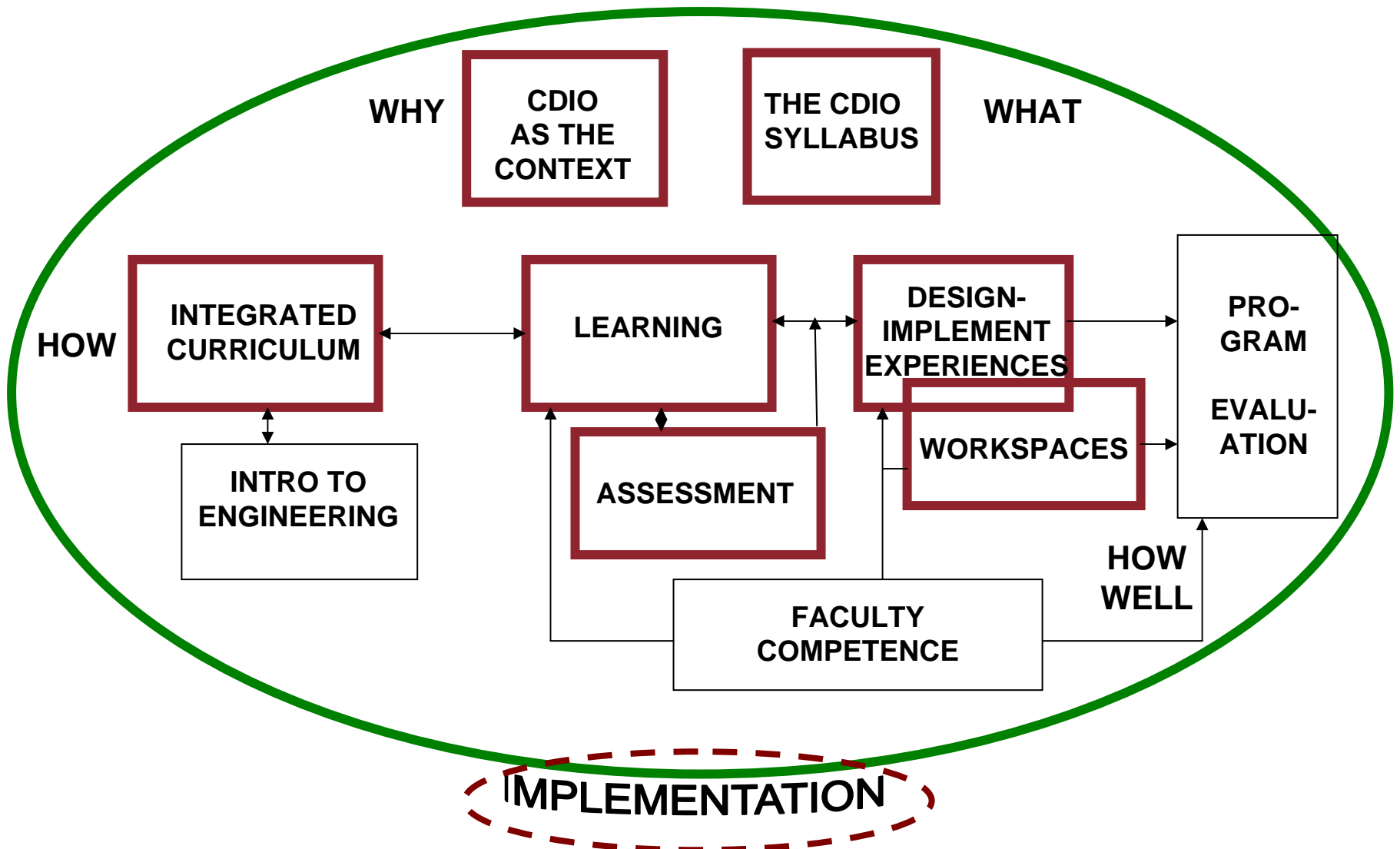




# THE CDIO APPROACH TO ENGINEERING EDUCATION: 6. Adapting And Implementing The CDIO Approach

Helene Leong (helene\_leong@sp.edu.sg)  
Revised June 2010

## INTRODUCTION



# 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**

**(See Handbook, pp. 34-36)**

## **INSTITUTIONALIZING CHANGE**

- 10 Faculty recognition and incentives**
- 11 Faculty learning culture**
- 12 Student expectations and academic requirements**

# 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

# ACTIVITY: KEY CHANGE FACTORS



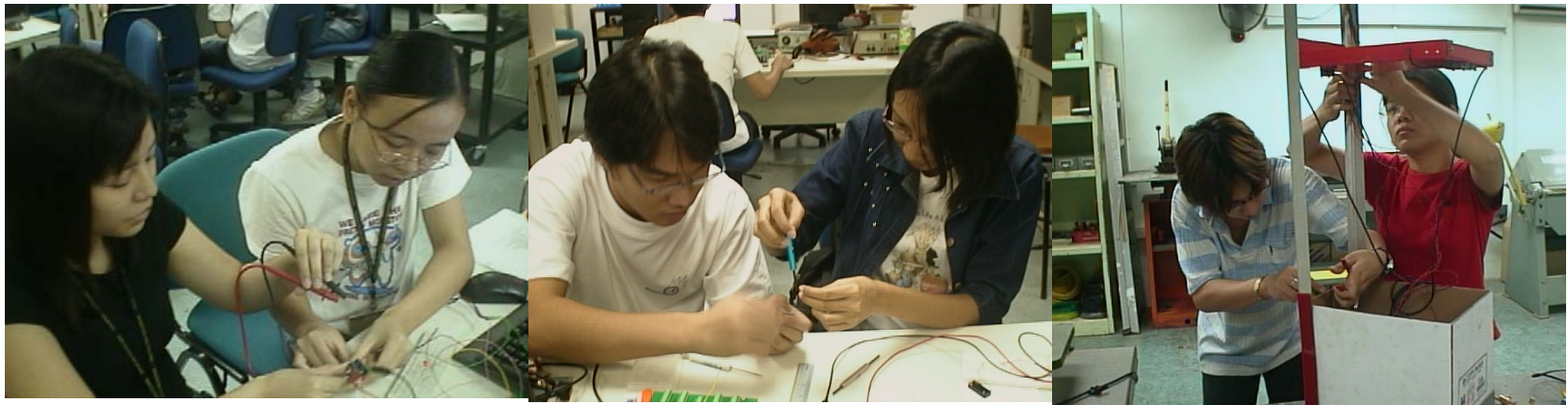
Working with the key change factor assigned to your group, and the descriptions found in the **Handbook**, pp. 34-36

- 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





## The Change Process At Singapore Polytechnic

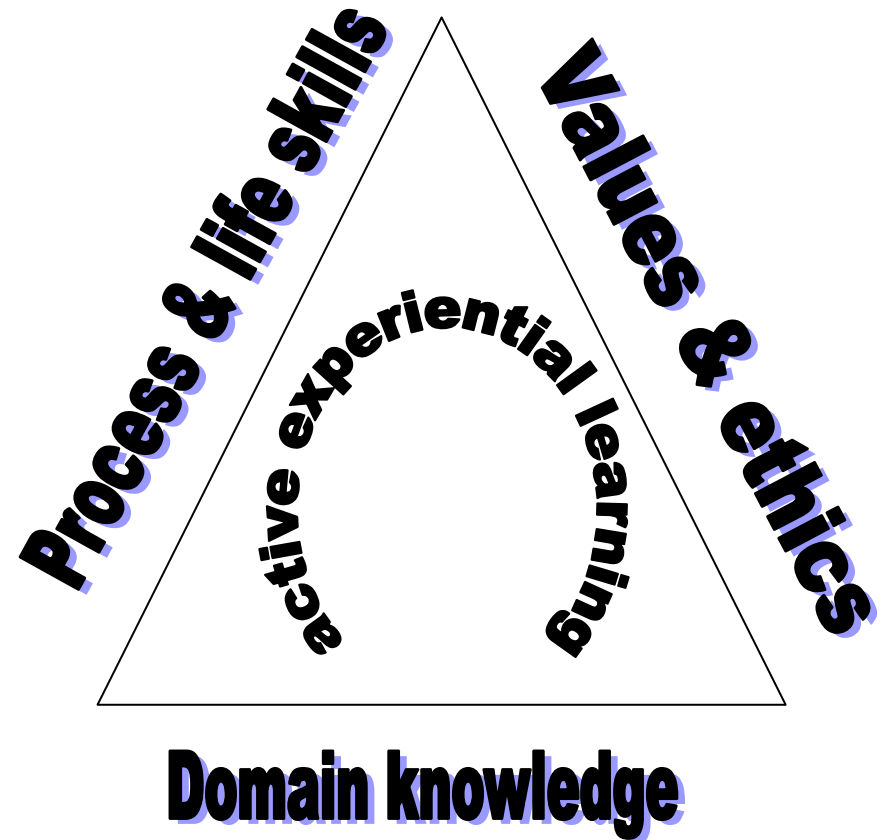


- CDIO collaborator since 2004 – piloted in the School of Electrical and Electronic Engineering
- Adopted by 5 academic schools
  - in 2007
    - ❖ Architecture and the Built Environment
    - ❖ Chemical and Life Sciences
    - ❖ Electrical and Electronic Engineering
    - ❖ Mechanical and Aeronautical 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
  - Global mindset,
  - Creative, innovative and enterprising, and
  - Competent in areas beyond their core discipline,
  - Grounded in a strong set of core values

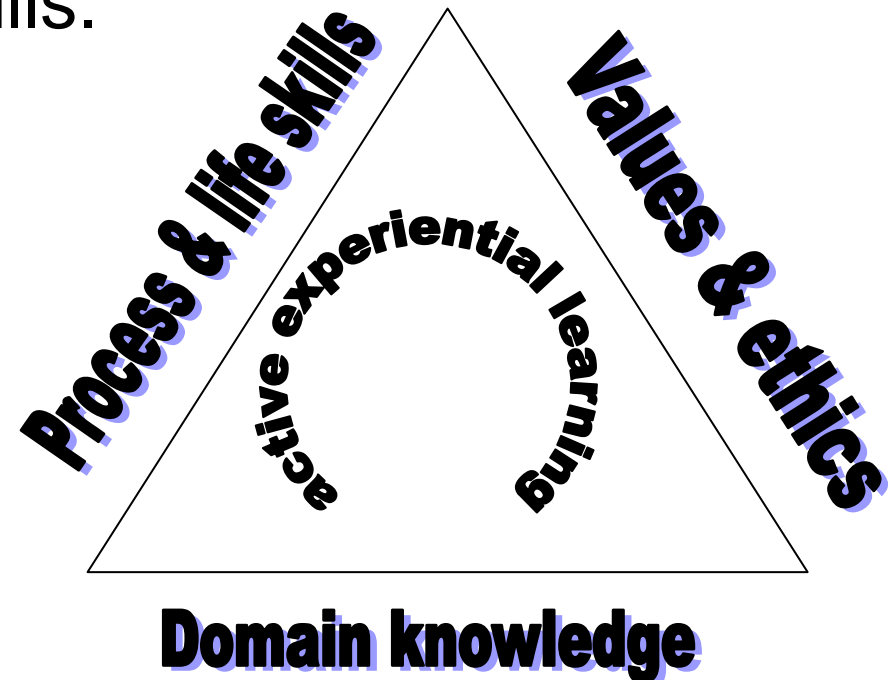


# FORMULATING AN EDUCATION MODEL OF THE FUTURE



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.



- 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

- 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.



## **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

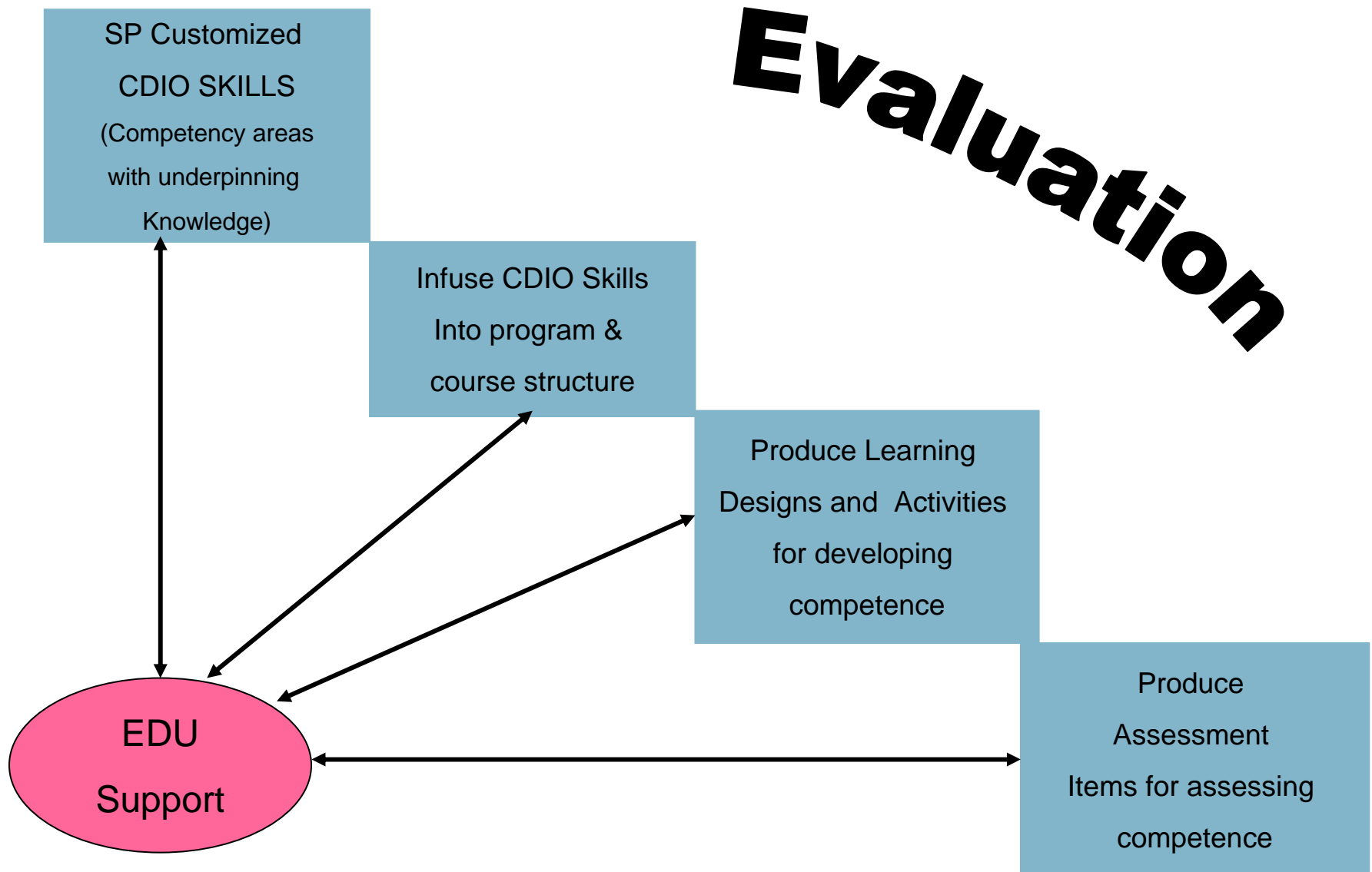
Year 2:

Conceive, Design, System Thinking, Experimentation and Knowledge Discovery

Year 3:

Professional Skills and Attitudes, C-D-I-O

- **New Courses:**
  - ❑ Introduction to Engineering course in 1<sup>st</sup> year
  - ❑ Teamwork and Communication Skills in 1<sup>st</sup> year
  - ❑ Design Implement experiences in 2<sup>nd</sup> year (emphasis on C & D)
  - ❑ Revised Final Year Project in the 3<sup>rd</sup> year (C-D-I-O)
- **Greater emphasis on**
  - ❑ Assessment of skills
  - ❑ Integrated learning experiences
  - ❑ Active Learning





[VIEW TODAY](#)

[VIEW LAST 7 DAYS](#)

[VIEW LAST 30 DAYS](#)

[VIEW ALL](#)

May 23, 2010 - May 30, 2010



Tue, Mar 24, 2009 -- *Evaluation Data for Semester 1 09/10*

Posted by: CHERYL WEI

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*

Posted by: CHERYL WEI

A new [CDIO Evaluation](#) folder has been created under the [ACAD SCHOOLS](#) button. Journal entries and questionnaire results have been uploaded in the folder.

My SP

Guides

My Modules

My Contents



My Community

Holistic Education

Prof Devt

Announcements  
What is CDIO?  
CDIO Syllabus  
Intro 2  
Engineering  
Design-Build Exp  
Workspaces  
Acad Schools  
CDIO Evaluation  
Graduate  
Attributes  
Resources

Tools

 Communication  
 Course Tools

## School of Chemical & Life Sciences



Click here to access workshop and briefing material for CLS staff.

## School of Electrical & Electronic Engineering



Click here to access workshop material for EEE staff.

## School of Mechanical & Manufacturing Engineering



Click here to access workshop material for MM staff.

## School of Architecture & the Built Environment



Click here to access materials for ABE staff

## Department of Mathematics & Science



Click here to access materials for MS staff

## School of Digital Media and Infocomm Technology



## Purpose of the Evaluation

- To provide a structured research driven approach to monitor and review the implementation of the CDIO Framework

# EVALUATION – RESEARCH QUESTIONS



- 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?



- 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)

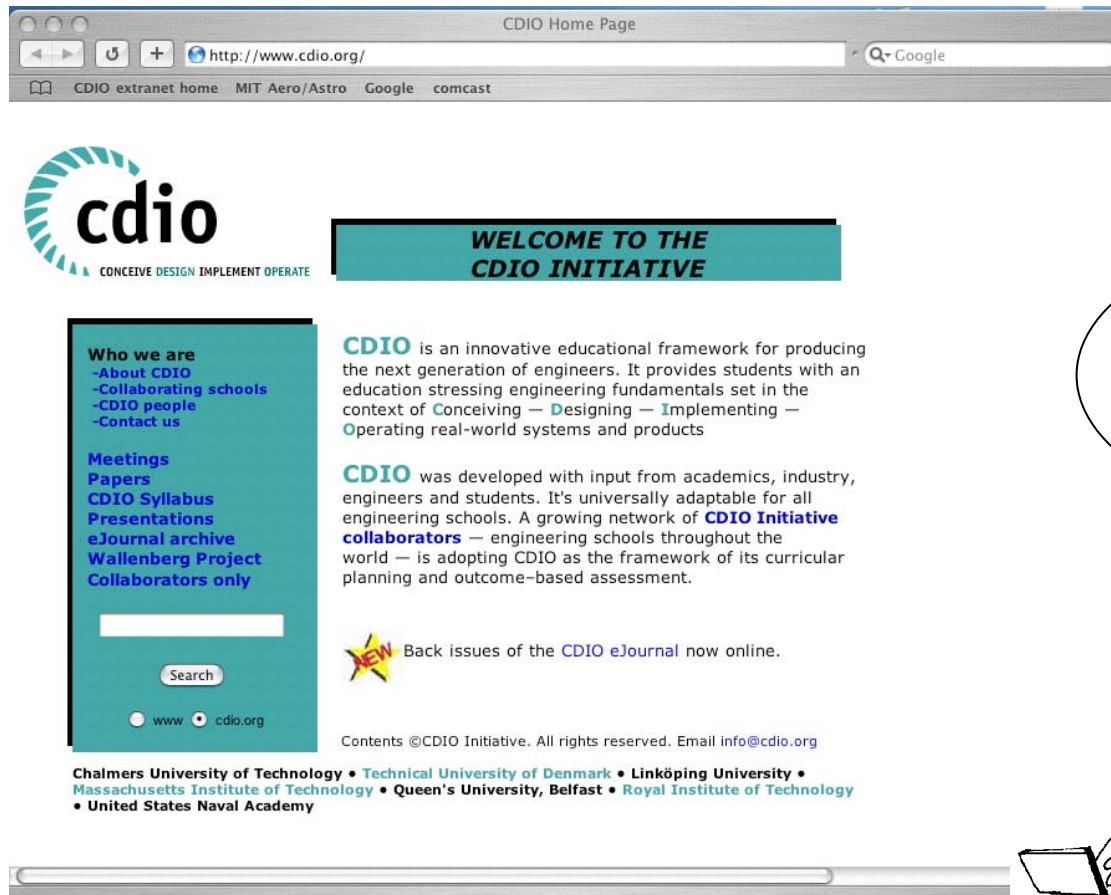
2009 - Hosted the 5<sup>th</sup> International CDIO Conference

2010 - SP's **School of Chemical & Life Sciences**

- ❑ first winner of the "**Excellence in Education and Training in Chemical Engineering**"
- ❑ awarded by IChemE (UK)
- ❑ for **adopting the CDIO Framework** to deliver the best educational experience to students.

- 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 ...



The screenshot shows a web browser window titled "CDIO Home Page" with the address bar containing "http://www.cdio.org/". The browser's address bar also includes a search engine icon and the text "Google". Below the address bar, there are several bookmarks: "CDIO extranet home", "MIT Aero/Astro", "Google", and "comcast". The main content area of the page features the CDIO logo on the left, a teal banner with the text "WELCOME TO THE CDIO INITIATIVE", and a sidebar with navigation links. The main text area contains two paragraphs of introductory text about the CDIO framework and a "NEW" announcement. At the bottom of the page, there is a copyright notice and a list of member institutions.

**Who we are**  
-About CDIO  
-Collaborating schools  
-CDIO people  
-Contact us

**Meetings**  
**Papers**  
**CDIO Syllabus**  
**Presentations**  
**eJournal archive**  
**Wallenberg Project**  
**Collaborators only**

Search

www cdio.org

**WELCOME TO THE CDIO INITIATIVE**

**CDIO** is an innovative educational framework for producing the next generation of engineers. It provides students with an education stressing engineering fundamentals set in the context of **C**onceiving — **D**esigning — **I**mplementing — **O**perating real-world systems and products

**CDIO** was developed with input from academics, industry, engineers and students. It's universally adaptable for all engineering schools. A growing network of **CDIO Initiative collaborators** — engineering schools throughout the world — is adopting CDIO as the framework of its curricular planning and outcome-based assessment.

**NEW** Back issues of the **CDIO eJournal** now online.

Contents ©CDIO Initiative. All rights reserved. Email [info@cdio.org](mailto:info@cdio.org)

Chalmers University of Technology • Technical University of Denmark • Linköping University • Massachusetts Institute of Technology • Queen's University, Belfast • Royal Institute of Technology • United States Naval Academy

Visit [www.cdio.org](http://www.cdio.org)!



## 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

## 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?



**See Handbook, pp. 37-39 for Frequently Asked Questions**

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



	Little or no progress	Some progress	Very good progress
Explain the CDIO approach to engineering education			
Determine ways in which the CDIO approach may be adapted to your own programs			
Share your ideas and experiences of engineering education reform			
Other (please specify)		(See Handbook, p. 42)	

Please write additional comments on the back of this page.

# Thank You!

Helene Leong  
Deputy Director  
Educational Development Department  
Singapore Polytechnic  
[helene\\_leong@sp.edu.sg](mailto:helene_leong@sp.edu.sg)