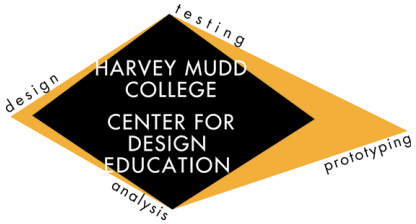
"SUSTAINING SUSTAINABLE DESIGN"

MUDD DESIGN WORKSHOP VII

28–30 MAY 2009

PROGRAM & PROCEEDINGS



CENTER FOR DESIGN EDUCATION
HARVEY MUDD COLLEGE
CLAREMONT, CALIFORNIA, USA

Foreword

The contents of this compact disk (CD) represent the preliminary proceedings of Mudd Design Workshop VII, "Sustaining Sustainable Design," which was held on the campus of Harvey Mudd College in Claremont, California, during 28–30 May 2009. Supported by Harvey Mudd College's Department of Engineering, this workshop brought together engineers and designers—both educators and practitioners—over three very busy days to talk about how sustainability, including global warming and the consequent degradation of the environmental affect what we do as engineering design educators. The preliminary proceedings include the program, the papers written in advance of the workshop and served as the basis for the workshop presentations, and an advance list of workshop participants.

At the opening lunch, our keynote speaker, Malcolm Lewis, Founder and CEO of the Constructive Technologies Group, Chief Engineer of the NASA, will talk about "Sustainable Design From a Practitioner's Perspective." Malcolm, also an HMC alumnus and trustee and, will describe some of the challenges attendant to dealing with sustainability issues as a practicing engineer.

A broad variety of engineering education issues will be discussed over eight formal sessions that are titled:

- Paradigmatic issues;
- Sustaining sustainability;
- What are students are thinking?;
- Curricula matters (I and II);
- Innovation;
- Sustainability projects and products; and
- Wrap-up session.

Following the long-established MDW tradition, the workshop sessions are construct to provide *everyone* a chance to participate, to be heard as well as to listen. Workshop sessions are scheduled for two hours, starting with brief presentations by three or four panelists in each session, and concluding with moderated, open discussion. Panelists are asked to reflect on ideas and attitudes about things to be done in the future, rather focusing on their own current research. The papers that appear here are (for the most part) the panelists' research and position papers. Clearly, these papers represent a rich body of experience and knowledge that certainly advance our understanding of the many meanings of *learning* in the context of *engineering design*. I anticipate that discussion at each of the eight sessions will be lively.

We are once again fortunate to have two outstanding evening events. In the first, Ton Meijknecht, Renske Oldenboom and Hans van Drongelen of the MOTIV project at the Delft University of Technology will show a video and lead an after-dinner discussion on "A Spirit of Sustainability." In the second we intend to honor the memory and contributions of two long-time friends of the MDW community who we lost since MDW VI, John H. McMasters (1939–2008) and Michael Wald (1932–2008), in a session entitled "Sustaining Tradition." Alice M. Agogino will describe John McMasters' legacy, with a particular focus on his work in biomimetic design, while Sheri Sheppard is preparing an appreciation of Michael Wald that will be read by John W. Prados.

I want to acknowledge once again the support of the remaining members of MDW V's Organizing Committee. They worked hard to maintain the MDW's reputation for providing an informative, stimulating and inspiring venue for discussing engineering education: Alice M. Agogino, *University of California, Berkeley*; Aaron Altman, *University of Dayton*; Cindy J. Atman, *University of Washington*; J. Edward Colgate, *Northwestern University*; Ahmad Ibrahim, *Yorkville University*; John S. Lamancusa, *Pennsylvania State University*; Chris L. Magee, *Massachusetts Institute of Technology*; Gregory B. Olson, *Northwestern University*; John W. Prados, *University of Tennessee, Knoxville*; Sheri D. Sheppard, *Stanford University*; Janis P. Terpenny, *Virginia Polytechnic Institute and State University*; and John W. Wesner, *Carnegie Mellon University*. The Organizing Committee's involvement led as it always has to an MDW that will be stimulating, thought-provoking and interesting, as well as being serious, engaging and fun.

Finally, Harvey Mudd College continues to offer the MDWs a very supportive environment. Ziyad H. Duron, Chair of the Department of Engineering, deserves my thanks, as do President Maria Klawe and Robert Cave, Vice President for Academic Affairs and Dean of Faculty. I *particularly* and *vigorously* and *cheerfully* thank Sydney Torrey for outstanding administrative support, without which the workshop preparations would have been incredibly painful. I also wish to thank Sue Lindley, Daniel Pereira and Cynthia Wheeler of the Department of Engineering for continuing to make a host of organizational, logistical, and administrative contributions.

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Editorial

This issue of the IJEE is devoted entirely to the theme *Sustaining Sustainable Design*.

The concept of sustainability and sustainable design has wide interest. It is of special importance to both professional engineers and engineering educators.

The selection of papers included in this issue is based on updated and revised papers presented in the Mudd Design Workshop VII, held in May 2009. The Harvey-Mudd workshops are one of the most valuable and important thematic workshops that address important engineering education topics. It takes place bi-annually in Claremont, California. The last issue of the IJEE devoted to the Harvey-Mudd workshop was in 2008 (vol. 24, issue 2) with the theme *Design and Engineering Education in a Flat World.* It presented 24 contributions. This issue includes 31 contributions, and I hope that it will be met with the same interest and enthusiasm that the previous issue enjoyed.

The comprehensive guest-editorial and the summation paper at the end: *What we have learned at Mudd Design Workshop VII: Sustaining Sustainable Design,* leave nothing for me to say but to express my gratitude and thanks to the guest-editors: Professor Clive Dym and Professor Janis Terpenny. The time and effort they devoted to selecting, reviewing, and re-reviewing this large number of papers is very much valued. I would also like to thank the numerous authors who contributed to this issue; their work will definitely be appreciated by the readers.

Ahmad Ibrahim

Guest Editorial

The papers in this special issue of the *International Journal of Engineering Education* represent much of the proceedings of Mudd Design Workshop VII, "Sustaining Sustainable Design," which was held on the campus of Harvey Mudd College in Claremont, California, during 28–30 May 2009. Supported by Harvey Mudd College's Department of Engineering and Center for Design Education, this workshop brought together engineers and designers—both educators and practitioners—over three very busy days to talk about the importance of sustainability in engineering design and practice and in engineering education.

At the opening luncheon, the Chair of the MDW VII Organizing Committee, noted that sustainability issues are often driven by economic, rather than technical considerations. Nonetheless, he put sustainability squarely at the center of good engineering practice, noting that engineers had an ethical responsibility to do sustainable design. Dr. Dym also paid homage to two recently deceased friends and supporters of the MDW series, Drs. John H. McMasters and Michael Wald, and noted that their memories would be at the center of the banquet's activities on the following evening. The keynote speaker, Malcolm Lewis (HMC '67), Founder and President of Constructive Technologies Group, Inc., spoke on "Sustainability: The View from a Practitioner's Perspective." Dr. Lewis described sustainability as the ethos of meeting present day needs while at the same time not compromising the ability of future generations to meet their needs. He went on to note that sustainability must be incorporated from the very beginning of each project, and it became more complex as the size of the designed system increased, especially when there were intersections and interactions with public systems. Dr. Lewis also noted that both analytical and "squishy" habits of thought were required to properly address sustainability issues.

A broad variety of sustainability design, engineering and education issues were discussed in the next seven sessions, which were entitled: Paradigmatic Issues; Sustaining Sustainability; What Are the Students Thinking?; Curricula Matters I & II; Innovation; and, Sustainability Projects and Products.

The major themes or "Learnings" that emerged included the ideas that: sustainability may be thought of as a philosophical concept that can be used as a basis for understanding and application; thinking about sustainability requires clear definitions and terminology in order to foster and support fruitful discussion; sustainability must be considered in context; there are both methods and tools that can be wielded to do sustainable design; sustainable design has many non-engineering aspects; and, finally, that sustainability issues are myriad in the engineering curriculum in many dimensions. These "Learnings" are explicated and amplified in the wrap-up paper by J. W. Wesner and C. L. Dym .

We were once again fortunate to have two outstanding after-dinner events. In the first, Hans van Drongelen and Renske Oldenboom of the *MOTIV* Project at the University of Technology Delft, showed a video, "A Spirit of Sustainability," that detailed how some of their students thought and felt about sustainability. After this presentation, Hans and Renske led the evening audience in a colorful and stimulating discussion directed toward understanding of the meaning and implications of sustainability in people's professional and personal lives. At Thursday's banquet, Alice Agogino presented a remembrance of the work of John H. McMasters and John Prados read Sheri Sheppard's memoir of Michael Wald. Then Clive Dym opened a discussion of the roles and importance and mentors in our lives and, after briefly mentioning a few people who were importance in his own life, asked the audience to share vignettes and anecdotes (and photos, as available) of those who had been mentors to them.

Following the long-established MDW tradition, the workshop sessions were constructed to give *everyone* a chance to participate, to be heard as well as to listen. Workshop sessions were typically scheduled for two hours, starting with brief presentations by three or four panelists in each session, and concluding with moderated, open discussion. Rather than focusing on their own current research, panelists were asked to reflect on ideas and attitudes about things to be done in the future. The papers that appear here are (for the most part) the panelists' research and position papers. Clearly, these papers represent a rich body of experience and knowledge that certainly advance our understanding of the many meanings of *Learning* in the context of *sustainability* and *engineering design*. We hope that experience and knowledge can be brought to bear in support of design education with the same intelligence and vigor that the participants brought to Mudd Design Workshop VII.

We want to acknowledge once again the support of the remaining members of MDW VII's Organizing Committee. They worked hard to maintain the MDW's reputation for providing an informative, stimulating and inspiring venue for discussing engineering education: Alice M. Agogino, *University of California at Berkeley*; Aaron Altman, *University of Dayton*; Cindy J. Atman, *University of Washington*; J. Edward Colgate, *Northwestern University*; John S. Lamancusa, *Pennsylvania State University*; John

McMasters, *The Boeing Company*; Chris Magee, *Massachusetts Intitutute of Technology*; Gregory B. Olson, *Northwestern University*; John W. Prados, *University of Tennessee, Knoxville*; Sheri D. Sheppard, *Stanford University*; and John W. Wesner, *Carnegie Mellon University*. The Organizing Committee's involvement once again led to an MDW that was stimulating, thought-provoking and interesting, as well as being serious, engaging and fun.

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