Changing Contexts For Engineering Education

3rd International CDIO Conference

June 11 – 14, 2007
Massachusetts Institute of Technology
Stata Center
Cambridge, Massachusetts

The Bernard M. Gordon Engineering Leadership Conference

June 11, 2007
Massachusetts Institute of Technology
Stata Center
Cambridge, Massachusetts

Monday, June 11, 2007 – Workshops

8:00 am – 9:00 am Registration Stata Center, Ground Floor, near Room 141 - Coffee, beverages, breakfast breads/pastries
All sessions, breaks and lunches are in the Stata Center (building 32) unless otherwise noted.

9:00 am – 10:30 am Workshop Room 123

MW1. *CDIO Overview,* Edward F. Crawley, Massachusetts Institute of Technology
Provides an introduction to CDIO in the context of the twelve CDIO Standards. Gives examples of CDIO program components from a number of CDIO collaborating institutions. (introductory)

10:30 am – 10:45 am Break – coffee, beverages, snacks

10:45 am – 12:30 pm Workshops

MW2. *Integrated Curriculum Design,* Sören Östlund and Kristina Edström, KTH-Royal Institute of Technology Room 124
Explains curriculum design in CDIO programs. Illustrates the concepts of curriculum structure, learning outcomes, curriculum mapping, and sequencing. Gives examples of how participants can integrate personal, interpersonal, and product, process, and system building skills into an engineering curriculum. (introductory)

MW3. *Active and Experiential Learning,* Matt Murphy, University of Liverpool Room 155
Gives examples of active and experiential learning methods that have been shown to be effective in CDIO programs. Highlights the importance of engaging students in their own learning. Demonstrates selected methods with audience participation.

MW4. *Connecting CDIO With Student Driven Initiatives*, Olivier L. deWeck, Massachusetts Institute of Technology Room 141
Presents major student-driven design-implement projects and examines ways in which they can be better integrated with CDIO programs. Gives participants an opportunity to hear student, staff, and faculty advisors' views on the benefits of such projects. Opens the discussion to workshop participants. (advanced)

MW5. *Teaching for Transfer*, Julia Khodor and Sanjoy Mahajan, Massachusetts Institute of Technology Room 144
Illustrates the principles of teaching for transfer. Invites participants to experience an application of transfer learning in a lesson on dimensional reasoning. Gives examples of learning transfer in science and engineering. (advanced)

12:30 pm – 1:45 pm Lunch

1:45 pm – 3:30 pm Workshops

MW6. *Design-Implement Experiences,* Geoffrey Cunningham, Queen's University, Belfast Room 141
Explains the rationale for design-implement experiences. Suggests guidelines for these experiences and gives examples from a number of CDIO programs. Invites participants to discuss how to incorporate basic and advanced design-implement experiences into their programs. (introductory)

MW7. *Learning Assessment*, Peter Gray, United States Naval Academy Room 124
Highlights the importance of student learning assessment aligned with learning outcomes. Gives examples of effective assessment methods in CDIO programs. Invites participants to critique sample rubrics designed to measure personal, interpersonal, and product, process, and system building skills. (introductory)

MW8. *A Systems View on Courses and Universities*, Kristina Edström, KTH-Royal Institute of Technology; Marie Arehag, Chalmers University of Technology Room 144
Explains the concepts of deep and surface approaches to learning. Illustrates the use of a constructive alignment model for course design. Gives examples of factors that create the conditions for teaching at a university, and invites participants to discuss ways in which these conditions can enable or limit educational development. (advanced)

MW9. Teaching Measurement Principles in Context: Instrumentation Laboratory for Biological Engineers, Maxim Shusteff, David C. Appleyard, Matthew J. Lang, Peter T. C. So, and Scott R. Manalis, Massachusetts Institute of Technology Building 56, Floor 3, Room 302
Invites participants to experience selected measurement systems used in biological engineering. Includes experiments in imaging, force spectroscopy, *E. coli* flagellar motor characterization and relevant calibration techniques. Takes place in the biological engineering laboratory. Limited to 18 participants. (advanced)

3:30 pm – 3:45 pm Break - coffee, cold beverages, snacks

3:45 pm – 5:00 pm Workshop

MW10. *Implementing the CDIO Approach,* Edward F. Crawley, Massachusetts Institute of Technology; Clément Fortin, École Polytechnique de Montréal Room 123
Highlights twelve factors that influence the change process, and gives examples of these factors in the implementation of a CDIO program. Presents a case study of the implementation of a CDIO program. Invites participants to share their greatest challenges in implementing change in their own programs. (introductory)

5:00 pm – 6:00 pm Tours Meet by Registration Table

6:00 pm – 7:00 pm Meet the Authors -- Wine and Cheese Reception
MIT Museum, 265 Massachusetts Avenue, Building N52
Hosts: Conference Planning Committee Members
Opportunity to meet and greet colleagues from around the world, as well as the authors of the forthcoming *Rethinking Engineering Education: The CDIO Approach.*

Monday, June 11, 2007
The Bernard M. Gordon Engineering Leadership Conference

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10:45 am – 11:45 pm Address Building 33, Floor 2, Room 206
The Need for Organizational Change, Lotte Bailyn, Sloan School of Management, Massachusetts Institute of Technology
Argues that organizations will fail in an intensely competitive world unless they take into account the changing nature of the professional workforce.

12:00 pm – 12:30 pm Lunch Building 33, Floor 2, Room 206

12:30 pm – 1:30 pm Address Building 33, Floor 2, Room 206
CASEE and Progress on Engineering Education Research and Development, Norman Fortenberry, Director of the Center for Advancement of Scholarship on Engineering Education, National Academy of Engineering
Reviews the progress and achievements of CASEE, a collaborative effort to sustain excellence in engineering education and contribute to the production of a diverse, globally competitive workforce. Addresses plans for the future.

1:30 pm – 2:00 pm Address Building 33, Floor 2, Room 206
Educational Initiatives at MIT, Daniel Hastings, Dean for Undergraduate Education, Massachusetts Institute of Technology
Provides an overview of the array of educational initiatives and reform efforts underway at MIT, in the context of national U. S. and global initiatives.

2:15 pm – 3:30 pm Discussion Building 33, Floor 2, Room 206
Engineering Education and Organizational Change Issues, discussion facilitated by Ian A. Waitz, Massachusetts Institute of Technology

3:30 pm – 3:45 pm Break - coffee, cold beverages, snacks Stata Center

3:45 pm – 5:00 pm Workshop Stata Center, Room 123
MW10. *Implementing the CDIO Approach,* Edward F. Crawley, Massachusetts Institute of Technology; Clément Fortin, École Polytechnique de Montréal
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Tuesday, June 12, 2007 – Plenary and Concurrent Sessions

8:00 am – 8:45 am Registration Stata Center, Ground Floor, near Room 141 - Coffee, beverages, breakfast breads/pastries
All sessions, breaks and lunches are in the Stata Center (building 32) unless otherwise noted.

8:00 am – 8:45 am CDIO Leaders' Meeting Room 124

9:00 am – 9:30 am Welcome Room 123
Wesley Harris, Department Head, Aeronautics and Astronautics, MIT
Johan Malmqvist, Co-Director of the CDIO Initiative

9:30 am – 11:00 am T1. Plenary Session Room 123

Session Moderators: Robert Niewhoener, Peter Goodhew, and Kristina Edström

Changing Contexts of Undergraduate Engineering Education

Addresses changing expectations for undergraduate education, changing audiences, our evolving understanding of the learning process, and challenges for faculty and instructional resources.

Susan M. Ambrose
Associate Provost for Education, Director of the Eberly Center for Teaching Excellence, and Teaching Professor in the Department of History at Carnegie Mellon University, Pittsburg, Pennsylvania

Sheri D. Sheppard
Professor of Mechanical Engineering and Senior Scholar for the Carnegie Foundation for the Advancement of Teaching at Stanford University, California

Simon Barrie
Associate Director of the Institute for Teaching and Learning at the University of Sydney, Australia

11:00 am – 11:15 am Break – coffee, beverages, snacks

11:15 am – 12:30 pm T2. Concurrent Sessions

T2A. Formulating Educational Program Goals Room 124
Session Moderator: Lori Breslow

What Competencies Should Engineering Programs Emphasize? A Meta-Analysis of Practitioners' Opinions Informs Curricular Design, Honor J. Passow, University of Michigan

Synthesizes the opinions of more than 5000 engineering professionals as reported in ten published studies, including studies of CDIO. Answers key design questions about the expected competencies of graduating students and the relative importance of these competencies.

The Goals of Engineering Education: A Rationale for a Universal Document Based on the CDIO Syllabus and the Taxonomy of Engineering Competencies, Laurie Woollacott, University of Witwatersrand

Compares the CDIO Syllabus and the Taxonomy of Engineering Competencies in terms of providing a framework for setting educational goals. Provides a rationale for the formulation of a universal document that combines the strengths of both documents for curriculum design.

Large-Scale Use of the CDIO Syllabus in the Formulation of Program and Course Goals, Svante Gunnarsson, Ingela Wiklund, Tomas Svensson, Anna-Lena Kindgren, and Sten Granath, Linköping University

Presents the experiences and results of using the CDIO Syllabus in the formulation of learning outcomes for more than 1000 courses in 25 programs in the Faculty of Science and Engineering at Linköping University. Describes the use of a CDIO benchmarking tool, called *Introduce-Teach-Utilize* (ITU), to design curriculum.

T2B. Planning Design-Implement Experiences Room 141
Session Moderator: Stefan Hallström

Comparison of First-Year Design-Implement Experiences, Their Assessment and Resources, Geoffrey Cunningham, Queen's University Belfast; Melissa Balson, Queen's University (Canada); Johan Bankel, Chalmers University of Technology; Charles D. McCartan, Queen's University Belfast; Craig Putnam, Daniel Webster College; Christian Vandenplas, Hogeschool Gent

Summarizes a survey of design-implement experiences at nine CDIO collaborating institutions. Compares results and provides guidelines for those contemplating such experiences for their programs.

Towards the Systematic Definition of Project-Based Design Modules, Vassilis Agouridas, University of Leeds, UK

Presents an approach that enables teaching staff to assure that the disciplinary content of their design modules is continuously and demonstrably aligned with the needs of changing contexts in design higher education. Demonstrates prototype software that supports the traceable and efficient definition of project-based design modules.

The Use of International Development Type Projects in CDIO Programs, Patrick H. Oosthuizen and Urs Wyss, Queen's University, Canada

Discusses reasons that projects and case studies related to developing countries should be incorporated into a CDIO program. Highlights considerations that enter into the selection of suitable projects and case studies and gives examples.

T2C. Developing and Assessing Student Skills Room 155

Session Moderator: Michael Christie

"Communication of Mathematics" as a Tool to Improve Students' General Communicative Skills, Jan-Åke Larsson, Linköping University

Describes the experiences from a course on the communication of mathematics, in the first year of the engineering program at Linköping University. Results indicate that this course improves students' overall communication skills, even though they are included in a mathematics course.

Using Rubrics to Assess the Development of CDIO Syllabus Personal and Professional Skills and Attributes at the 2.x.x Level, Daryl G. Boden and Peter J. Gray, United States Naval Academy

Describes the process of developing personal and professional skills and attributes of students in the aerospace program at the United States Naval Academy. Highlights the design and implementation of rubrics to assess students' proficiency in these skills.

The Use of Learning Styles as a Tool for Curriculum and Personal Development, J. P. Hermon, Queen's University Belfast

Gives an overview of the use of learning styles for profiling student cohorts across a range of undergraduate degree programs. Reports the initial results of curriculum development that aims to balance learning style preferences.

T2D. Improving Engineering Learning Room 144

Session Moderator: Earll Murman

Developing a National Research Agenda to Shape the Landscape of Engineering Education, P. K. Imbrie, Purdue University; and the Steering Committee of the Engineering Education Research Colloquies (EERC)

Presents the National Research Agenda for Engineering Education recently developed by the Engineering Education Research Colloquies (EERC). Highlights five research areas and their respective research strands: epistemologies, learning mechanisms, learning systems, diversity and inclusiveness, and assessment.

Math, Science, and Engineering Curriculum Integration, Janet Rankin and a faculty panel, Massachusetts Institute of Technology

Showcases initiatives at MIT to integrate the teaching of key math and science concepts in introductory courses with the application of those concepts in downstream engineering courses. Discusses project-specific goals, implementation, and design, and offers lessons learned from the initial stages.

12:30 pm – 1:45 pm Lunch

Lunchtime Steelmaking Challenge: a Design Challenge Competition, facilitated by Andrew Green, University of Liverpool and Ruth Hambleton, International Iron and Steele Institute.

Open to all conference participants; sign up to be in the challenge at the Registration Table, or just come to watch!

1:45 pm – 3:15 pm T3. Concurrent Sessions

T3A. Adapting CDIO to New Disciplines I Room 124

Session Moderator: Charles McCartan

Teaching the History of Engineering: Reasons and Possible Approaches, Patrick H. Oosthuizen and Jane T. Paul, Queen's University, Canada

Discusses reasons for teaching the history of engineering within a CDIO program, emphasizing the interrelationships between engineering and society. Gives suggestions about relevant topics and methods to integrate them into a CDIO program.

CDIO in Chemical Education, Martin E. Vigild, Michael May, and Karsten H. Clement, Technical University of Denmark

Focuses on the experience of adapting the CDIO Standards and the CDIO Syllabus to chemical engineering education, namely, the BSC program at the Technical University of Denmark. Explains how implementation is a task of educating faculty on the CDIO approach, identifying elements that already exist, and planning areas of improvement.

Connecting the Dots: A New Multidisciplinary Approach to Teaching Biomedical Implants Engineering, Sumitra Rajagopalan, McGill University

Highlights the salient features of a design course that includes lifecycle and reliability engineering, a communication protocol with surgeons to elucidate design requirements, the role of the device-tissue interface, critical thinking strategies, and the introduction of clinical readiness levels. Presents the course as a model for introducing medical device design electives within existing engineering programs.

T3B. Sustaining Design-Implement Experiences Room 141

Session Moderator: Clément Fortin

Multidisciplinary Project-Based Product Development Learning In Collaboration With Industry, Fredrik Berglund, Hans Johannesson and Göran Gustafsson, Chalmers University of Technology

Describes a multidisciplinary project course open to students with engineering, business, and industrial design backgrounds. Presents data and lessons learned from the ten years of implementing the course, including process design, supervision, pedagogy, teamwork, and collaborations with industry.

The Route Towards a Sustainable Design-Implement Course, Stefan Hallström, Jakob Kuttenkeuler, and Kristina Edström, KTH-Royal Institute of Technology

Describes ways in which student learning is increased when the focus is centered on student performance. Illustrates how this change of perspective influences students' views of knowledge and the learning process. Gives examples in the context of seven years' experience with design-implement courses at KTH.

T3C. Enhancing Student Experiences Room 155

Session Moderator: Peter Gray

Engineering Students' Experiences of the Transition From Study to Work, Elinor Edvardsson Stiwne and Tomas Jungert, Linköping University

Presents data from a longitudinal study of four cohorts of engineering students at Linköping University, concerning their experiences of the transition from study to work. Comparisons are made between the experiences of those students who studied within a CDIO curriculum and those who did not.

To Rescue Eggs: A Design-Build-Test Experience for Children, Per-Anders Träff, Maria Knutson Wedel, Göran Gustafsson, and Johan Malmqvist, Chalmers University of Technology

Describes a project for primary school children in which they create a device that will allow a raw egg to withstand a fall from a height of 15 meters onto a concrete floor. Presents the children's general attitudes toward engineering and their learning experiences. Examines systematic differences between girls and boys in their problem solving approaches.

Computer-Aided Learning (CAL) and Computer-Aided Assessment (CAA) in Civil Engineering, S. G. Millard, University of Liverpool

Demonstrates the use of computer-assisted assessment to support computer-assisted learning and motivate students to take responsibility for their learning.

T3D. Meeting with the Education Experts I Room 144

Session Moderator: Robert Niewhoener

Exploring Research-Based Teaching That Focuses on Learning, Susan A. Ambrose, Carnegie Mellon University

Discusses a set of theory and research-based principles that underlie effective teaching and learning. Explores ways to reveal and monitor these principles through assessment, and how to promote these principles through various instructional strategies.

3:15 pm – 3:30 pm Break - coffee, cold beverages, snacks

3:30 pm – 5:00 pm T4. Concurrent Sessions

T4A. Adapting CDIO to New Disciplines II Room 124

Session Moderator: Martin Vigild

CDIO Applied in the Context of Materials Science, Maria Knutson Wedel, Chalmers University of Technology; Peter J. Goodhew, University of Liverpool; Johan Malmqvist, Chalmers University of Technology

Describes the differences of materials science from other engineering disciplines with respect to engineering design. Discusses what a materials science engineer means by conceive-design-implement-operate, and the type of activities that support student learning. Gives examples from a new master's program.

CDIO Curriculum Development for the Program of Civil Engineering, Guangjing Xiong and Xiaohua Lu, Shantou University

Presents the processes and considerations of designing a curriculum for a program in civil engineering. Explains how CDIO is applied to large-scale projects, for example, buildings and bridges, that require long time periods, large spaces, great amounts of money, and special tools and skills.

Integrating CDIO Experiences Into a New Program Environment, Joakim Lundblad, Leif Kari, and Sören Östlund, KTH-Royal Institute of Technology

Describes the development of a new program in engineering physics that integrates CDIO standards and experiences. Compares the curriculum with a more-established CDIO program in vehicle engineering. Suggests approaches for continuous program improvement.

The Other New York Crashes: Their Use in a CDIO Program, Patrick H. Oosthuizen, Queen's University, Canada

Argues that problems that occur during the operation of a device or system should be included in a CDIO program. Uses the examples of four aircraft crashes that occurred in New York from 1996 to 2001. Demonstrates how official investigations and reports of these product and system failures can foster worthwhile discussions.

T4B. Incorporating New Design-Implement Experiences I Room 141

Session Moderator: Matt Murphy

Design-Implement Experiences From the 2nd-Year Capstone Course, "Integrated Design and Manufacturing," Magnus Evertsson, Johan Bankel, Mikael Enelund, Andreas Eriksson, Per Lindstedt, and Christine Räisänen, Chalmers University of Technology

Reports experiences from a new design-implement project course in the second year of the mechanical engineering master's program at Chalmers University of Technology. Describes the source of project ideas, the process of product development, and student learning assessment methods.

The Experience of Teaching Software Development in Robotics Project Courses, Nicholas Roy, John Leonard, Una-May O'Reilly, Daniela Rus, Seth Teller, Massachusetts Institute of Technology

Describes a curriculum for a two-semester course sequence in hardware-software development, taking students through a complete development cycle of the various capabilities for an autonomous mobile robot. Shares insights into teaching large-scale system development, especially with respect to software-intensive courses.

Designing a CDIO Final-Year Project, Helene Leong-Wee and S. H. Pee, Singapore Polytechnic

Shares the process of developing a CDIO final-year student project for all programs at Singapore Polytechnic. Discusses implementation issues that include ways to meet the curriculum objectives, new workspace requirements, assessment criteria, and implications for administrative support and structure.

T4C. Improving Student Learning Room 155

Session Moderator: Elinor Edvardsson Stiwne

Methodological Innovation in an Electrical Engineering Control Systems Course, Doris Saez and Rosita Uribe, Universidad de Chile

Presents the innovations in teaching methods implemented in a control systems course at Universidad de Chile. Emphasizes the use of learning objectives, cooperative learning, case studies, and visits to industrial sites. Discusses the reasons for the innovations, and the transformations that occurred in the process of moving toward a student-centered learning approach.

An Integrated Approach to Teaching First-Year Diploma in Bioelectonics, Christopher Teoh, Au Siew Hong, Peh King Sing, Tan Hua Joo, and Tsui Ping, Singapore Polytechnic

Explains a model of integrating traditional lecture, tutorials, and practical project work in the first year of a new diploma program in bioelectronics at Singapore Polytechnic. Describes the benefits to students, and the influence of the integrated approach on student motivation.

Integrating Risk Concepts Into Undergraduate Engineering Courses, Nicola Stacey and Julian Williamson, Health and Safety Laboratory, Buxton, England; Graham Schleyer and Rui Fang Duan, University of Liverpool; Richard Taylor, City University, London, and University of Bristol

Describes various initiatives to develop suitable materials to teach health and safety risk concepts to undergraduate engineering students. Demonstrates how these materials can be successfully integrated into degree programs. Provides results of an assessment of students' understanding of risk concepts.

T4D. Meeting with the Education Experts II Room 144

Session Moderator: Peter J. Goodhew

Research on Engineering Education, Sheri Sheppard, Stanford University and the Carnegie Foundation for the Advancement of Teaching

Shares the findings from three major nationally-focused engineering education studies that focus on how well programs educate practitioners, the nature of students' experiences as they navigate programs, and the improvement of teaching and learning. Invites participants to explore the implications of research findings for improving their own engineering programs.

5:00 pm – 6:00 pm T5. Poster Session Stata Center Hall - outside session rooms

Session Moderator: Sören Ostlund

1. *CDIO Teaching Reform and Implementation in Communication Engineering*, Jingwen Yan, Yongquan Jiang, Zhemin Zhuang, and Fenlan Li, Shantou University

Applies the CDIO approach to curriculum design and renewal in communications engineering at Shantou University

2. *Virtual Reconstruction of an Accident Investigation: A Year One Laboratory Exercise,* Graham Schleyer and Rui Fang Duan, University of Liverpool; Nicola Stacey, Health and Safety Laboratory

Demonstrates that reconstruction of real-life scenarios enables students to learn in context, and highlights safety risk concepts and skills being implemented through active experiential learning.

3. *Introducing the CDIO Concept in Basic Research Methodology*, Mikael Syväjärvi, Cecilia Vahlberg, Kenneth Järrendahl, and Svante Gunnarsson, Linköping University

Describes a project that introduces students who are at a beginning level to concepts of CDIO and research methodology in complex multidisciplinary fields. Shares experiences of the past two years.

4. *MoRETA Modular Rover for Extreme Terrain Environments*, John E. Keesee and David Miller, Massachusetts Institute of Technology

Explains the educational and technical objectives of a capstone design project at MIT, in which students are designing a prototype rover test bed that will allow rovers to autonomously explore extreme environments on Mars.

5. *Mars Gravity Biosatellite Program*, John E. Keesee and members of the Mars Gravity Team, Massachusetts Institute of Technology

Explains ways in which a large, student-led complex engineering project, which extends beyond the prescribed curriculum, affects students' overall engineering education experience.

6. *Integration of Key Competencies into the Teaching of Product Development*, Albert Albers, Norbert Burkardt, and Tobias Deigendesch, Universität Karlsruhe

Explains ways in which key student competencies can be developed in product development experiences that are adapted from industrial product development processes.

7. *Applying Business Stakeholder Analysis to Renewing Built-Environment Education in KTH-Stockholm*, Samuel Azasu, KTH-Royal Institute of Technology

Applies a stakeholder matrix to identifying the major stakeholders of real estate education in Sweden, and discusses how stakeholder input influences curriculum design and renewal.

8. An Introductory Course in Aerospace Engineering and Design at MIT, Jeffrey A. Hoffman, Massachusetts Institute of Technology

Describes the design-implement projects that are part of a first-year introductory course in aerospace engineering and design. Highlights the application of the CDIO approach and the changes in the course over the past eight years.

9. *Assessing Project Courses With Several Teachers Involved*, Stefan Östlund and Joakim Lilliesköld, KTH-Royal Institute of Technology

Describes a system used in a first-year project course in the School of Electrical Engineering at KTH, and examines issues that have been considered in the six years of experience with the course.

10. *CDIO and Beyond: A Real World Experience*, Durga Murti, Zadco, United Arab Emirates

Applies lifecycle integrity management in an oil and gas industry, and draws parallels with the CDIO product, process, and system lifecycle.

11. *Experiences With Recorded Remote Student Access to Lecture Materials*, facilitated by S. G. Millard and N. Bunyan, University of Liverpool

Discusses the use of computer hardware and software to provide more flexible student access to lectures and to make efficient use of lecture facilities for large classes.

12. *MIT's Entry to the AIAA Design, Build, Fly Competition: Optimizing the Design-Build Process for Success*, facilitated by G. Kiwada, N.Armar, C. Engel, A. Woodworth, B. Suarez, R. Castonia, D. Sanchez, F. Hu, Massachusetts Institute of Technology

Describes the processes, analyses, assessment and lessons learned in the development of a design-build-fly aircraft to compete and win the AIAA Design-Build-Fly international competition

13. *Project-Based Learning Framework and Engineering Competencies in a French Grande École,* Gabrielle Landrac, Gilbert Lainey, and Gilles Coppin, École Nationale Supérieure des Télécommunications, Bretagne

Describes the recent changes and enhancements that were applied to the engineering education program in order to improve the development of student competencies. Highlights the project-based framework and active learning pedagogies that provide students with real engineering experiences.

7:00 pm Conference Dinner

Jasper White's Summer Shack, Cambridge, Massachusetts
149 Alewife Brook Parkway - Directly across the street from Alewife T Station
Host: John E. Keesee, Massachusetts Institute of Technology

Wednesday, June 13, 2007 – Plenary and Concurrent Sessions

8:00 am – 8:30 am Registration Stata Center, Ground Floor, near Room 141 - Coffee, beverages, breakfast breads/pastries
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8:30 am – 10:00 am W1. Concurrent Sessions

W1A. Benchmarking and Developing Curriculum Room 124
Session Moderator: Udo Onnen-Weber

Benchmarking the Queen's University Mechanical and Materials Engineering Curriculum With the CDIO Syllabus, Patrick H. Oosthuizen, Urs Wyss, Nathalie Kubrick, and Dane Smith, Queen's University, Canada

Describes the procedure used to benchmark the curriculum, and discusses problems that arose in the process. Explains the results and the implications for curriculum renewal in Mechanical Engineering at Queen's University.

Experiences From Using Integrated Program Descriptions to Support Program Development, Johan Malmqvist and Marie Arehag, Chalmers University of Technology

Analyzes the experiences of using integrated program descriptions to support the development of new master's programs at Chalmers University of Technology. Provides guidelines for future use of integrated program descriptions.

CDIO-Based Master Programme in Product Development, Fredrik Berglund and Johan Malmqvist, Chalmers University of Technology

Analyzes experiences of developing a CDIO-based master's program in product development, using the CDIO Standards and the CDIO Syllabus, at Chalmers University of Technology.

W1B. Developing and Implementing First-Year Courses Room 141
Session Moderator: Svante Gunnarsson

The Systematic Development of a New Introductory Course, Charles D. McCartan, Geoff Cunningham, Emmanuel Bernard, Fraser J. Buchanan, Marion McAfee, Robert G. Kenny, Queen's University Belfast; Ian Taylor, Adam Mannis, UK Centre for Materials Education

Describes a definitive, but simple, change management process that was applied effectively to implement changes in the curriculum. Gives an example drawn from an introductory course for first-year mechanical and aerospace engineering students at Queen's University Belfast.

Balancing Pedagogy and Student Experience in First-Year Engineering Courses, Duncan Campbell, Wageeh Boles, Mahalinga Iyer, Doug Hargreaves, and Andrew Keir, Queensland University of Technology

Examines a number of approaches to the design and delivery of first-year courses, including problem-based learning, project-based learning, context-based learning, multidisciplinary integrated programs, and systems-based courses.

Design and Conduct of an Introductory Course in the Current Chinese Context, Xiaohua Lu and Zhulin Chen, Shantou University

Presents the experiences and achievements of designing and implementing a common introductory course for first-year engineering students at Shantou University. Applies the basic principles of CDIO Standard 4 to implement the new course.

W1C. Applying Lean Thinking in CDIO Contexts Room 155
Session Moderator: Sumitra Rajagopalan

Enhancing Faculty Competence in Lean Thinking Bodies of Knowledge, Earll Murman, Massachusetts Institute of Technology; Hugh McManus, Metis Design; Jacqueline P. Candido, MIT Lean Aerospace Initiative

Describes the way in which a network of university, industry, and government members have collaborated to build faculty capability to teach principles of Lean Thinking in campus, industrial, and government venues. Provides data on the effectiveness of this network, and summarizes lessons learned from the experiences.

Active Learning Strategies for Teaching Lean Thinking, Jacqueline P. Candido, MIT Lean Aerospace Initiative; Earll Murman, Massachusetts Institute of Technology; Hugh McManus, Metis Design

Provides an overview of active learning and ways in which it can be used throughout a curriculum focused on lean principles. Examples include supply chain puzzles, sailing tools for lean engineering principles, tours, interviews, presentations, games and simulations.

Teaching Lean Thinking Principles Through Hands-On Simulations, Hugh McManus, Metis Design, Cambridge, MA; Eric Rebentesch and Earll Murman, Massachusetts Institute of Technology; Alexis Stanke, Eclipse Aviation, Albuquerque, NM

Describes a teaching simulation of a complex aerospace enterprise, and illustrates the way in which such a simulation can be used as a CDIO exercise. Presents experiences to date on the usefulness of this tool for teaching complex and unfamiliar concepts quickly and effectively.

W1D. Enhancing Teaching and Learning Through Reflection Room 144

Session Moderator: Perry Armstrong

Reflective Memos: Capturing Lessons Learned and Implementing Change, Ian Waitz and Edward Greitzer, Massachusetts Institute of Technology

Discusses the attributes and uses of reflective memos with faculty in the Department of Aeronautics and Astronautics at MIT. Explains the rationale and benefits of this approach for enhancing faculty competence in, and improving the quality of, teaching and learning.

Helping Engineering Educators Reflect On, and Adapt to, Changing Contexts, Michael Christie, Chalmers University of Technology

Illustrates ways in which the critical incident technique can help engineering educators uncover, question, and subsequently change their assumptions upon which they base their teaching. Presents the findings of an action research project investigating the use of this critical incident technique.

10:00 am – 10:15 am Break – coffee, beverages, snacks

10:15 am – 12:00 pm W2. Plenary Session Room 123

Session Moderator: Ian A. Waitz

Changing Contexts for Engineering Practice

Addresses the changing contexts of engineering disciplines, innovations in engineering research and practice, and the changing professional engineering workforce.

Bernard M. Gordon, Founder, Analogic Corporation
Mark Lundstrom, CEO, Bioscale Inc.
David Wisler, Manager, University Programs, GE Aviation

12:00 pm – 1:15 pm Lunch

1:15 pm – 2:45 pm W3. Concurrent Sessions

W3A. Renewing and Improving Curriculum I Room 124

Session Moderator: Patrick H. Oosthuizen

Curriculum Renewal at Two Universities in Chile Using the CDIO Syllabus, Patricio V. Poblete, Ximena Vargas, and Sergio Celis, Universidad de Chile; Pedro Gazmuri and José Bilbao, Pontificia Universidad Católica de Chile; Doris R. Brodeur, Massachusetts Institute of Technology

Describes the way in which the CDIO Syllabus was applied to the redesign of the basic common core of the engineering curriculum at two universities in Chile. Demonstrates how consensus was reached on the expected levels of proficiency in each discipline of the common core.

Towards CDIO-Based B. Eng. Studies at the Technical University of Denmark, Jens Sparsø, Peder Klit, Michael May, Gunnar Mohr, Martin E. Vigild, Technical University of Denmark

Reports on the process of introducing CDIO in all eight B. Eng. programs of study, and of defining common goals and guidelines. Highlights areas where the context or the approach differs from that of previous adopters of CDIO.

Curricular Reform Based on the CDIO Initiative in Shantou University, Peihua Gu, Minfen Shen, and Xiaohua Lu, Shantou University

Presents an analysis of the most urgent problems facing engineering education in China, and describes the ways in which a CDIO approach addresses them. Reports data and comparisons from pilot projects and implementation of CDIO in specific courses.

W3B. Renewing and Improving Curriculum II Room 141

Session Moderator: Nicholas Roy

Redesign of an Engineering Curriculum Based on Four Integrated Learning Projects, Clément Fortin, Bernard Sanschagrin, Guy Cloutier, and Greg Huet, École Polytechnique de Montréal

Describes the evolution of the implementation of CDIO in a mechanical engineering curriculum that is designed around four integrated learning design projects. Discusses the results of stakeholder surveys, and highlights some of the most important issues of the implementation.

Continuous Improvement of a CDIO Program Using Management-By-Means, Sören Östlund and Karin Blom, KTH-The Royal Institute of Technology; P. O. Hjorth and Jonas Ahlstrand, Samarbetande Konsulter AB

Shares experiences in sustaining momentum in the continuous improvement work of a CDIO program. Demonstrates the ways in which management-by-means tools are implemented in continuous improvement work.

Product Innovation Engineering Program: A Systematic Change Towards Innovation in Engineering Education, Martin Grimheden, Margareta Norell Bergendahl, and Jan Wikander, KTH-The Royal Institute of Technology

Describes experiences from the Product Innovation Engineering program, a Swedish national research and development effort focused on strengthening innovative product and business development. Highlights the component of the system that utilizes student ideas and promotes entrepreneurship.

W3C. Enhancing Learning in Project-Based Courses Room 155

Session Moderator: Nicola Stacey

Expectations of Learning Outcomes in Project-Based First-Year Courses, Edward F. Crawley and Diane H. Soderholm, Massachusetts Institute of Technology

Reports a study of expected learning outcomes of first-year students in project-based courses at MIT. Highlights the results of a survey to determine the extent of community consensus on the desired learning outcomes, and draws conclusions about the implications for the design of first-year project-based courses.

Implementing Design-Build Projects: Skills Development by Faculty Through Case Analysis, Isabelle Claeys and Ivan D'haese, Hogeschool Gent

Describes a case study analysis of a design-build project in wood technology, which was used for the enhancement of faculty competence in teaching skills. Generalizes the methodology of using such a case analysis approach to improve teaching and learning in project-based courses.

W3D. Meeting With the Education Experts III Room 144

Session Moderator: Kristina Edström

Curriculum Renewal Through Graduate Attributes, Simon Barrie, University of Sydney

Explores the findings of Australian research describing ways in which faculty understand the relationship between the acquisition of disciplinary content and the development of generic outcomes, such as scholarship or creativity. Invites participants to share experiences with teaching practice and curriculum development activities in light of these ideas.

2:45 pm – 3:00 pm Break - coffee, cold beverages, snacks Stratton Student Center Building W20 Floor 3

3:00 pm – 3:55 pm W4. Roundtable Discussions Stratton Student Center Building W20 Floor 3

Session Moderator: William T.G. Litant

1. *Enhancing the First-Year Experience*, facilitated by Matt Murphy, University of Liverpool; Charlie McCartan, Queen's University Belfast

Focuses on the design and implementation of introductory courses for first-year engineering students. Topics include: a structured method for designing the course, course content, assessment methods, and linking recruitment to first-year experiences.

2. *Integrating Entrepreneurship Education Into Engineering Education*, facilitated by Terrence E. Brown, KTH–The Royal Institute of Technology

Addresses some of the challenges facing an educator trying to integrate knowledge perceived as "soft" into engineering and science.

3. *CDIO and the Bologna Model*, facilitated by Gunnar Mohr, Technical University of Denmark

Discusses the challenges to European universities of offering two different bachelor programs, and raises questions about how a CDIO approach can be an excellent response to the challenges.

4. *Instructor Resource Materials on the Web*, facilitated by John Keesee, Massachusetts Institute of Technology

Reports on the progress of the development and use of Instructor Resource Materials found on the CDIO website. Invites participants to explore the materials and provide feedback on their usefulness in supporting the teaching of personal, interpersonal, and system building skills.

5. *Entrepreneurship as a Part of CDIO Standard 3 (Integrated Curriculum),* facilitated by Udo Onnen-Weber and Norbert Gruenwald, Hochschule Wismar

Discusses the required competencies for entrepreneurship and their correlation with the CDIO Syllabus. Gives examples from the Wismar program of integrating entrepreneurship processes in engineering education.

6. *Creating Pathways for Faculty Change*, facilitated by Donna M. Qualters, Suffolk University

Invites participants to share ideas, techniques, and strategies to create venues and activities that promote faculty growth and development in the 21st century. Provides a rationale for a coordinated approach to faculty development.

7. *Approaches, Aims, and Experiences With First-Year Engineering Across a Wide Spectrum of Institutions*, facilitated by Marie Dillon Dahleh and Ambuj Sager, Harvard University

Shares experiences of seven institutions with engineering courses for first-year students. Invites participants to describe their own experiences with first-year courses, with the aim of identifying those elements that enrich the first-year experience for students, both inside and outside the classroom.

8. *Personalized Learning*, facilitated by Peter J. Goodhew, University of Liverpool

Shares best-practice techniques of personalized learning that can be used to address the challenges of teaching students from widely diverse backgrounds and experiences, in such a way as to draw out the best from every student.

9. *An Experiment in Small-Group Teaching at MIT Modeled After the University of Cambridge Supervision System*, Warren Seering and Lori Breslow, Massachusetts Institute of Technology

Reports a study of small-group tutorials in six foundation courses in mechanical engineering at MIT over a two-year period. Compares the results of two different types of tutorials, both modeled after the supervision system at the University of Cambridge. Draws conclusions about student satisfaction and learning gains.

4:00 pm – 4:55 pm W5. Roundtable Discussions Stratton Student Center Building W20 Floor 3

Session Moderator: Göran Gustafsson

1. *Engineering Education and Global Outsourcing*, facilitated by Sumitra Rajagopaian, McGill University
   Addresses the challenges of engineering education in the context of increased global outsourcing. Topics include: re-engineering the curriculum, engineering in elementary and secondary schools, and reshaping science and education policies.
2. *The Use of Computer-Based Simulations,* facilitated by Peter J. Goodhew
   Invites participants to share ideas on how to use computer-based simulations in engineering education. Welcomes examples of simulations of devices, processes, and experiments that have been used successfully in engineering programs.
3. *Strategic Teaching*, facilitated by Lori Breslow, Massachusetts Institute of Technology
   Examines an approach to the design and development of an engineering course. Invites participants to share experiences with the design of learning outcomes, pedagogical methods, educational technologies, and assessment.
4. *Teaching Engineering Science Courses in a CDIO-Based Engineering Program*, facilitated by Patrick H. Oosthuizen, Queen's University, Canada
   Discusses the importance of matching teaching methods with student learning styles, disciplinary content, and learning environments. Invites participants to share ideas of how to promote students' understanding of the interrelatedness of what they are learning across courses and programs.
5. *Language and Communication Goals: Methods and Strategies for Teaching and Learning*, facilitated by Carl Johan Carlsson, Chalmers University of Technology
   Compares ideas and practices of language and communication study in engineering education. Provides a forum to share ideas on the integration of language and communication activities into core engineering disciplines.
6. *Internships and Cooperative Learning Experiences in Engineering Programs*, facilitated by Claire Yang, University of Colorado at Boulder; Barbara Lechner, Massachusetts Institute of Technology
   Invites participants to share experiences with providing internship and cooperative learning experiences in industry for students in engineering programs.
7. *Enhancing Student Learning in the Laboratory*, facilitated by Matt Murphy, University of Liverpool
   Discusses the role of the traditional engineering laboratory in supporting theoretical learning, and explores ways in which student learning might be enhanced by developing new approaches to laboratory work that reflect CDIO principles.
8. *Education for Sustainable Development*, facilitated by Marie Arehag, Chalmers University of Technology
   Discusses ways to enhance education for sustainable development within a CDIO approach, and invites participants to share their examples. Continues the discussion of earlier conference presentations on sustainability.
9. *Seven Years of Capstone Design Courses in Aeronautics and Astronautics at MIT*, David Miller, John E. Keesee, and Diane H. Soderholm, Massachusetts Institute of Technology
   Summarizes the lessons learned from seven years of complex design-implement projects in aerospace engineering at MIT. Addresses the types of projects, assessment techniques, management processes, funding, and sustainability of these large projects. Presents data of students' perceptions of their experiences.

5:00 pm – 5:30 pm Closing Session Stratton Student Center Building W20 Floor 3

Session Moderator: Johan Malmqvist

Taking the Necessary Steps to Change
Edward F. Crawley, Massachusetts Institute of Technology

Invitation to the 4th International CDIO Conference
Marc Vanhaelst, Hogeschool Gent

Thursday, June 14, 2007 – Collaborators' Meetings
(open to all conference participants)

8:00 am – 9:30 am Invited Presentations From New Universities Stata Center Room 123
Coordinator: Johan Malmqvist

9:30 am – 9:45 am Break – coffee, beverages, snacks

9:45 am – 11:00 am CDIO Regional Center Meetings

11:00 am – 12:15 pm Project Group Meetings
Curriculum
Student Learning and Assessment
Design-Implement Experiences
Implementation
Students

12:15 pm – 1:00 pm Lunch

1:00 pm – 2:00 pm Reports from Regions and Project Groups

2:00 pm – 2:15 pm Summary and Future Plans

2:15 pm – 2:30 pm Break - coffee, cold beverages, snacks

2:30 pm – 3:30 pm CDIO Leaders Meeting
Co-Chairs: Edward F. Crawley
Johan Malmqvist