SESSION SIX

CDIO AS THE CONTEXT

THE CDIO SYLLABUS

INTEGRATED CURRICULUM

INTRO TO ENGINEERING

LEARNING

ASSESSMENT

DESIGN-IMPLEMENT EXPERIENCES

WORKSPACES

FACULTY COMPETENCE

PROGRAM EVALUATION

HOW WELL

HOW

WHY

WHAT

IMPLEMENTATION
SESSION SIX OBJECTIVES

- Recognize key factors that influence change in an organization
- Examine the implementation process in a selected CDIO program
- Describe resources that facilitate the adoption of CDIO in engineering programs
KEY FACTORS THAT PROMOTE CULTURAL CHANGE

GETTING OFF TO THE RIGHT START
1  Understanding the need for change
2  Leadership from the top
3  Creating a vision
4  Support of early adopters
5  Early successes

BUILDING MOMENTUM IN THE CORE ACTIVITIES OF CHANGE
6  Moving off assumptions
7  Including students as agents of change
8  Involvement and ownership
9  Adequate resources

INSTITUTIONALIZING CHANGE
10 Faculty recognition and incentives
11 Faculty learning culture
12 Student expectations and academic requirements

(See Handbook, pp. 34-36)
EXAMPLES:
#5 EARLY SUCCESSES

- Identify learning outcomes for several courses.

- Start, or modify, a first-year engineering course that includes a simple design-implement experience.

- Modify an upper-level course to include a simple, low-cost design-implement experience.

- Modify an appropriate meeting room or flexible classroom space to create a design-implement workspace that supports hands-on and social learning.
Enhancement of CDIO Skills

• Hire faculty with industrial experience
• Give new hires a year to gain experience before beginning program responsibilities
• Create educational programs for current faculty
• Provide faculty with leave to work in industry
• Encourage outside professional activities that give faculty appropriate experiences
• Recruit senior faculty with significant professional engineering experience
Enhancement of Teaching Skills

- Hire faculty with interest in education and ask them to discuss teaching during their interviews
- Encourage faculty to take part in CDIO workshops
- Connect with the teaching and learning centers at your universities
- Invite guest speakers on teaching topics
- Organize coaching by educational professionals or distinguished peers
- Participate in teaching mentorship programs
Working with the key change factor assigned to your group, and the descriptions found in the *Handbook*, pp. 34-36

- Discuss what the factor means
- List 3 or 4 examples of ways that you can apply that change factor in your engineering program
- Share an example with the whole group
AN IMPLEMENTATION STORY

The Change Process
At Singapore Polytechnic
• CDIO collaborator since 2004 – piloted in the School of Electrical and Electronic Engineering

• Adopted by 5 academic schools
  - in 2007
    - Architecture and the Built Environment
    - Chemical and Life Sciences
    - Electrical and Electronic Engineering
    - Mechanical and Aeronautical Engineering
  - In 2009
    - Digital Media and Info-comm Technology

• Implemented in 15 programs
UNDERSTANDING THE NEED FOR CHANGE

• A new education model that produce graduates geared to the needs of the 21st century
  
  o Global mindset,
  
  o Creative, innovative and enterprising, and
  
  o Competent in areas beyond their core discipline,
  
  o Grounded in a strong set of core values
Redesign the curriculum for the program as a whole to infuse
• key process / life skills
• dispositions (e.g. values / ethics and CIE)
• domain knowledge and skills.
LEADING THE CHANGE

- Identify early adopters and owners
  - Workgroup to lead the change – meetings once a week
  - Experimenters, influential, dare to make changes
  - Equipped with good knowledge of CDIO and its practices - CDIO conference and collaborators’ meetings
  - Support of management – in school’s strategic plans
SP CDIO COMMITTEE – SP LEVEL

• Tasked to adapt the CDIO initiative to SP’s context
  - Understand CDIO framework and practices
  - Customise CDIO syllabus for SP
  - Suggest appropriate approaches, activities and assessment
  - Conduct training/workshops
  - Conduct evaluation
  - Set up website for sharing of resources

• Made up of representatives of the 5 schools and the Educational Development Department.
Work Groups formed to implement CDIO

- Decide and select courses directly affected by CDIO implementation
- Decide on which skills to infuse into courses
- Decide on T&L activities required to infuse skills
- Ensure technical courses are well integrated
- Ensure that assessment schemes are in place
- Ensure that course and program documentation is updated
- Co-ordinate training for faculty in CDIO framework
Before
• Learning outcome is determined by “what we think students are capable of doing”
• Courses are still largely “independent”, ie. compartmentalized learning and not integrative

With CDIO
• Learning outcome is determined by what the graduates are expected to do, ie job competency
• Courses are integrated to support the job competency.
CURRICULUM CHANGES

Before
• Few opportunities for Conceive, some Design, mostly Implement and Operate.

• Assessment is heavy on testing knowledge

With CDIO
• Balanced treatment of CDIO elements

• Assessment of application of knowledge and CDIO skills enhanced
CURRICULUM CHANGES

• Integrated Curriculum - Existing courses reorganised and linked. Some courses merged or removed.

• Syllabuses revised to incorporate the CDIO skills

  Year 1:
  Personal Skills and Attitudes, Teamwork, Communication

  Year 2:
  Conceive, Design, System Thinking, Experimentation and Knowledge Discovery

  Year 3:
  Professional Skills and Attitudes, C-D-I-O
CURRICULUM CHANGES

• New Courses:
  - Introduction to Engineering course in 1\textsuperscript{st} year
  - Teamwork and Communication Skills in 1\textsuperscript{st} year
  - Design Implement experiences in 2\textsuperscript{nd} year (emphasis on C & D)
  - Revised Final Year Project in the 3\textsuperscript{rd} year (C-D-I-O)

• Greater emphasis on
  - Assessment of skills
  - Integrated learning experiences
  - Active Learning
Professional Development

SP Customized
CDIO SKILLS
(Competency areas with underpinning Knowledge)

Infuse CDIO Skills Into program & course structure

Produce Learning Designs and Activities for developing competence

Produce Assessment Items for assessing competence

EDU Support

Evaluation
May 23, 2010 - May 30, 2010

Tue, Mar 24, 2009 -- Evaluation Data for Semester 1 09/10
All journal entries and end semester questionnaire results have been collated and uploaded in the CDIO Evaluation folder under the respective ACAD SCHOOLS button.

Wed, Aug 20, 2008 -- Student Journal Entries
A new CDIO Evaluation folder has been created under the ACAD SCHOOLS button. Journal entries and questionnaire results have been uploaded in the folder.
<table>
<thead>
<tr>
<th>School</th>
<th>Description</th>
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<tbody>
<tr>
<td><strong>School of Chemical &amp; Life Sciences</strong></td>
<td>Click here to access workshop and briefing material for CLS staff.</td>
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<tr>
<td><strong>School of Electrical &amp; Electronic Engineering</strong></td>
<td>Click here to access workshop material for EEE staff.</td>
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<tr>
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<td><strong>Department of Mathematics &amp; Science</strong></td>
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<tr>
<td><strong>School of Digital Media and Infocomm Technology</strong></td>
<td>Click here to access materials for DMIT staff.</td>
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Purpose of the Evaluation

• To provide a structured research driven approach to monitor and review the implementation of the CDIO Framework
• Were the learning outcomes, learning activities and assessments aligned?

• Were the learning of the courses integrated?

• How has the integration of the CDIO skills into the syllabuses impacted the students?

• What were the faculty’s perception of the curriculum changes and their impact on students’ competence in the selected CDIO skills and interest in subject?
EVALUATION METHODS

- Examination of a range of curriculum materials
- Student questionnaires
- Student Blogs
- Focus group interviews with students and faculty teaching the CDIO programs
- Observation of selected lessons (e.g., those incorporating activities related to selected CDIO skills)
ACHIEVEMENTS

2009 - Hosted the 5\textsuperscript{th} International CDIO Conference

2010 - SP’s \textbf{School of Chemical \& Life Sciences}

- first winner of the “\textbf{Excellence in Education and Training in Chemical Engineering}”

- awarded by IChemE (UK)

- for \textbf{adopting the CDIO Framework} to deliver the best educational experience to students.
ADVICE FOR ADOPTERS

• Evaluate your program. What are your strengths and weaknesses with respect to the CDIO Syllabus?
• Identify some early successes *(5. Early Successes)*
  - Easy to implement
  - Quick payoff
  - Visible results
• Generate buy-in from faculty *(8. Involvement and Ownership)*
  - Give them tools to help with changes
  - Reward faculty who embrace CDIO
  - Give faculty ownership in the project
• Be ready to assess changes
• Identify resources needed before you embark on large changes – especially project-based courses *(9. Adequate Resources)*
TO LEARN MORE ABOUT CDIO …

Visit www.cdio.org!
OPEN-SOURCE RESOURCES

Available at http://www.cdio.org

• The CDIO Syllabus
• The CDIO Standards
• Start-Up Guidance
• Implementation Kit (I-Kit)
• Instructional Resource Materials (IRMs)

Other

• Rethinking Engineering Education: The CDIO Approach by Crawley, Malmqvist, Östlund, & Brodeur, 2007
• Annual international CDIO conference
• Local, regional, and international workshops
ACTIVITY: DISCUSSION

CHALLENGES

Identify 3 key challenges that you face in implementing a CDIO approach in your program.

What resources can you draw on to address these challenges?

### SUMMARY: How much progress did you make toward the workshop objectives?

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<tr>
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<th>Little or no progress</th>
<th>Some progress</th>
<th>Very good progress</th>
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<tr>
<td>Explain the CDIO approach to engineering education</td>
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<td>Determine ways in which the CDIO approach may be adapted to your own programs</td>
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<td>Share your ideas and experiences of engineering education reform</td>
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<td>Other (please specify)</td>
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Please write additional comments on the back of this page.
Thank You!

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