways Student Conceptualize Harm from Engineering Design” was presented in this session and exemplifies the invention and integration that were common throughout the LEES program. The authors of this paper (Alexis Papek, Ayush Gupta, and Chandra Turpen), all faculty at the University of Maryland, College Park, are integrative individuals. All three completed their bachelor’s degrees in Engineering Physics; are either research assistants or research assistant professors of Physics; are members of the Physics Education Research group; and are engaged in a broad range of educational research, mostly at “the intersection of ethnic studies, critical pedagogies, and STEM teaching and learning” (author’s biographical sketch) with a focus on engineering design and equitable change in STEM programs.

The diversity of the authors’ expertise and interests was reflected in the qualities that the selection committee for LEES best paper focused in in explaining its choice of this paper. “The examination of student engagement with ethics and ethical reasoning builds on past work on the mismatch between engineering-science dominated engineering curricula and the assumptions students carry into their enrollment within an engineering school. The work presented in this paper provides an empirical depth to this observation, while also exploring other dimensions of the student’s moral and ethical engagement and development. The methods are innovative and robust, and the authors’ theoretical arugmentation based on the empirical results is also impressive.”

V. Interweaving All Four Themes

U434C: Learning Outcomes and Pedagogical Strategies: Problems of Alignment
U534A: Communicating Across Cultural and Epistemological Boundaries
M534: Who’s in the Driver’s Seat of Engineering Education? (Interdivisional Town Hall Meeting)
W134: Seeking Resilience and Learning to Thrive Through Engineering

The sessions that interwove all four themes reveal that, although we have yet to overcome the cognitive and cultural barriers to integrating LEES content and perspectives into engineering education and practice, we have made progress in identifying and naming the behaviors and ideas that make integration difficult. These include “epistemic habits” and the bias they create; knowledge hierarchies, which are mostly tacit but seem to play a crucial role in the formation of
engineering identity and profoundly affect the way engineering students view non-technical content and faculty; and the tendency of concepts such as “empathy” and “human centered design” to lose nuance and depth when they become part of the discourse of engineering education.

Session U434C: Learning Outcomes and Pedagogical Strategies: Problems of Alignment explored the extent to which the articulated outcomes of engineering education align (or not) with the design of courses and curricula, the expertise of individual faculty members, and the terms and educational theories we use to describe the education of young adults, including engineering students. Like other sessions, this one highlighted the mismatch between the expertise of most engineering faculty and the requirements of preparing undergraduates to practice engineering. Perhaps one way to characterize the role of LEES faculty in engineering education is that we are brought in to compensate for that mismatch. Graham and Porterfield’s “Preparing Today’s Engineering Graduate: An Empirical Study of Professional Skills Required by Employers” compared the language used by ABET to describe non-technical skills with that used in advertisements for engineering jobs and found many inconsistencies in the categories and terminology used. As the faculty responsible for helping students develop non-technical skills and competencies, we may have an important role to play in establishing more consistency.

Session 534A: Communicating Across Cultural and Epistemological Boundaries raised the longest list of issues and potential research topics. One of the strongest unifying themes of the session, however, was the challenging of integrating social justice into the engineering curriculum and on the links between intellectual diversity and demographic diversity. The four papers identified several different kinds of boundaries:

- Between the disciplinary expertise of engineering and that of design, specifically human-centered design;
- Between engineering designers and the stakeholders the designs are supposed to benefit;
- Between engineering colleagues who have experienced various forms of marginalization in the workplace and those who have not experienced marginalization; and
- Between various engineering disciplines treating the same broad topic.

These boundaries seem to emerge most clearly in attempts to integrate social justice into the engineering curriculum, though they operate in many other contexts as well, and are particularly visible in the ongoing problems that we face with terminology and the mental models underlying different sets of terms.

Session W134: Seeking Resilience and Learning to Thrive Through Engineering Education wove together the four threads and themes in the exploration of what might be called the human dimension of engineering education, in other words, recognizing that the students we are educating and the faculty charged with facilitating their education are human beings, not machines. The authors were not suggesting that challenging circumstances can or should be avoided, but, rather, that the growth that can result of dealing with challenges—and even trauma—requires purposeful action and a mindful approach. The papers demonstrated several different strategies for conducting rigorous research related to the human dimension of engineering education in areas like understanding differences between departments, programs,
and institutions with respect to student experiences of belonging stress, and coping. Their efforts to recognize and change the culture of engineering with the goal of enhancing human flourishing, specifically the flourishing of students, if successfully implemented, would truly constitute a sea change in engineering education.

**Conclusion: Embryonic Sea Change and the Seeds of Transformation**

It seems clear that engineering education as a whole has not been transformed through the implementation of the EC2000 criteria. On the other hand, we also have not experienced curricular anarchy, and we have seen numerous instances of invention by and integration of faculty. Perhaps the most encouraging phenomenon that has emerged over the last 15 years is the growing numbers of integrative individuals who can in turn form integrative teams and design integrative educational experiences. From an intellectual perspective, the most important development has been the emergence and growing dominance of sociotechnical systems thinking (STST), which allows all of the stakeholders involved in engineering education to see themselves as part of the same enterprise. We have a better understanding of why we need STST and, at least as importantly, a better understanding of why it is difficult to integrate STST into the engineering curriculum. Our success in deepening and broadening the discourse on diversity within ASEE is from one perspective not surprising: within engineering education, we are a marginalized group, and we have exceptional intellectual tools with which to analyze the sources of that marginalization. Our experience over the last 15 years has made it clear that changing the evaluation criteria and the assessment approach are not the same as changing the faculty who make up the assessment teams or the culture in which they were formed as professionals. Perhaps our most important imperative moving forward is to cultivate and increase the numbers of integrative individuals who do have the potential, eventually, to bring about a sea change.

**References**


Papers Published in the Proceedings of the American Society for Engineering Education, 2018


Keogh, M., Zarske, M. & Tsai, J. Y. (2018). Active Learning Group Work: Helpful or Harmful for Women in Engineering?


Appendix A. Liberal Education/Engineering & Society (LEES) Complete Conference Program -- 2018
Sunday, June 24

U434A · Learning How to be Socially Responsible Engineers – A Comparison of Methods and Lessons Learned
Panel · Liberal Education/Engineering & Society Division; joint session with Community Engagement and Ethics
Sun. June 24, 2018 1:15 PM to 2:45 PM
Room 151 F, Convention Center - Salt Palace

As engineering students go through college and transition into the workforce, they assume significant responsibility for individuals and society based on their decisions. Problematically, multiple recent studies have shown that as they progress through college, many students become less engaged in the societal implications of their work, and their sense of social responsibility decreases. Therefore, we recognize the imperative of providing time and space for students to learn and engage with their future social responsibilities as engineers. Within ASEE, we have decades of experience teaching and researching about ethics, social responsibility, and social justice in engineering. Our students will face many more complex challenges in the future, and we feel it is time to have a conversation about best practices for various educational environments.

In this panel session, four faculty members who have significant experience teaching in this space at their various universities will share their methods to facilitate learning about social responsibility. They will have stories to tell about trying to integrate ethics into their core engineering courses, collaborating with community members in service-learning projects, teaching a course focused entirely on engineering for social and environmental responsibility, and delivering an engineering for social justice class. We also aim to have a variety of engineering disciplines and university contexts represented.

Speakers

1. Dr. Juan C. Lucena, Colorado School of Mines, Engineering and Social Justice at Colorado School of Mines
2. Dr. Nathan E Canney P.E. Integrated social responsibility through service learning at Seattle University
3. Dr. Angela R Bielefeldt P.E., University of Colorado, Boulder, Explicit engineering professional responsibility course at CU Boulder
4. Dr. James L. Huff, Harding University, Electrical engineering course with social responsibility considerations

U434B · Diversity and Inclusion: Concepts, Mental Models, and Interventions
Technical · Liberal Education/Engineering & Society Division
Sun. June 24, 2018 1:15 PM to 2:45 PM
Room 151 C, Convention Center - Salt Palace
Moderated by Dr. Kathryn A. Neeley

Papers Presented

1. **Dimensions of Diversity in Engineering: What We Can Learn from STS** [view paper] Dr. Toluwalogo Odumosu (University of Virginia), Dr. Sean Ferguson (University of Virginia), Dr. Rider W. Foley (University of Virginia), Dr. Kathryn A. Neeley (University of Virginia), Dr. Caitlin Donahue Wylie (University of Virginia), Dr. Sharon Tsai-hsuan Ku (University of Virginia), and Prof. Rosalyn W. Berne (University of Virginia)

2. **Diversity and Inclusion in Engineering: Students’ Perceptions of Learning and Engaging with Difference** [view paper] Mr. Sean M. Eddington (Purdue University, West Lafayette), Dr. Carla B. Zoltowski (Purdue University, West Lafayette), Dr. Andrew O. Brightman (Purdue University, West Lafayette), Dr. Rucha Joshi (Purdue University, West Lafayette), Prof. Patrice Marie Buzzanell (Purdue University, West Lafayette), and David Torres (Purdue University, West Lafayette) Finalist for Best Diversity Paper

3. How Theater Can Promote Inclusive Engineering Campuses [view paper] Dr. David DiBiasio (Worcester Polytechnic Institute), Kristin Boudreau (Worcester Polytechnic Institute), and Ms. Paula Quinn (Worcester Polytechnic Institute)

4. **Active Learning Group Work: Helpful or Harmful for Women in Engineering?** [view paper] Ms. Megan Keogh (University of Colorado, Boulder), Dr. Malinda S. Zarske (University of Colorado, Boulder), and Dr. Janet Y. Tsai (University of Colorado, Boulder)

U434C·Learning Outcomes and Pedagogical Strategies: Problems of Alignment
Technical · Liberal Education/Engineering & Society Division
Sun. June 24, 2018 1:15 PM to 2:45 PM
Room 257 A, Convention Center - Salt Palace

Moderated by Dr. Jerry W. Gravander

Papers Presented

1. **Preparing Today’s Engineering Graduate: An Empirical Study of Professional Skills Required by Employers** [view paper] Mr. Robert Graham (Johns Hopkins University) and Dr. Tobin Porterfield (Towson University)

2. **Faculty Perceptions of the Most Effective Settings and Approaches for Educating Engineering and Computing Students About Ethics and Societal Impacts** [view paper] Ms. Madeline Polmear (University of Colorado, Boulder), Dr. Angela R. Bielefeldt (University of Colorado, Boulder), Dr. Daniel Knight (University of Colorado, Boulder), Dr. Nathan E. Canney (CYS Structural Engineers Inc.), and Dr. Chris Swan (Tufts University)

3. **A Broader Look at The Role of Andragogy in Engineering Education** [view paper] Col. Richard Melnyk (United States Military Academy), Lt. Col. Brian J. Novoselich (United States Military Academy), and Dr. Gregory Martin Freisinger (United States Military Academy)
U534A·Communicating Across Cultural and Epistemological Boundaries
Technical·Liberal Education/Engineering & Society Division
Sun. June 24, 2018 3:00 PM to 4:30 PM
Room 151 F, Convention Center - Salt Palace

Moderated by Dr. Judith Shaul Norback

Papers Presented

1. **Engineering/Design Frictions: Exploring Competing Knowledge Systems via Efforts to Integrate Design Principles into Engineering Education** [view paper] Dr. Dean Nieusma (Rensselaer Polytechnic Institute)

2. **From 'Empathic Design' to 'Empathic Engineering': Toward a Genealogy of Empathy in Engineering Education** [view paper] Dr. Xiaofeng Tang (Ohio State University)

3. **Where's My Code? Engineers Navigating Ethical Issues on an Uneven Terrain** [view paper] Dr. Cindy Rottmann (University of Toronto), Dr. Doug Reeve (University of Toronto), Dr. Robin Sacks (University of Toronto), and Mr. Mike Klassen (University of Toronto)

4. **Reimagining Energy: Deconstructing Traditional Engineering Silos Using Culturally Sustaining Pedagogies** [view paper] Dr. Gordon D. Hoople (University of San Diego), Dr. Joel Alejandro Mejia (University of San Diego), Dr. Diana A. Chen (University of San Diego), and Dr. Susan M. Lord (University of San Diego)

U534B·Design, Assessment, and Redesign of Writing Instruction for Engineers
Technical·Liberal Education/Engineering & Society Division
Sun. June 24, 2018 3:00 PM to 4:30 PM
Room 151 G, Convention Center - Salt Palace

Moderated by Dr. Deanna H Matthews

Papers Presented

1. **Examining engineering writing instruction at a large research university through the lens of writing studies** [view paper] John Y. Yoritomo (University of Illinois at Urbana-Champaign), Nicole Turnipseed (University of Illinois at Urbana Champaign), Prof. S. Lance Cooper (University of Illinois at Urbana-Champaign), Celia Mathews Elliott (University of Illinois at Urbana-Champaign), Dr. John R. Gallagher (University of Illinois at Urbana-Champaign), Prof. John S. Popovics (University of Illinois at Urbana-Champaign), Prof. Paul Prior (University of Illinois at Urbana-Champaign), and Julie L Zilles (University of Illinois Urbana Champaign)

2. **Satisfaction: Intrinsic and Extrinsic Motivation in Engineering Writing Coursework** [view paper] Dr. Stephanie Pulford (University of California, Davis), Jiahui Tan (University of California, Davis), Michael Raymond Gonzalez (University of California, Davis), and Ms. Amanda Modell (University of California, Davis)
3. **Beyond Drag and Drop: Balancing Experience and Innovation in Online Technical Communication Course Development** [view paper]Jessica Livingston (Rose-Hulman Institute of Technology), Dr. Sarah Summers (Rose-Hulman Institute of Technology), and Mary Jane Szabo (Rose-Hulman Institute of Technology)

4. **Technical Communication Across the ME Curriculum at Rose-Hulman** [view paper]Dr. Rebecca Bercich (Rose-Hulman Institute of Technology), Dr. Sarah Summers (Rose-Hulman Institute of Technology), Dr. Phillip Cornwell (Rose-Hulman Institute of Technology), and James Mayhew (Rose-Hulman Institute of Technology)

Monday, June 25

**M334· Ethical Awareness and Social Responsibility in a Corporate/Team Context**
Technical: Liberal Education/Engineering & Society Division
Mon. June 25, 2018 11:30 AM to 1:00 PM
Room 355 A, Convention Center - Salt Palace

**Moderated by** Prof. Rosalyn W Berne

Papers Presented

1. **Social Responsibility in Engineering Education and Practice: Alignments, Mismatches, and Future Directions** [view paper]Dr. Jessica Mary Smith (Colorado School of Mines) and Dr. Juan C. Lucena (Colorado School of Mines)

2. **Exploring Team Social Responsibility in Multidisciplinary Design Teams** [view paper]Katharine E. Miller (Purdue University, West Lafayette), Dr. Carla B. Zoltowski (Purdue University, West Lafayette), Prof. Patrice Marie Buzzanell (University of South Florida), David Torres (Purdue University, West Lafayette), Danielle Corple (Purdue University), and Dr. Megan Kenny Feister (California State University, Channel Islands)

3. **Project-based Learning as a Vehicle for Social Responsibility and Social Justice in Engineering Education** [view paper]Dr. Greg Rulifson P.E. (Colorado School of Mines), Dr. Carrie J. McClelland P.E. (Colorado School of Mines), and Dr. Linda A. Battalora (Colorado School of Mines)

4. **Developing an Integrated Curriculum-wide Teamwork Instructional Strategy** [view paper]Dr. Natasha D. Mallette P.E. (Oregon State University), Michelle Kay Bothwell (Oregon State University), and Dr. Christine Kelly (Oregon State University)

**M434· Panel: Embedding Writing in Experiential Learning**
Technical: Liberal Education/Engineering & Society Division
Mon. June 25, 2018 1:30 PM to 3:00 PM
Room 255 F, Convention Center - Salt Palace

**Moderated by** Dr. Lindsay Corneal
Panel: Embedding Technical Writing with Experiential Learning Components into Engineering Curricula [view paper] Dr. Lindsay Corneal (Grand Valley State University), Ms. Debbie Morrow (Grand Valley State University), Dr. Tracy Volz (Rice University), Dr. Ann Saterbak (Duke University), Dr. Susan Conrad (Portland State University), Mr. Timothy James Pfeiffer P.E. (Foundation Engineering, Inc.), Kenneth Lamb (California State Polytechnic University, Pomona), and Dr. William A. Kitch (Angelo State University)

M5112A·Impacts of Sexual Harassment in Academic Science, Engineering, and Medicine

Responding to growing awareness of sexual harassment in academia, the Committee on Women in Science, Engineering, and Medicine (CWSEM) of the National Academies of Sciences, Engineering, and Medicine initiated a study on the impacts of sexual harassment on the career advancement of women in these disciplines in academia. The study committee conducted (1) a review of research on the extent to which women are victimized by sexual harassment, (2) an examination of information on the extent to which sexual harassment in academia negatively impacts the recruitment, retention, and advancement of women p ... (continued)

Moderated by Dr. Frazier Benya

Speakers

1. Dr. Frazier Benya, National Academy of Engineering
2. Dr. Alice Merner Agogino, Roscoe and Elizabeth Hughes Professor of Mechanical Engineering at the University of California, Berkeley
3. Dr. Nicholas Arnold, Professor of Engineering at Santa Barbara Community College
4. Dr. Gilda A. Barabino, Dean of Engineering at The City College of the City University of New York

M534·2018 Interdivisional Town Hall Meeting: Who's in the Driver's Seat of Engineering Education?

Panel: Liberal Education/Engineering & Society Division, Aerospace Division, ASEE Board of Directors, Biological and Agricultural Engineering Division, Chemical Engineering Division, Biomedical Engineering Division, College Industry Partnerships Division, Community Engagement Division, Computers in Education Division, Computing and Information Technology Division, Construction Engineering Division, Continuing Professional Development Division, Design in Engineering Education Division, Cooperative and Experiential Education Division, Educational Research and Methods Division, Energy Conversion and Conservation Division, Engineering and Public Policy Division, Engineering Design Graphics Division, Engineering Deans Council, Engineering Libraries Division, Engineering Management Division, Engineering Physics and Physics Division, Entrepreneurship & Engineering Innovation Division, Manufacturing Division, Mathematics Division, Mechanical Engineering Division, Mechanics Division, Military and Veterans Division, New Engineering Educators Division, Ocean and Marine...
Mon. June 25, 2018 3:15 PM to 4:45 PM
Grand Ballroom I & J, Convention Center - Salt Palace

For this year’s Interdivisional Town Hall Meeting, participants will be given an opportunity to share their experiences in transforming engineering education, while also contributing directly to a National Science Foundation-sponsored study on this topic. Unlike medicine, the engineering profession establishes new standards for engineering education through a distributed system of gove... (continued)

Moderated by Dr. Atsushi Akera and Prof. Joe Tranquillo

Speakers

1. **Dr. Atsushi Akera**, Rensselaer Polytechnic Institute

   Dr. Akera is an Associate Professor in the Department of Science and Technology Studies at Rensselaer, and does research on the history of engineering education reform. He is author of /Calculating a Natural World: Scientists, Engineers, and Computers during the Rise of U.S. Cold War Research (2006) form MIT Press. He also serves as the Chair of the Ad Hoc Committee on Interdivisional Cooperation.

2. **Dr. Donna M Riley**, Purdue University-Main Campus, West Lafayette (College of Engineering)

   Dr. Riley is the Kamyar Haghighi Head of the School of Engineering Education at Purdue University, and has served as Program Director for Engineering Education at NSF. She is the author of two books, /Engineering and Social Justice/ and /Engineering Thermodynamics and 21st Century Energy Problems/, both published by Morgan and Claypool. She is a fellow of the American Society for Engineering Education.

3. **Dr. Alan Cheville**, Bucknell University

   Dr. Cheville is Department Chair and the T. Jefferson Miers Chair in Electrical Engineering at Bucknell University. Active in engineering as well as engineering education research, he conducts work on Optoelectronically generated THz spectroscopy and imaging, and the study of engineering education systems and learning environments. He has served as the NSF Program Director for Engineering Education Education (2010-2012), and holds the NSF Director's Award for Program Management Excellence (2012).

4. **Dr. Jennifer Karlin**, Minnesota State University, Mankato

   Dr. Karlin is Research Professor at the Minnesota State University, Mankato. She holds a PhD in Industrial and Operations Engineering from the University of Michigan, and does extensive research in engineering education in the areas of student development, faculty development, organizational development, operational excellence, and regional economic development.
Tuesday, June 26

T432·Globalizing Engineering Education? A Retrospective on the Newport Declaration
Panel·International Division
Tue. June 26, 2018 1:30 PM to 3:00 PM
Room 355 A, Convention Center - Salt Palace

Released in 2008 in the wake of a National Science Foundation-sponsored summit meeting, The Newport Declaration to Globalize U.S. Engineering Education was initially endorsed by 19 signatories and later attracted nearly 50 more signatures of support. The document built a strong case for enhancing the ability of all engineering students to span national and cultural boundaries, in turn calling on educators, administrators, and policymakers to “integrate global education into the engineering curriculum to impact all students.” Since the release of the Newport Declaration, the number of engineering s ... (continued)

Moderated by Prof. Brent K. Jesiek

Speakers

1. Dr. Larry J. Shuman, University of Pittsburgh

   Larry J. Shuman is a Distinguished Service Professor of Industrial Engineering, University of Pittsburgh, having recently stepped down as Senior Associate Dean for Academic Affairs. In that latter position he led the development of a very successful cooperative engineering education program and an innovative study abroad program. This included the “Plus3” integrated field trip abroad for rising engineering and business sophomores, which received the 2005 Heiskell Award from the Institute for International Education for “Innovations in Study Abroad,” the INNOVATE program (initially with Rice Univ ... (continued)

2. Prof. Kent J Rissmiller

   Kent Rissmiller, Ph.D., JD, is Dean, ad interim, of the Interdisciplinary and Global Studies Division at Worcester Polytechnic Institute, Worcester, MA. He has also been the Associate Dean of the Division since 2006. As Dean, he is responsible for WPI’s Global Projects Program which provides off-campus project opportunities for nearly 1000 students and their faculty advisers at 50 project centers in 26 countries. In addition, he is active in assessing student learning in the global program and has co-authored papers on the impact of program participation on WPI alumni. Prof. Rissmiller is also an associate professor in Social Science and Policy Studies at WPI.

3. Dr. Niko Tracksdorf, University of Rhode Island
Niko Tracksdorf joined the University of Rhode Island as Assistant Professor of German and Associate Director of the German International Engineering Program in June 2018. His research and teaching focuses on German for Engineers, intercultural competence, and online and blended learning. In his previous positions as coordinator for the German IEP at URI, and as assistant for the Eurotech program at the University of Connecticut, he helped prepare engineering students linguistically and culturally for international study, research, and internship opportunities. He is currently serving on the AATG ... (continued)

4. **Dr. Yannis C. Yortsos**, University of Southern California

Yannis C. Yortsos is the Dean of the USC Viterbi School of Engineering and the Zohrab Kaprielian Chair in Engineering. He received a BS degree from the National Technical University of Athens, Greece, and MS and PhD degrees from the California Institute of Technology, all in chemical engineering. He was elected to the National Academy of Engineering in 2008 where he also serves as a member of the NAE Council. Yortsos is an honorary member of the AIME (2011), of the Academy of Athens (2013), a recipient of the Ellis Medal of Honor (2014) and an honorary professor at Tsinghua University (2017). As d ... (continued)

5. **E. Daniel Hirleman**, Purdue University

E. Daniel Hirleman Jr. joined Purdue as Chief Corporate and Global Partnerships Officer in 2014 with responsibility for substantially growing research and education partnerships with the private sector, and for strategic global partnerships with nations, universities, NGOs and companies. He serves as Purdue’s Senior International Officer, and in 2015 and 2016 was Senior Intellectual Property Officer. Dr. Hirleman has also served in faculty and administrative roles at Arizona State and University of California, Merced. He has received the INEER Int’l Achievement Award, the Hon. George Brown Award ... (continued)

6. **Prof. Gayle G. Elliott**, University of Cincinnati

Gayle Elliott earned undergraduate and graduate degrees at the University of Cincinnati (UC). She is a Professor of Experiential Learning and has been responsible for UC’s International Co-op Program (ICP) for 25 years. She has extensive experience preparing students, developing international co-op jobs, and developing international exchange programs.

7. **Prof. Brent K Jesiek**, Purdue University-Main Campus, West Lafayette (College of Engineering)

Brent K. Jesiek is an Associate Professor in the Schools of Engineering Education and Electrical and Computer Engineering at Purdue University. He is currently chair of the Engineering Education graduate program at Purdue, and is a former Associate Director of
Global Engineering Programs at Purdue. He also leads the Global Engineering Education Collaboratory (GEEC) research group, and is the recipient of an NSF CAREER award to study boundary-spanning roles and competencies among early career engineers.

T434: Imagining and Reimagining Engineering Education as a Dynamic System

Technical - Liberal Education/Engineering & Society Division
Tue. June 26, 2018 1:30 PM to 3:00 PM
Room 255 C, Convention Center - Salt Palace

Moderated by Dr. Dean Nieusma

Papers Presented

1. The Distributed System of Governance in Engineering Education: A Report on Initial Findings [view paper]Dr. Atsushi Akera (Rensselaer Polytechnic Institute), Dr. Donna M. Riley (Purdue University, West Lafayette), Dr. Alan Cheville (Bucknell University), Dr. Jennifer Karlin (Minnesota State University, Mankato), and Thomas A. De Pree (Rensselaer Polytechnic Institute)

2. Building Your Change-agent Toolkit: The Power of Story [view paper]Dr. Jennifer Karlin (Minnesota State University, Mankato), Prof. Rebecca A. Bates (Minnesota State University, Mankato), Dr. Cheryl Allendoerfer (University of Washington), Dr. Dan Ewert (Anderson Industries), and Mr. Ronald R. Ulseth (Itasca Community College)

3. Scaling Up or Scale-making? Examining Sociocultural Factors in a New Model for Engineering Mathematics Education [view paper]Dr. Janet Y. Tsai (University of Colorado, Boulder), Kevin O'Connor (University of Colorado, Boulder), Dr. Beth A. Myers (University of Colorado Boulder), Dr. Jacquelyn F. Sullivan (University of Colorado, Boulder), Prof. Derek T. Reamon (University of Colorado, Boulder), and Dr. Kenneth M. Anderson (University of Colorado, Boulder)

T534: Imagining Others, Defining Self Through Consideration of Ethical and Social Implications

Technical - Liberal Education/Engineering & Society Division
Tue. June 26, 2018 3:15 PM to 4:45 PM
Room 155 F, Convention Center - Salt Palace

Moderated by Dr. Sara A. Atwood

Papers Presented

1. Examining the Relationships Between How Students Construct Stakeholders and the Ways Students Conceptualize Harm from Engineering Design [view paper]Alexis Papak
(University of Maryland, College Park), Dr. Ayush Gupta (University of Maryland, College Park), and Dr. Chandra Anne Turpen (University of Maryland, College Park)

**LEES Nominee for PIC 3 Best Paper:** The committee were impressed with the focus on student perspectives. The examination of student engagement with ethics and ethical reasoning builds on past work on the mismatch between engineering-science dominated engineering curricula and the assumptions students carry into their enrollment within an engineering school. This work provides an empirical depth to this observation, while also exploring other dimensions of the student’s moral and ethical engagement and development. The methods are innovative and robust and the authors’ theoretical argumentation based on the empirical results is also impressive.

2. **Engineers’ Imaginaries of 'The Public': Dominant Themes from Interviews with Engineering Students, Faculty, and Professionals** [view paper]Dr. Nathan E. Canney (CYS Structural Engineers Inc.)

3. **Exploring Students’ and Instructors’ Perceptions of Engineering: Case Studies of Professionally Focused and Career Exploration Courses** [view paper]Dr. Idalis Villanueva (Utah State University), Dr. Louis S. Nadelson (Colorado Mesa University), Dr. Jana Bouwma-Gearhart (Affiliation unknown), Katherine L. Youmans (Utah State University), Sarah Lanci (Colorado Mesa University), and Dr. Adam Lenz (Oregon State University)

4. **Challenges and Opportunities in International Service Learning** [view paper]Dr. Tina Lee (University of Wisconsin-Stout), Dr. Devin R. Berg (University of Wisconsin-Stout), and Dr. Elizabeth A. Buchanan (University of Wisconsin-Stout)

**Wednesday, June 27**

**W1112A·Revealing the Invisible: Engineering Course Activities that Address Privilege, -Isms, and Power Relations (Interactive Session)**

*NOTE: The session information below is the most current information and differs from the printed program guide.*

**Panel** - ASEE Diversity Committee, Faculty Development Constituency Committee, Design in Engineering Education Division, Liberal Education/Engineering & Society Division, International Division, and Minorities in Engineering Division

**Wed. June 27, 2018 8:00 AM to 9:30 AM**
Salon H, HQ Hotel - Marriott at City Creek

Privilege is often not recognizable by those who benefit from the consequential unearned advantages (McIntosh, 2010). Undetected, this “invisible knapsack,” as defined by Peggy McIntosh, perpetuates through intergenerational inheritance, normalizing the resulting inequities. In the United States there are entrenched notions of superiority and inferiority tied to many socially constructed identities such as race, ethnicity, gender, and socio-economic status. The subsequent hierarchies place whiteness, European traditions, masculinity and middle-to-high socioeconomic status at the top, entitling tho ... (continued)

Speakers
1. **Dr. Odesma Onika Dalrymple**, University of San Diego, Assistant Professor, Industrial Engineering
2. **Dr. Susan M Lord**, University of San Diego, Professor & Chair, General Engineering
3. **Diana Chen**, University of San Diego, Assistant Professor, General Engineering
4. **Dr. Joel Alejandro Mejia**, University of San Diego, Assistant Professor, General Engineering

Papers Presented

1. **Revealing the Invisible: Conversations about -Isms and Power Relations in Engineering Courses** [view paper] Dr. Joel Alejandro Mejia (University of San Diego), Dr. Diana A. Chen (University of San Diego), Dr. Odesma Onika Dalrymple (University of San Diego), and Dr. Susan M Lord (University of San Diego)

**W134· Seeking Resilience and Learning to Thrive Through Engineering Education**

*Technical· Liberal Education/Engineering & Society Division*

Wed. June 27, 2018 8:00 AM to 9:30 AM
Room 260 B, Convention Center - Salt Palace

1. **Moderated by** Mr. Jared David Berezin

Papers Presented

1. **Thriving for Engineering Students and Institutions: Definition, Potential Impact, and Proposed Conceptual Framework** [view paper] Ms. Julianna Sun Ge (Purdue University, West Lafayette) and Dr. Edward J. Berger (Purdue University, West Lafayette)


3. **Work in Progress: Understanding Student Perceptions of Stress as Part of Engineering Culture** [view paper] Dr. Karin Jensen (University of Illinois, Urbana-Champaign) and Dr. Kelly J. Cross (University of Illinois, Urbana-Champaign)

4. **Fostering Engineering Thinking in a Democratic Learning Space: A Classroom Application Pilot Study in the Azraq Refugee Camp, Jordan** [view paper] Mr. Claudio Cesar Silva de Freitas (Purdue University, West Lafayette), Zachary James Beyer (Purdue University, West Lafayette), Mr. Hassan Ali Al Yagoub (Purdue University, West Lafayette), and Prof. Jennifer DeBoer (Purdue University, West Lafayette)

**W2112·DISTINGUISHED LECTURE: A Voice for Change – Building an Inclusive Future with Local Policy and Engineers**

*Dist. Lecture· ASEE Diversity Committee, Environmental Engineering Division, Civil Engineering Division, Community Engagement Division, Energy Conversion and Conservation Division, Liberal Education/Engineering & Society Division, and Engineering Ethics Division*

Wed. June 27, 2018 9:45 AM to 11:15 AM
Room 155 E, Convention Center - Salt Palace
Since the Year of Action on Diversity, the social and political landscape of the United States has changed significantly. Finding ways to bridge divides is more important now than ever. In 2015, the very conservative Salt Lake City elected its second female, and first openly gay, mayor. Mayor Jackie Biskupski brought a vision for the future that built on the best of the city's culture as a community that values the environment, mutual support, and high quality of life. She also brought her understanding of how important vibrant small and large business activity is for a thriving community. See ... (continued)

Speaker

Jackie Biskupski

Mayor, Salt Lake City

Jackie Biskupski took office as Salt Lake City mayor on January 4, 2016. Her political career also includes 13 years as a member of the Utah House of Representatives from 1998 to 2011, where she made history as the state’s first openly gay elected official.

The Mayor’s top priorities include economic development, homelessness, air quality, affordable housing, and creating an inclusive and welcoming city. She is focused on building a city that fosters equity, opportunity, and hope for everyone.

She has worked throughout her career to mentor others--particularly young women--in politics, publ ... (continued)

W220-DISTINGUISHED LECTURE: It Takes More Than Good Intentions – Do Engineers Have Responsibility for Social In/Justice?

Dist. Lecture · Engineering Ethics Division and Liberal Education/Engineering & Society Division
Wed. June 27, 2018 9:45 AM to 11:15 AM
Room 155 D, Convention Center - Salt Palace

The idea that engineering makes a positive contribution to human well-being is a central aspect of engineering identity and a particularly important motivation to current undergraduate engineering students. The Grand Challenges put forward by the National Academy of Engineering, for example, take as their foundation the belief that the 20th century was a time in which “engineering revolutionized and improved virtually every aspect of human life.” From a historical perspective, however, the relationship between engineering and social justice is complicated, particularly to the extent that engineers work for employers and their clients under the demands of business environments.

Deborah G. Johnson, one of the leading experts in engineering ethics, has recently suggested that the social responsibility of engineers should be understood not as the product of a social contract between the profession and society, but rather as a form of accountability in which engineers and the organizations of which they are a part assume obligations to explain and justify behavior and share norms regarding what needs to be explained, what counts as an adequate explanation, and what consequences might follow. As Johnson aptly points out, “Engineers are not required to
explain or justify their behavior to publics until something goes wrong or until engineers—in the act of whistleblowing—bring something to the attention of a public.” Johnson urges us to pay attention to the ways in which the “social responsibilities of engineers are constructed and manifested through concrete practice in which norms and expectations are manifested and enforced.” The integration of engineering ethics with the perspectives of Science, Technology, and Society (STS) provides a framework for understanding the interaction between norms, expectations, and practices. In this lecture, Johnson will provide a roadmap for such integration.

Speaker

1. **Dr. Deborah Johnson**

   University of Virginia

   Deborah G. Johnson recently retired as the Anne Shirley Carter Olsson Professor of Applied Ethics in the Department of Science, Technology, and Society in the School of Engineering and Applied Sciences of the University of Virginia. Johnson received the John Barwise prize from the American Philosophical Association in 2004; the Sterling Olmsted Award from the Liberal Education Division of the American Society for Engineering Education in 2001; and the ACM SIGCAS Making a Difference Award in 2000. Johnson is the author or editor of *Computer Ethics*, *Computers, Ethics, and Social Values* (co-edited... (continued)

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**W334B·Undergraduate Peer Educators: Mentoring, Observing, Learning**  
*Technical·Liberal Education/Engineering & Society Division*  
**Wed. June 27, 2018 11:30 AM to 1:00 PM**  
**Room 151 C, Convention Center - Salt Palace**

1. **Moderated by** Dr. Rider Foley [change from published program]

  **Papers Presented**

1. **Successes and Challenges in Supporting Undergraduate Peer Educators to Notice and Respond to Equity Considerations within Design Teams**  
   [view paper]Dr. Chandra Anne Turpen (University of Maryland, College Park), Dr. Ayush Gupta (University of Maryland, College Park), Dr. Jennifer Radoff (University of Maryland, College Park), Andrew Elby (University of Maryland, College Park), Hannah Sabo (Affiliation unknown), and Dr. Gina Marie Quan (University of Maryland, College Park)

2. **Motivational Factors of Undergraduate Engineering Students in Introductory Non-technical Courses**  
   [view paper]Dr. YunJeong Chang (University of Virginia) and Dr. Rider W. Foley (University of Virginia)

3. **Peer Review and Reflection in Engineering Labs: Writing to Learn and Learning to Write**  
   [view paper]Dr. Vanessa Svihla (University of New Mexico), Ms. Catherine Anne Hubka (University of New Mexico), and Prof. Eva Chi (University of New Mexico)
4. Using Undergraduate Mentors to Scale the Teaching of Engineering Writing [view paper] Mr. Michael Alley (Pennsylvania State University, University Park)

W334C·Embedding Sociotechnical Systems Thinking I
Technical · Liberal Education/Engineering & Society Division
Wed. June 27, 2018 11:30 AM to 1:00 PM
Room 155 A, Convention Center - Salt Palace

Moderated by Dr. Amber Genau [change from published program]

Papers Presented

1. Measuring Change over Time in Sociotechnical Thinking: A Survey/validation Model for Sociotechnical Habits of Mind [view paper] Dr. Jon A. Leydens (Colorado School of Mines), Dr. Kathryn Johnson (Colorado School of Mines), Dr. Stephanie Claussen (Colorado School of Mines), Prof. Jenifer Blacklock (University of Colorado, Boulder), Dr. Barbara M. Moskal (Texas Tech University), and Olivia Cordova (Colorado School of Mines)

2. Engineering and Sustainability: The Challenge of Integrating Social and Ethical Issues into a Technical Course [view paper] Dr. Natasha A. Andrade (University of Maryland, College Park) and Dr. David Tomblin (University of Maryland, College Park)

3. Connecting with First-year Engineering Students’ Interest in Social Justice Issues through Ethics Lessons to Sustain Student Retention in Engineering [view paper] Ms. Kathryn Waugaman (University of Colorado Boulder), Dr. Janet Y Tsai (University of Colorado, Boulder), and Dr. Malinda S Zarske (University of Colorado, Boulder)

W434·Maps, Metaphors, Tweets, and Drafts
Technical · Liberal Education/Engineering & Society Division
Wed. June 27, 2018 1:15 PM to 3:00 PM
Room 151 D, Convention Center - Salt Palace

Moderated by Dr. John W. Brocato

Papers Presented

1. Undergraduate Engineering Students’ Use of Metaphor in Presenting Prototypes to a Technical and Non-technical Public Audience [view paper] Mr. Jared David Berezin (Massachusetts Institute of Technology)

2. Refining Concept Maps as Method to Assess Learning Outcomes Among Engineering Students [view paper] Dr. Sean Michael Ferguson (University of Virginia), Dr. Rider W. Foley (University of Virginia), Mr. John Kofi Eshirow Jr. (University of Virginia), and Miss Catherine Claire Pollack (University of Virginia)

3. Improving Senior Design Proposals Through Revision by Responding to Reviewer Comments [view paper] Prof. Judy Randi (University of New Haven), Dr. Ronald S.
4. **Classical Rhetoric and the Political Tweet** [view paper] Dr. Caroline Carvill (Rose-Hulman Institute of Technology) and Dr. Anneliese Watt (Rose-Hulman Institute of Technology)

**W4112A: Action on Diversity - Round Table Conversations on Diversity, Equity, and Inclusion**
Panel: ASEE Diversity Committee, International Division, and Minorities in Engineering Division

**Wed. June 27, 2018 1:30 PM to 3:00 PM**
**Room 150 F, Convention Center - Salt Palace**

Bring your voice to the table. We will have multiple topics for small groups to discuss, including how to start a difficult conversation about diversity. Come ready to listen, learn and contribute. We will provide an opportunity to plan for next steps that all can take to support diversity, equity, and inclusion in engineering.

**Moderated by** Dr. Susan E. Walden

**Speaker**

1. **Prof. Rebecca A Bates**, Minnesota State University, Mankato

And other ASEE Diversity Committee members and delegates including Christopher Carr (NSBE), Tony Butterfield (University of Utah), and Kelly Cross (University of Illinois Urbana-Champaign)

**W534: Embedding Sociotechnical Systems Thinking II**
Technical: Liberal Education/Engineering & Society Division

**Wed. June 27, 2018 3:15 PM to 4:45 PM**
**Room 151 F, Convention Center - Salt Palace**

**Moderated by** Prof. Dr. Bernd Steffensen

**Papers Presented**

1. **Measuring the Impact of an Interdisciplinary Experiential-learning Activity on Student Learning** [view paper] Dr. Anne-Marie Nickel (Milwaukee School of Engineering), Dr. Jennifer Kelso Farrell (Milwaukee School of Engineering), Dr. Alicia Domack (Milwaukee School of Engineering), and Ms. Gina Elizabeth Mazzone (Milwaukee School of Engineering)

2. **Exploring the Human Dimension of Engineering Through the Built Environment** [view paper] Dr. Jeffrey C. Evans P.E. (Bucknell University)

3. **Reclaiming General Education: History for Engineers** [view paper] Dr. Amber Genau (University of Alabama at Birmingham) and Dr. Andre Millard (University of Alabama at Birmingham)
Appendix B. Common and Emergent Themes from the 2018 LEES Program

1. Cognitive and cultural barriers to integrating LEES content and perspectives into engineering education and practice: epistemic habits/bias, tendency toward quantification, traditional notions of rigor, disciplinary egocentrism, knowledge hierarchies, tacit mental models, common narratives, tendency of concepts such as “empathy” and “human centered design” to lose nuance and depth when they become part of the engineering education discourse.

2. Diversity and inclusion, including problematizing diversity, but also applying what we have learned (largely through research done by LEES members) and making meaningful change in courses and curricula; considering the connections between demographic diversity and intellectual/disciplinary diversity.

3. Structures of power, teaching students how to read them and to understand how those structures operate with respect to #1 and #2 above.

4. Engineering identity, particularly its formation and the way it shapes the perception of non-technical content and faculty in the engineering curriculum, especially writing and communication.

5. The gap between the expertise of most engineering faculty and the preparation students need for the successful practice of engineering—and the pros and cons of various strategies for filling that gap, including what appears to be an increase in embedding non-technical content in engineering departments and schools (as opposed to adding courses taught in non-engineering disciplines) and the emergence of professors of practice and engineering faculty with engineering education research and expertise.

6. Mindfulness and the psychological well-being of students and faculty, including specific interventions to enhance these and the tensions between engineering culture and these interventions (similar to the barriers to non-technical integration and diversity/inclusion).

7. Developing shared resources to support writing/communication instruction for engineers, including discipline-specific resources like Susan Conrad’s Civil Engineering Writing Project, using workplace context and communication genres as a resource, and other strategies to increase efficiency.

8. Problem framing and (re) definition as a crucial and problematic, especially as we seek to integrate social justice, corporate social responsibility, sustainability, diversity, and other social and ethical concerns into engineering education and practice.

9. Problems of terminology, including translating LEES terminology and perspectives so that they resonate with engineers and confusion around clusters of terms like human-centered design/ethical and social issues/sociotechnical systems thinking and professional skills/soft skills/ non-technical skills/contextual skills.

10. The relationship between engineering ethics and STS/LEES—clearly not exactly the same, but there’s lots of overlap and opportunity for more effective collaboration.
11. History, including history of ideas and intellectual genealogy, as a resource for understanding the dynamics of change (or lack thereof) in engineering education.
12. Peer educators as an emerging group in engineering education—the needs they meet, the benefits they bring, the challenges they present, and their potential for distinctive strength as a resource for LEES.
13. Ethical critiques of service learning—thinking beyond the educational value for students and considering the welfare of the communities where they learn.
14. Opportunities for potentially high-impact collective action by LEES, both collaborative research projects and efforts to create a more visible and cohesive group of scholars and body of scholarship.

Appendix C. Integration

T434: Engineering Education as a Dynamic System
W334B: Undergraduate Peer Educators: Mentoring, Observing, Learning
W334C: Embedding Sociotechnical Systems Thinking I
W534: Embedding Sociotechnical Systems Thinking II

T434: Imagining and Reimagining Engineering Education as a Dynamic System

Discussion Notes

All of the papers in this session were concerned with the epistemic habits of engineers and the influence of sociocultural factors in both destabilizing and resisting change in engineering education. In differing ways, they highlighted the power that resides in systems and narratives, as opposed to particular people or institutions.

Possible Topics for Future Papers/Collaborations

- What do we mean when we talk about “the epistemic habits of engineers”? What does this phrase capture that wasn’t emphasized or explicit in earlier discussions of engineering education? To what extent is it another name for issues LEES educators and researchers have dealt with for a long time?
- What do we mean when we talk about “the theory of narrative causality”?
- How might we translate these concepts so that they resonate with engineering students and faculty? To what extent does their use imply a critique of engineering? Are epistemic habits and narratives equally important in all disciplines (as opposed to distinctively important in engineering)?
- What is the connection between epistemic habits and stories/narratives? How can we use analysis of stories as a way of uncovering, critiquing, and changing epistemic habits? What are the differences between epistemic habits, narratives, and myths?
- How do we craft/find good stories and tell them effectively, both in our efforts as faculty to effect change in engineering education and to help engineers/engineering students communicate?
- What are the common themes and points of convergence in the narratives embodied in the landmark self-studies of engineering education? How do these themes and narratives
differ from or resemble conceptions of engineering and engineering education among non-engineers?

• How does understanding that learning is situated in a complex web of social organization and historical contexts improve or otherwise change the learning process/educational enterprise?

• What are the most important shared narratives that constitute/shape engineering identity? What besides shared narratives shapes that identity?

• What is the relationship between metaphors and narratives in shaping our understanding of engineering, engineering education, and change management?

• What are the important similarities and differences in the understanding and delivery of instruction in (applied) mathematics versus LEES? How can an understanding of one of these dimensions of engineering education enhance our understanding of the role of non-engineering disciplinary knowledge in engineering education?

W334B: Undergraduate Peer Educators: Mentoring, Observing, Learning

Discussion Notes

All of the papers in this session described and reported on the outcomes of instructional strategies in engineering education that incorporate undergraduates as peer educators. The subjects and contexts of instruction varied considerably (equity considerations in design teams, introduction to engineering, introduction to STS, mechanical engineering design, and chemical engineering labs); however, all four papers dealt in one way or another with attempts to integrate LEES topics and skills into engineering education.

Possible Topics for Future Papers/Collaborations

• What best practices have emerged for the selection, training, and roles of undergraduate peer educators? In particular, what is an optimal amount of time for peer educators to spend in regularly scheduled meetings that focus on their activities and the knowledge they need as peer educators?

• What differences in the implicit conception of the role are reflected in the various terms “undergraduate peer educator,” “learning assistant,” “near peer,” and “teaching assistant”? What value might there be in regularizing the terminology we use? How does the terminology of “aspirational peers” fit into the cluster of concepts associated with undergraduate peer educators?

• What do we know about the value of peer education systems for the students serving as peer educators, the students being served, and for the faculty and institutions who use peer educators? Where does the most learning take place (students taking the course, students providing support, faculty seeking to improve course design, etc.)? Does it matter whether the students involved are from highly selective as opposed to less selective schools?

• In what respects does the use of undergraduate peer educators empower students who might not otherwise feel empowered?

• How do engineering students develop the identity of “engineer as writer”? To what extent does the acquisition of that identity derive from the kind of course in which students
receive instruction and practice in writing? What kinds of assignments bridge the engineer-writer gap? How can we use this knowledge to improve writing instruction?
• In the context of teamwork, what merit is there in evaluating teamwork in terms of “emergent systems” versus “individual accountability” and delegation of work”? Are these concepts necessarily in tension with each other? How do they relate to ideological assumptions about meritocracy and socio-technical duality? Are these ideas operating in peer education contexts other than teamwork? How might our answers to these questions shape the pedagogical instruction peer educators receive?
• Is the teaching of writing in engineering evolving toward an embedded model? What factors might hinder this evolution? What might be lost and gained if most or all writing instruction takes places in technical courses?

W334C: Embedding Sociotechnical Systems Thinking I
Discussion Notes (See also W534C)

The papers in this session all discussed approaches to integrating sociotechnical systems thinking (STST) into the engineering curriculum. The first two approached embedding of STST as a way to better prepare students for engineering practice. The third paper described and assessed the effect of integrating ethics instruction into an introductory course with the ultimate goal of increasing retention in engineering.

Possible Topics for Future Papers/Collaborations

• If we accept define “embedding sociotechnical systems thinking in engineering” as “focusing on the interplay between relevant social and technical factors in the problem to be solved” as proposed by Leydens et al., what are the most important lessons we have learned so far about efforts like those described in this session and session W534C? What challenges remain? What advantages and disadvantages does embedding offer the technical and non-technical faculty involved in such efforts?
• The efforts described in these papers involve collaborations between people in various engineering disciplines and in various HSS/LEES fields. What useful and reliable generalizations can we make about the composition of such teams? For example, are there combinations of disciplines or levels of courses that seem to work better than others? Does the stage of career of the faculty matter? Is an expert in education research essential?
• Do we have a comprehensive review of literature that establishes the value of embedding STST and suggests future directions for institutions that are thinking of embedding STST in their curricula? If not, LEES should organize the writing of such a review of literature.
• What effective strategies for assessing embedded STST have emerged? In what ways could the LEES community support the development and dissemination of such practices and instruments?
• How can we more precisely articulate what we mean by “habits of mind” as the concept applies to STST? How does the concept relate to other concepts such as “contextual thinking”? Should the LEES community attempt to standardize the terminology? If so, how would we go about it?
• How widely supported in the literature and shared among relevant stakeholders in engineering education is the idea that “the development of assessment instruments is a form of research in itself” (Leydens et al.)? Has the evidence been synthesized so that it can be used in decision making about curricula?
• To what extent has Downey’s problem definition and solution (PDS) model (2005) propagated through engineering education? Does it have important successors? If it has not been particularly influential, what might be done to extend its influence?

What scholarly resources and theoretical frameworks do we have for thinking systematically about the “second-order effects...[and] indirect connections and consequences...associated with socio-technical complexity”? Which of these are likely to resonate with engineering students

W534: Embedding Sociotechnical Systems Thinking II
Discussion Notes

All of the papers in this session discussed the integration and application of diverse areas of expertise and experience to create high-impact learning opportunities for students but also required the faculty involved to grow, learn, and get out of their comfort zones.

Possible Topics for Future Papers/Collaborations

• What are the challenges and benefits of engaging in inter-/cross-disciplinary partnerships for faculty and students? In particular, if you are a faculty member who wishes to find a collaborator in another discipline at your own institution, how do you “find someone who will talk to you” and work with you? How can we assess the benefits of such collaborations for faculty?
• What are the distinctive traits of the kinds of individuals who succeed in interdisciplinary collaboration? More specifically, what distinguishes engineering faculty who engage in such collaborations? What makes for a good partnership?
• What assessment data support the benefits of such integrations for students? What criteria do we use to assess both the short- and long-term benefits of such experiences?
• What role does reflection play in optimizing student learning and providing input for course refinement and improvement? What specific features of reflection assignments seem to elicit the best results from students?
• In cases where a single faculty member integrates diverse kinds of expertise, what circumstances of experiences provide the foundation for developing expertise beyond one’s core expertise? How can faculty who are interested in broadening their experience/expertise identify opportunities for doing so?
• What role might ASEE play in promoting the broadening of individual expertise and the development of successful interdisciplinary collaborations?
• What analytical frameworks are useful for thinking about sociotechnical systems? How might those be applied in interdisciplinary integrations?
• What evidence supports the assertion that “understanding history makes you a better engineer”?
• What reasons are there to think that contextualized/applied history might be an important part of the future of history as a discipline? What resources are currently available for
developing courses on contextualized/applied history topics? What are the obstacles to creating such courses? How do we balance celebration and critique in such courses?

- In what specific ways does study abroad promote critical thinking? How can we assess whether study abroad does in fact promote critical thinking? Is there any particular value in study abroad for engineering students (as opposed to other students)?
- What particular value is there for engineering students to understand the various ways that diplomacy and STEM are connected? What are the challenges of making those connections?

Appendix D. Diversity and Inclusion

U434B: Diversity and Inclusion: Concepts, Mental Models, and Interventions
M5112A: Impacts of Sexual Harassment in Academic Science, Engineering, and Medicine (Panel Discussion—no discussion notes)
W1112A: Revealing the Invisible: Engineering Course Activities That Address Privilege, -isms, and Power Relations (Interactive Session with a Single Paper Published in the Proceedings—no discussion notes)
W2112: A Voice for Change—Building an Inclusive Future with Local Policy and Engineers (Distinguished Lecture—no discussion notes)

Possible Topics for Future Papers/Collaborations

- Given that engaged reflection is essential for students to optimize their learning from intercultural interactions and other diversity interventions, what are the most effective pedagogical strategies for getting students to engage in meaningful reflection? How can we structure reflection assignments so that they are optimally timed, efficient, and focused while still allowing space for individualized learning?
- How can we get beyond addressing the diversity challenge in terms of numbers (as important as that is) and create the intellectual and institutional spaces that allow for the expression of multiple viewpoints and perspectives?
- In what ways do notions of rigor create barriers to intercultural learning? Are these barriers more significant in highly selective institutions than elsewhere? What are the most effective strategies for helping engineering faculty recognize the unintended negative consequences of traditional notions of rigor?
• How does disciplinary egocentrism manifest itself in engineering education? Is disciplinary egocentrism more of a problem in engineering than in other disciplines in the sense that it creates a bigger obstacle to diversity and inclusion? How does intellectual diversity relate to demographic diversity?
• How does theater function as a space in which difficult subjects can be safely explored? What are the similarities between laboratories and theaters as educational spaces? How might the educational experience in laboratories be enhanced by exploiting the parallels between labs and theaters? For example, what are the equivalents of directors, script writers, and actors in laboratories?
• What conclusions can we draw from the relative frequency with which theater has been treated as a contributor to liberal education for engineers?
• How does playwriting facilitate the development of moral imagination, especially for engineering students? How does writing plays help (or hinder) the connection between writing and engineering identity?
• How can the imaginative activity of writing and performing plays help faculty and students in the necessary and difficult process of reimagining our engineering institutions, classes spaces, and research environments to create the room for different voices to speak and be heard?

Appendix E. Communication

U534B: Design, Assessment, and Redesign of Writing Instruction for Engineers
M434: Embedding Writing in Experiential Learning
W434: Maps, Metaphors, Tweets, and Drafts

U534B: Design, Assessment, and Redesign of Writing Instruction for Engineers

Discussion Notes

The papers in this session all focused on two general themes in writing instruction for engineers: (1) curricular scaffolding / more connections to support writing development across curriculum, and (2) motivating students to put forth effort on writing tasks or in writing courses.

1. In a writing across the curriculum (WAC) approach, what are the challenges and merits of spreading writing throughout the curriculum? How can we appropriately increase the difficulty of the writing assignments as students progress through their technical curricula?
2. How does the context in which students encounter writing shape their perception of the role of writing in engineering? For example, if we “outsource” the teaching of technical writing to the English department, do we at least implicitly confirm the mistaken notion that engineers don’t write?
3. How do we better support improving writing within engineering courses and by engineering faculty? In particular, how can we help engineering faculty make use a scaffolded learning process based on principles such as (a) providing simple feedback on one item or skill at a time, (b) explaining how we expect students to use that skill in future assignments, (c) focusing on the quality of the writing and not just formatting, and (d) responding to writing effectively?
4. How can we help students understand how the writing process is similar in classrooms and workplaces? For example, (a) the differences between the editing process a student goes through on a single assignment versus the back and forth updating that would occur in the workplace and (b) peer review as part of the writing process.

5. What evidence-based practices from writing studies generally (as opposed to engineering writing studies) be used to enhance writing instruction for engineers?

6. How do rubrics convey/capture the relationship between the grading of content and writing quality? What strategies can help get students past the notion that the grading of content is objective while the grading of writing quality is subjective?

7. How can we help engineering students see the connection between writing and thinking, including the way that writing requires and develops critical thinking skills?

8. More specifically, how widely has H. A. Michaelson’s concept of incremental writing, which is based on the claim that “most writing about engineering development is creative effort, subtle but powerful” and that the insights an author gains through the process of writing are “a two-way bridge between the manuscript and the work”? Note: Michaelson was an editor for the IBM Journal of Research and Development and wrote How to Write and Publish Engineering Papers and Reports (ISI Press, several editions).

9. What research might we conduct to evaluate the validity of Michaelson’s claims?

10. How might we make better use of the research of Wolfe and others into instructional strategies that help students translate numbers into persuasive arguments? (Journal of Business and Technical Communication, 2011, for example)

M434: Embedding Writing in Experiential Learning

Discussion Notes

There was only one published paper for this session, but it incorporated the experiences and perspectives of four different interventions that integrated technical writing into experiential learning of various forms (co-op experiences, design courses, collaboration with practitioners, and throughout an engineering curriculum). A common theme in all of these interventions is improving student motivation and the efficacy of writing instruction by focusing on the kinds of communication that are actually used in engineering workplaces and practice, including technical memos, proposals to justify a project or change in an organization, field observation memos, multi-modal communication, and oral presentation.

Possible Topics for Future Papers/Collaborations

- How can instructors give adequate substance and structure to activities designed to improve communication ability when those activities are not the entirety of a course? Similarly, how do we hold students accountable for their performance on such activities (i.e., including the grade for communication assignments in the grade for a co-op experience or technical course)?
- How can we more precisely articulate what we mean when we say “embedded” and “experiential learning”? Do these terms communicate effectively with the practitioners we need to engage?
- What are the communication abilities that render engineering graduates “practice-ready”? How do we get adequate agreement among faculty about what constitutes good
writing/effective communication? What are the most effective ways for engaging practitioners in defining what students need to know and be able to do?

- What are some effective ways of (1) providing students with experience in authentic writing/communication tasks? (2) developing assignments and rubrics that minimize the writing load for students and grading load for faculty while also helping students practice the skills and develop the abilities that will need in engineering practice?
- How do we understand and overcome student resistance to writing, including exploring how communication fits into engineering identity? What role might “near peers” play in this process?
- Should we continue to teach and require genres that are not practitioner based (such as lab reports) or try to develop alternatives that fulfill the same pedagogical goals as lab reports but also reflect workplace practices?
- What are the advantages and disadvantages of discipline-based instruction? How does discipline-based instruction differ from practitioner-based instruction?
- How can the kinds of resources that have been developed by Susan Conrad and her colleagues in the Civil Engineering Writing Project be adapted to and/or created for other engineering disciplines—or for engineering more generally?
- What are the most important myths about writing instruction that persist and stand in the way of scaling up embedded writing instruction?

**W434: Maps, Metaphors, Tweets, and Drafts**

*Discussion Notes*

The papers in this session all focused on making implicit aspects of learning and communication explicit, both to improve communication and to increase awareness of the relationship between representation/communication and learning. The genres that the papers dealt with varied widely (concept maps, product pitches/demonstrations, metaphors, and design proposals), but all were concerned with the social, cognitive, and transactional dimensions of communication.

**Possible Topics for Future Papers/Collaborations**

- What factors motivate engineering educators with expertise in technical disciplines to gain expertise in and become engaged in helping students develop their communication abilities? What benefits accrue to both instructors and students when this happens?
- In what ways is classical rhetoric particularly suited to supporting instruction in professional engineering communication? What makes it challenging to use in engineering contexts? What strategies are helpful in overcoming the barriers of time and vocabulary that separate today’s engineering students from classical rhetoricians?
- How do the technologies used in representation and expression relate to the genres that students and faculty use to communicate? In what ways do the technologies and genres reflect the historical circumstances in which they emerge? Shape human behavior and social practices?
- How can we think more productively about the role of disruption/destabilization in educational practice? How can we help our students recognize and articulate the potential benefits of disruption/destabilization? What strategies can mitigate the sense students
may have that pedagogical strategies aimed at disruption and destabilization are hostile either to them personally or to the engineering profession as a whole?

- In what ways are metaphors audience-dependent? How can students become more adept at recognizing the ways that metaphors both include and exclude particular audiences? How do metaphors facilitate creativity? What strategies can help students create and think critically about metaphors?
- What strategies are most effective for helping students learn how to communicate with mixed audiences and cope with situations where it is difficult to precisely identify the relevant characteristics of the audience for a particular communication?
- When we talk about faculty with expertise in technical communication being “embedded” in engineering curricula are we simply talking about instruction that is more responsive to the contexts of engineering practice, or something beyond that? Is embedding a growing phenomenon in engineering education? Considering all of the stakeholders involved, what circumstances are conducive to its success?

Appendix F. The LEES-STS-Ethics Relationship

U434A: Learning How to Be Socially Responsible Engineers—A Comparison of Methods and Lessons Learned (Panel Session—no notes)
M334: Ethical Awareness and Social Responsibility in a Corporate/Team Context
T534: Imagining Others, Defining Self Through Consideration of Ethical and Social Implications
W220: It Takes More than Good Intentions—Do Engineers Have Responsibility for Social In/Justice? (Distinguished Lecture—no notes)

M334: Ethical Awareness and Social Responsibility in a Corporate/Team Context

Discussion Notes

All of the papers in this session took a macro-ethical perspective and focused on (a) strategies for increasing student motivation for studying ethics and (b) the structural conditions that both discourage and encourage ethical awareness and social responsibility in corporate contexts. Like several other sessions at this year’s conference, the speakers emphasized the importance of students learning to read/analyze the complex structures in which people act. Foreshadowing Deborah Johnson’s distinguished lecture, the presentations and discussion examined moral accountability as a social process, as an aspirational ideal, and a set of skills (as opposed to just being opinions). They also explored the connection between engineering ethics and social justice.

Possible Topics for Future Papers/Collaborations

- What does it mean to take a “critical perspective” on corporate social responsibility (CSR)? How can engineering educators take a critical perspective without seeming cynical or adversarial to business or the engineering profession?
- What specific strategies can instructors use to provide students with the practical, analytical tools they need to practice ethical awareness and social responsibility in a team context? How do we think about practical skills in relation to aspirational values and
analytical categories (reconcile aspirational pedagogy with the problem of breaking it all down so that students see how to operationalize aspirational values)?

- What steps can we take to ensure that CSR becomes an evaluation criterion for assessing the relative merits of specific engineering designs and innovations? Two possible answers to this question: (1) engage the NAE as partners in getting this to happen and (2) be more deliberate about bringing the Engineering Ethics Division and LEES into conversation with each other and with the engineering profession.

- How might we assess the long-term impact of interventions aimed at increasing ethical awareness and encouraging social responsibility? Leaving the feasibility of such assessment aside, to what extent are we as educators obligated to undertake it (as opposed to assessing performance in coursework and assuming it forecasts what graduates will do in the workplace)?

- How do we think about problem framing and problem definition as forms of stakeholder engagement? What specific instructional strategies can help engineering students think more creatively and expansively about the process of problem definition?

- How can we expand our knowledge of the behaviors that characterize teams and organizations that are more likely to hold each other accountable?

- How does the history of mindsets and problem redefinition contribute to our understanding of how engineering decision-making processes can be adapted to incorporate social justice as an important value/goal?

T534: Imagining Others, Defining Self Through Consideration of Ethical and Social Implications

Discussion Notes (See also U434B and U534B)

All of the papers in this session (a) dealt with the need for and challenges of integrating ethical and social considerations into engineering practice and education and (b) described research approaches that can be used to discover and articulate the mental models used by engineering students, faculty, and practitioners to locate their enterprises within larger social contexts.

Possible Topics for Future Papers/Collaborations

- To what extent is the term “moral imagination” appropriate for describing the intellectual and social structures addressed in studies like the ones presented in this session? What accounts of (specific publications on) moral imagination are most suitable for applying the concept to engineering education and practice?

- What role do non-technical courses and expertise play in the development of engineering identity? How do the circumstances in which engineering students encounter non-technical content influence their understanding of the role of such content in engineering?

- How do we analyze structures of power and help our students learn to do it? How can we do that without giving students the impression that we are denigrating the engineering profession as a whole or questioning the sincerity of their motives in attempting to use the power of engineering/technology to benefit groups they perceive as in need of help?

- What are the defining features of the narrative of “engineer as hero”? Where is this narrative most evident? What are its consequences? How does this narrative relate to what we think of as the “narrative of victimization” as it is manifest in engineering identity and discourse?
• How does the concept of “disciplinary egocentrism” help us understand and articulate the challenges of cultivating humility and breaking down barriers such as “us/them,” “first-world/third world,” and “engineers/public”?
• How can we most effectively frame an ethical critique of service learning and highlight the fact that students are not the only stakeholders in service learning contexts? Specifically, how can we convey the idea that we shouldn’t “play with people’s lives” in the process of providing experiential service learning opportunities?
• What are the most effective strategies for connecting cross-cultural studies to service learning enterprises? In particular, how can reflection on the part of students be used to enhance the learning that comes from service learning? What is the relationship between classroom and experiential learning in this context?
• What distinctive role does a historical perspective play in promoting macro-ethical awareness among engineering faculty and students?

Appendix G. Interweaving All Four Themes

U434C: Learning Outcomes and Pedagogical Strategies: Problems of Alignment
U534A: Communicating Across Cultural and Epistemological Boundaries
M534: Who’s in the Driver’s Seat of Engineering Education? (Interdivisional Town Hall Meeting)
W134: Seeking Resilience and Learning to Thrive Through Engineering

U434C: Learning Outcomes and Pedagogical Strategies: Problems of Alignment

Discussion Notes

The papers in this session explored the extent to which the articulated outcomes of engineering education align with the (1) design of courses and curricula, (2) the expertise of individual faculty members, and (3) the terms and educational theories we use to describe the education of young adults, including engineering students.

Possible Topics for Future Papers/Collaborations

• The terminology used to describe the “non-technical” skills required for engineering practice is problematic and the language used by ABET does not align with the language employers use in job ads. What might we gain by having more consistency and alignment? What role should the LEES community play in developing more precise, consistent language in this area?
• How might further analysis of the skills in Table 6 of Graham and Porterfield’s paper help us understand the skills in relation to each other? For example, character and communication are large, heterogeneous categories, each with many different features; and character is not a “skill.”
• How do the skills listed in Table 6 map on to (a) categories such as “ethical responsibilities/societal impacts of engineering (ESI)” and “sociotechnical systems thinking” or (b) similar lists for engineering leadership or technology entrepreneurship?
• Graham and Porterfield talk about the blind spots that managers have, “especially in areas where [they are] not strong” (“Discussion of Results”). How do these blind spots relate to
disciplinary egocentrism? How do interdisciplinary collaborations of the type that Polmear et al. describe broaden vision/sharpen perception?

- What research do we have that delineates common pathways by which individual faculty and students become aware of their blind spots?
- What do we know about “knowledge hierarchies” in engineering education? How do they relate to “epistemic habits/cultures” and “engineering identity”? How do these hierarchies exacerbate alignment problems?
- What do we mean by “macro-ethics education”? How does it relate to ESI?
- Polmear et al. highlight the limitations of the conceptual framework of “best practices” as it applies to HSS/STS/LEES models for engineering education. To what extent has this finding been established in other publications? What additional work should be done to investigate these limitations?
- Like other sessions, this one emphasized the mismatch between the expertise of most engineering faculty and the requirements of preparing undergraduates to practice engineering. Should LEES focus on this disparity as a high priority research topic?
- Professors of practice often fill these gaps in areas such as engineering business and leadership. What might they offer with respect to ESI and social justice? What limitations might they have?

U534A: Communicating Across Cultural and Epistemological Boundaries

Discussion Notes (See also U434B)

The four papers in this session dealt with communication across several different kinds of boundaries: (1) between the disciplinary experience base of engineering and that of design, specifically human-centered design (HSD); (2) between engineering designers and the stakeholders the designed are supposed to benefit; (3) between engineering colleagues who have experienced various forms of marginalization in the workplace and those who have not experienced marginalization; and (4) between various engineering disciplines treating the same broad topic. The strongest unifying themes of the session, however, focused on the challenges of integrating social justice into the engineering curriculum and on the links between intellectual diversity and demographic diversity.

Possible Topics for Future Papers/Collaborations

- As one of the papers indicated, “context is a tricky concept.” How can we be clearer about what we mean when we talk about the importance of context in engineering design? What strategies can we use for making the multifaceted and contingent nature of context apparent while still managing the complexity that heterogeneous, dynamic situations/systems entail?
- How can we bridge the gaps between problem framing/definition as understood in engineering fields and as conceptualized and taught in HCD, STS, and the humanities and social sciences (HSS) more generally (for example the distinction between iteration/experimentation as “wasted time” vs. “informed trial and error)?
- What do we know about the difference it makes when students (especially engineering students) opt in to non-technical or hybrid courses and programs in areas such as technology entrepreneurship, engineering leadership, engineering and public policy, or
topics like HCD? Given the “requirements for all” orientation of engineering education, the opt in approach can be challenging to implement. How might we overcome those challenges, especially with respect to ABET?

- To what extent are the frictions between design thinking and engineering pervasive throughout non-technical and hybrid educational experiences?
- What are the similarities and differences between the research approaches referred to as “genealogical studies” and “the history of ideas”? Regardless of the terminology we use, how can we refine and strengthen these research methods and establish their validity within engineering education research generally?
- What underlying tendencies and factors contribute to the propensity for concepts such as “design thinking,” “empathy,” or “the T-shaped professional” to lose nuance and depth as they are integrated into engineering education?
- Conversely, what nuances of engineering epistemology and methodology tend to be lost on humanists and social sciences? How are individuals with technical backgrounds and an interest in topics like HCD and SJ particularly well-positioned to establish shared understanding across boundaries?
- How do diversity, empathy, and social justice resemble and differ from other “ethical” concerns such as accountability or avoiding conflicts of interest? More specifically, how do the discourses of the communities who deal with these issues in engineering education intersect and differ? How can we bring them into more productive conversation with each other?
- How can engineering education draw on the resources and concepts of other fields such as psychology, social work, and philosophy in helping student develop frameworks for action and virtues, especially as those relate to various forms of communication (for example, contextual listening, empathic communication, and sociocultural/technocultural systems thinking)?
- What are the challenges of developing systematic language for dealing with topics such as “design,” “empathy,” and “creativity”? What strategies can help overcome these challenges?
- In what ways are the boundary-crossing challenges treated in these papers manifestations of long-standing issues of “integration” in engineering education? How does it help to think of integration as an “epistemological” problem?
- How do the difficulties described in these papers and elsewhere resemble and differ from the “science wars” conversations of the 1990s as exemplified by authors such as Gross and Levitt (Higher Superstition, 1997) and Latour (numerous works)?
- Given their many, well-documented limitations, why do we continue to devote so much attention to engineering codes of ethics? What might be more effective strategies for achieving the goals of engineering ethics education? To what extent are the codes fundamentally antithetical to sociotechnical systems thinking?
- It is common for authors writing on the subjects treated in these papers to talk about the need to respond to the demands of an “increasingly complex and diverse society.” What critical questions should we be asking about this theme, which tends to go unquestioned? To what extent are we just more aware of the complexity and diversity of engineering workplaces and sociotechnical systems?
- To what extent are “culturally sustaining pedagogies” different from earlier attempts to break down silos and make connections between students’ lived experience and what
they are taught in the engineering curriculum? How can STS and engineering studies contribute to the development and implementation of CSP at the college level?

- What evidence do we have that faculty use “disciplinary silos as a crutch to avoid engaging in unfamiliar material”? Does having such evidence really help in deconstructing disciplinary silos and dominant cultural perspectives?

U534A: Communicating Across Cultural and Epistemological Boundaries

Discussion Notes (See also U434B)

The four papers in this session dealt with communication across several different kinds of boundaries: (1) between the disciplinary experience base of engineering and that of design, specifically human-centered design (HSD); (2) between engineering designers and the stakeholders the designed are supposed to benefit; (3) between engineering colleagues who have experienced various forms of marginalization in the workplace and those who have not experienced marginalization; and (4) between various engineering disciplines treating the same broad topic. The strongest unifying themes of the session, however, focused on the challenges of integrating social justice into the engineering curriculum and on the links between intellectual diversity and demographic diversity.

Possible Topics for Future Papers/Collaborations

- As one of the papers indicated, “context is a tricky concept.” How can we be clearer about what we mean when we talk about the importance of context in engineering design? What strategies can we use for making the multifaceted and contingent nature of context apparent while still managing the complexity that heterogeneous, dynamic situations/systems entail?
- How can we bridge the gaps between problem framing/definition as understood in engineering fields and as conceptualized and taught in HCD, STS, and the humanities and social sciences (HSS) more generally (for example the distinction between iteration/experimentation as “wasted time” vs. “informed trial and error)?
- What do we know about the difference it makes when students (especially engineering students) opt in to non-technical or hybrid courses and programs in areas such as technology entrepreneurship, engineering leadership, engineering and public policy, or topics like HCD? Given the “requirements for all” orientation of engineering education, the opt in approach can be challenging to implement. How might we overcome those challenges, especially with respect to ABET?
- To what extent are the frictions between design thinking and engineering pervasive throughout non-technical and hybrid educational experiences?
- What are the similarities and differences between the research approaches referred to as “genealogical studies” and “the history of ideas”? Regardless of the terminology we use, how can we refine and strengthen these research methods and establish their validity within engineering education research generally?
- What underlying tendencies and factors contribute to the propensity for concepts such as “design thinking,” “empathy,” or “the T-shaped professional” to lose nuance and depth as they are integrated into engineering education?
• Conversely, what nuances of engineering epistemology and methodology tend to be lost on humanists and social sciences? How are individuals with technical backgrounds and an interest in topics like HCD and SJ particularly well-positioned to establish shared understanding across boundaries?
• How do diversity, empathy, and social justice resemble and differ from other “ethical” concerns such as accountability or avoiding conflicts of interest? More specifically, how do the discourses of the communities who deal with these issues in engineering education intersect and differ? How can we bring them into more productive conversation with each other?
• How can engineering education draw on the resources and concepts of other fields such as psychology, social work, and philosophy in helping student develop frameworks for action and virtues, especially as those relate to various forms of communication (for example, contextual listening, empathic communication, and sociocultural/technocultural systems thinking)?
• What are the challenges of developing systematic language for dealing with topics such as “design,” “empathy,” and “creativity”? What strategies can help overcome these challenges?
• In what ways are the boundary-crossing challenges treated in these papers manifestations of long-standing issues of “integration” in engineering education? How does it help to think of integration as an “epistemological” problem?
• How do the difficulties described in these papers and elsewhere resemble and differ from the “science wars” conversations of the 1990s as exemplified by authors such as Gross and Levitt (Higher Superstition, 1997) and Latour (numerous works)?
• Given their many, well-documented limitations, why do we continue to devote so much attention to engineering codes of ethics? What might be more effective strategies for achieving the goals of engineering ethics education? To what extent are the codes fundamentally antithetical to sociotechnical systems thinking?
• It is common for authors writing on the subjects treated in these papers to talk about the need to respond to the demands of an “increasingly complex and diverse society.” What critical questions should we be asking about this theme, which tends to go unquestioned? To what extent are we just more aware of the complexity and diversity of engineering workplaces and sociotechnical systems?
• To what extent are “culturally sustaining pedagogies” different from earlier attempts to break down silos and make connections between students’ lived experience and what they are taught in the engineering curriculum? How can STS and engineering studies contribute to the development and implementation of CSP at the college level?
• What evidence do we have that faculty use “disciplinary silos as a crutch to avoid engaging in unfamiliar material”? Does having such evidence really help in deconstructing disciplinary silos and dominant cultural perspectives?

W134: Seeking Resilience and Learning to Thrive Through Engineering Education

Discussion Notes

All of the papers in this session were concerned with the human dimension of engineering education, or, put differently, recognizing that the students we are educating and the faculty charged with facilitating their education are human beings, not machines. They were not suggesting that challenging circumstances can or should be avoided, but, rather, that the growth
that can result from dealing with challenges—and even trauma—requires purposeful action and a mindful approach.

**Possible Topics for Future Papers/Collaborations**

- What evidence suggests that the packed curriculum of all engineering majors contributes in a significant or distinctive way to the stress that many (if not most) engineering students experience? If such evidence exists, what strategies might we employ to enact the cultural and other changes that will be required to alleviate the crowding?
- How do educators and researchers working in this field balance a respect for rigorous research methodologies with care for the human beings who are involved?
- How can we research and understand the differences between departments, programs, and institutions with respect to student experiences of belonging, stress, and coping?
- How can we more persuasively articulate the notion of thriving in the context of engineering education and practice?
- What are the real goals of efforts to decrease stress and increase students’ opportunities to grow through dealing with stress? Increased motivation, which we hope will lead to increased effort and increased success? Drawing a broader range of students into engineering? Finding alternatives to individual counseling? Others?
- How do we promote cultures in which students feel safe in expressing anxiety, stress, or distress?
- How do we as faculty model mindfulness in our classrooms and in our other interactions with students?
- How can we bridge the gap between student needs and faculty expertise and inclinations?
- How can we take what we learn from novel learning situations and apply it in conventional learning situations?
- How does the conversation on empathy relate to that on mindfulness?
- **One answer:** organize a workshop for next year’s Annual Conference to help faculty understand the research on the benefits of mindfulness, strategies for deploying the understanding that results from that research in the classroom, and expand their own comfort zones for dealing with the human dimensions of engineering education both inside and outside of classrooms? We should start thinking sooner rather than later about how to do that.