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Guest Editorial

The papers in this special issue of the *International Journal of Engineering Education* detail the proceedings of the Clive L. Dym Mudd Design Workshop X, ''Design and the Future of the Engineer of 2020,'' which was held on the campus of Harvey Mudd College in Claremont, California from June 1–3, 2017. The workshop was supported by Harvey Mudd College's Department of Engineering and the Center for Design Education. Over the three days of the workshop, design educators and practitioners discussed and explored topics related to the Engineer of 2020 report with a focus on the design education needs of future engineers. The decision to reflect on the engineer of 2020 report was driven by a desire to consider the aspirations and expectations previously developed for those who are now our current students and to consider the needs of future engineers in this context. Thoughtful and interactive exploration of this broad topic was covered over a series of talks and posters. Impacts of different educational approaches in engineering design education were considered in the context of improving design, understanding of the design process, and better preparing students for professional practice and anticipating the skills needed for future engineers to thrive. There were 72 participants over the course of the workshop, which maintained and built upon the traditionally expected high degree of collegial interaction.

At the start of the workshop, I provided some brief remarks on the Engineer of 2020 report and noted that the class of 2020 is upon us. I encouraged the participants to broadly embrace and examine the different topics and perspectives that may come from the other participants and to welcome conflicting data and opinions. Forecasting future needs and the skills required to appropriately address them is a challenging and fraught with difficulty. Embracing the ambiguity of the design problem that is engineering design education will require a broad set of perspectives and manifold solution space.

Workshop participants were fortunate to enjoy two excellent keynote talks. At the opening luncheon on Thursday afternoon, Paul Saffo, the Chair of Future Studies at Singularity University, gave a keynote entitled ''Chasing fire: Anticipating the Engineer's World of 2020 and Beyond'' describing the future of engineering education needs. He provided perspectives on the pace layer change model and appropriate timescale for prediction of the future. For Friday's luncheon, Cindy Atman, Micah Lande, and Jennifer Turns delivered a highly interactive look at the work of Lisa Lattuca examining the reach of the Engineer of 2020 report, ''2020 Vision: Progress in Preparing the Engineer of the Future.'' In this ''mandatory participation'' session, the workshop participants examined data from Lisa's report and shared their perspectives prior to creating MadLibs style answers to identify what engineers might wish to do in the future, a skill they would need to do it, and how that skill might be acquired. On Thursday evening, we continued this activity by organizing and prioritizing the identified needs. Later in the workshop, different scenarios were developed and shared. The details of this work can be found in Key Ideas of the Clive L. Dym Mudd Design Workshop X accompanying article. Of most interest to me is the emphasis on skills that are exclusive of the technical skills we typically emphasize in engineering education, perhaps because we have learned to tacitly expect such skills.

Sessions throughout the workshop were run in sequence and attended by all participants. Each session of four speakers was assigned a moderator from the organizing committee and each speaker was limited to merely 10 minutes to describe their work. This almost unreasonably brief time was selected to emphasize the discussion of the session topic. Session topics included Engineering Identity, Innovation and Ideation, Specialized Skills in Engineering, Capstone/Reflection Learning, Communication, and Engineering in a Social Context. The presentations were followed by open moderated discussion. Discussion questions and comments explored the topics of each presentation and each session in greater depth, providing panelists and others to contribute further to the discussion. It was common for the audience to link topic session concepts in their questions and for presenters to cite work presented by other authors in their responses. The papers in this special issue reflect the research and positions of the panelists. In seeking positions, the organizers accept that authors may speculate or exceed their established research. This is a necessary risk to explore the future and invite authentic perspectives. Collectively, these papers represent the contributions of workshop participants to the body of knowledge and experience in engineering design education practice and theory. If these ideas can be adopted and applied with the vitality that they were presented and received, I am very optimistic that we will see an even more exciting collection of work for the next workshop and greatly enhanced design education experience for our students. The poster presentation at the workshop included 18 excellent posters and a very engaged audience excited to interact with the presenters. Once again,

the two most challenging aspects of the poster session were finding time to see them all and encouraging the participants to end their discussions to return to the workshop wrap-up session.

On Friday evening, led by Elizabeth Orwin, we remembered Professor Clive L. Dym, founder of the Mudd Design Workshop and founding Fletcher Jones Chair of Engineering Design at Harvey Mudd College. We were honored to be joined by Clive's family, his wife, Joan, and his daughters, Jordana and Miriam. Among his many contributions to the field of engineering, Clive was a transformative advocate for engineering design education. He built the Mudd Design Workshop and those associated with it, often despite differences in perspectives, have a feeling of collective identity and support. He embraced the uncertainty of the wicked problem that is the design education process. Perhaps only true in that sense of exploring problems completely from multiple perspectives, one attendee observed, ''For Clive, the messier the better.'' A man of unquestioned intellectual capability and exceptionally prolific, it was revealing that most frequently speakers recognized Clive's support and generosity of time and spirt coupled with his encouraging nature. It is one thing to be a giant in the field, as indeed Clive was, it is quite another to also be so helpful and supportive. One speaker reflecting on the challenge of establishing design education early in the undergraduate process in the face of significant opposition was lamenting the situation to which Clive responded, ''Of course it's hard. If it were easy we'd already be there.'' With his warmth and collegiality, Clive has given us the gift of a community with similar goals. Clive's establishment of the Mudd Design Workshop culture and his legacy continues in those gladly willing to dedicate their time to advance it.

The Mudd Design Workshop organizing committee worked hard to create the atmosphere of collaboration and inspiration that permeated the workshop. I was very happy to hear the positive response of many workshop participants regarding their experiences and impressions of the workshop.

I gratefully acknowledge once again the support of the members of MDW X's Organizing Committee. As they have done many times before, they worked hard to maintain the MDW's reputation for providing an informative, stimulating, and inspiring venue for discussing engineering education: A. M. Agogino, *University of California at Berkeley*; A. Altman, *University of Dayton*; C. J. Atman, *University of Washington*; R. Bailey, *University of Virginia;* G. Fine, *Boston University*; A. Ibrahim, *Yorkville University*; G. G. Krauss, *Harvey Mudd College*; M. Lande, *Arizona State University*; C. L. Magee, *Massachusetts Institute of Technology*; P. Y. Papalambros, *University of Michigan*; S. D. Sheppard, *Stanford University*; K. M. Sienko, *University of Michigan*; J. P. Terpenny, *Pennsylvania State University*; J. Townsend, *Olin College of Engineering*; and M. C. Yang, *Massachusetts Institute of Technology*. The Organizing Committee in addition to their many duties ensuring the quality of the workshop were valued in setting the tone of a workshop that is productive and fun.

Harvey Mudd College extended continuing support to the Mudd Design Workshop. In particular, Professor Elizabeth J. Orwin, Chair of the Department of Engineering, Jeffery Groves, Vice President for Academic Affairs and Dean of Faculty, and Maria Klawe, President of Harvey Mudd College, earned the gratitude of the workshop organizers and participants for the warm welcomes they delivered and for their support of the workshop series. Students Sitoë Thiam and Andrea Vasquez were very helpful in organizing the workshop. In particular, Sitoë improved our paper submission and review process. I especially thank Sydney Torrey of HMC's Department of Engineering for her many contributions to the workshop from logistical to culinary to editorial as well as the Department's Sue Lindley for a variety of helpful administrative actions. Sydney took and shared many photographs of the workshop during MDW X. Many of them can be found at the Mudd Design Workshop web site, www.mudddesignworkshop.com.

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