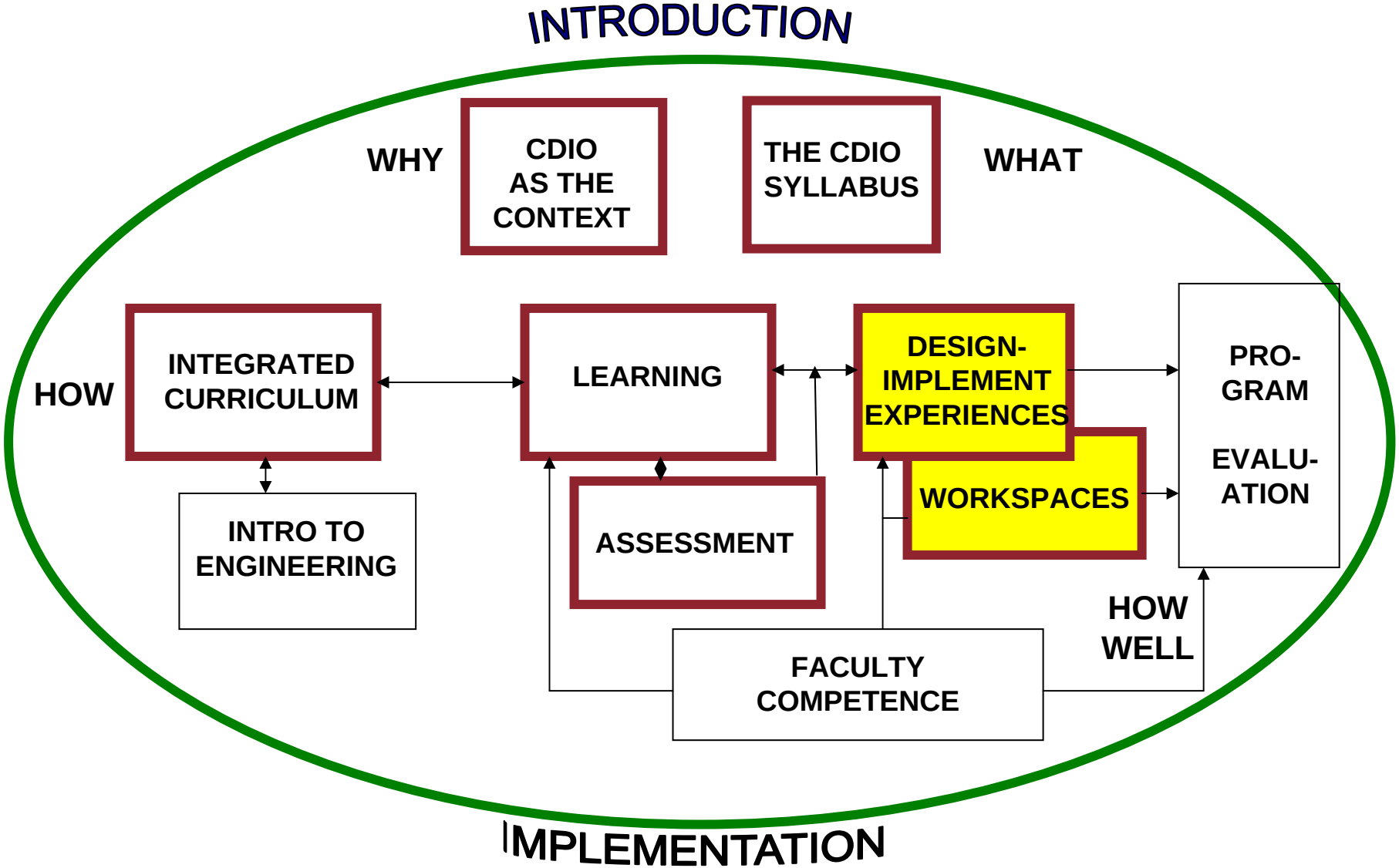
THE CDIO APPROACH TO ENGINEERING EDUCATION: 4. Designing and Integrating Design-Implement Experiences

Revised January 2008

SESSION FOUR



SESSION FOUR OBJECTIVES

Explain the rationale for design-implement experiences

Give examples of design-implement experiences in representative CDIO programs

Propose ideas for effective design-implement workspaces

DESIGN-IMPLEMENT EXPERIENCES

Design-implement experiences are instructional events in which learning occurs through the creation of a product, process, or system

- They should be progressed to a state where:
  - they can demonstrate that they meet the requirements
  - potential improvements can be identified
- The level of complexity can vary from basic to advanced
- They may focus on **Conceive**, **Design**, **Implement**, **or Operate**, or any combination of these stages

ALSO KNOWN AS …

***Design-Implement Experience**. Also known as …*

- Design-build
- Design-build-test
- Design-build-fly
- Design-build-compete

- Project-based learning
- Icebreaker
- Two-week creation
- Industrial design project

RATIONALE FOR D-I EXPERIENCES

A framework for students to learn engineering by building things

The Design-Implement Experience may change from year-to-year, but the learning objectives remain the same

SAMPLE LEARNING OBJECTIVES

Learning Objectives

Work effectively in a team

Communication

Analyze technical problems

Solve technical problems

Use appropriate eng. methods

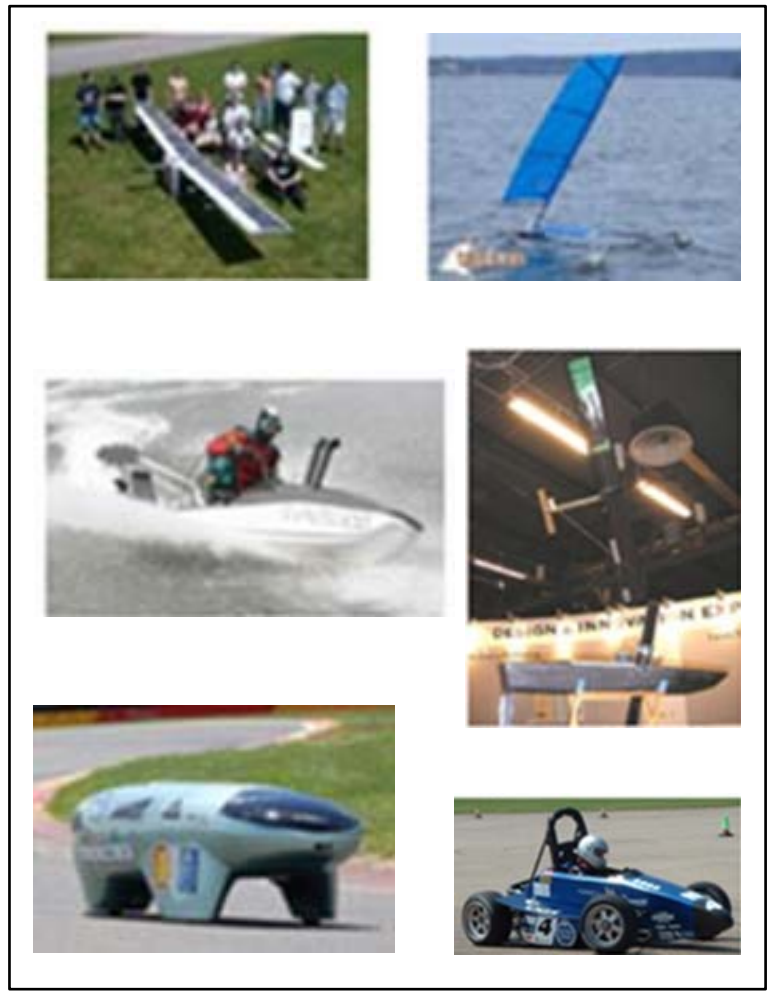
Learn how to make estimates

Develop concepts

Use acquired knowledge

Assess the quality of work

…



Courtesy of KTH

BEST PRACTICE

CDIO Standard 5 -- Design-Implement Experiences

A curriculum that includes two or more design-implement experiences, including one at a basic level and one at an advanced level

Design-implement experiences

- Add realism to the curriculum
- Illustrate connections between engineering disciplines
- Foster students' creative abilities
- Are motivating for students

(See Handbook, p. 8)

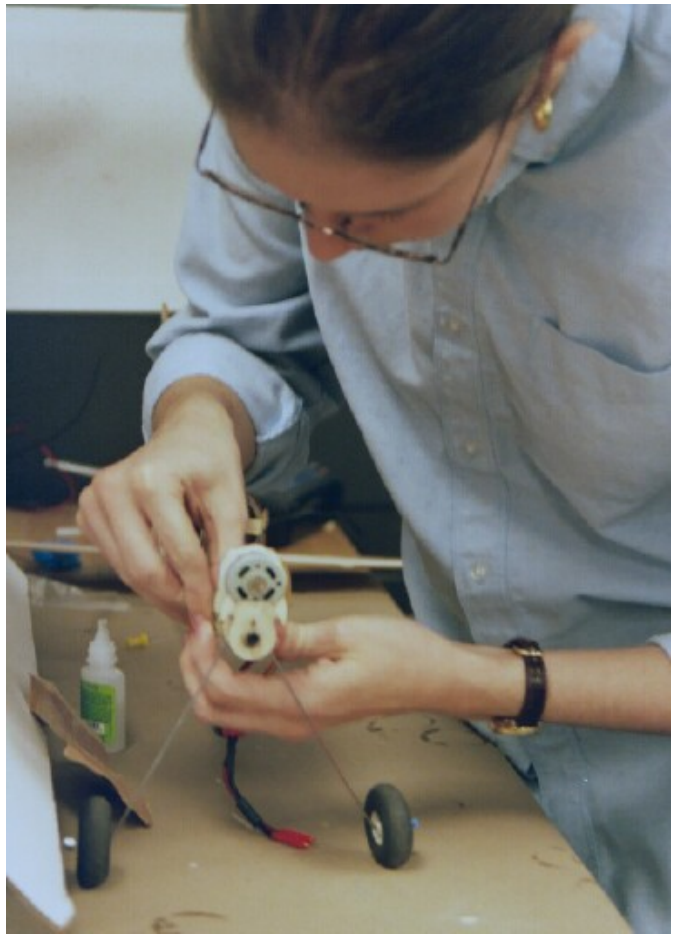
LEVELS OF COMPLEXITY

	Increasing Complexity →→→		
Activity	I-O	D-I-O	C-D-I-O
Structure	Structured	Unstructured	
Solution	Known	Unknown	
Team	Individual	Small Team	Large Team
Duration	Days	Weeks	Months

LEVEL OF COMPLEXITY #1

Building a model airplane from a kit

Activity	I-O
Structure	Structured
Solution	Known
Team	Individual
Duration	Days

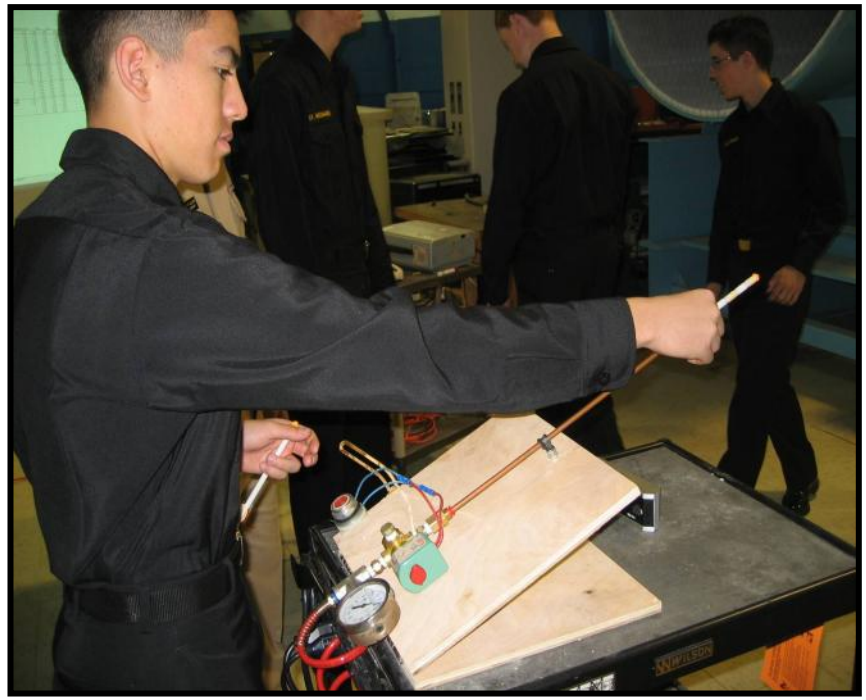


Courtesy of MIT

LEVEL OF COMPLEXITY #2

Building a model rocket from soda straws

Activity	**(D)-I-O**
Structure	Structured
Solution	Known
Team	**Small Team**
Duration	Days

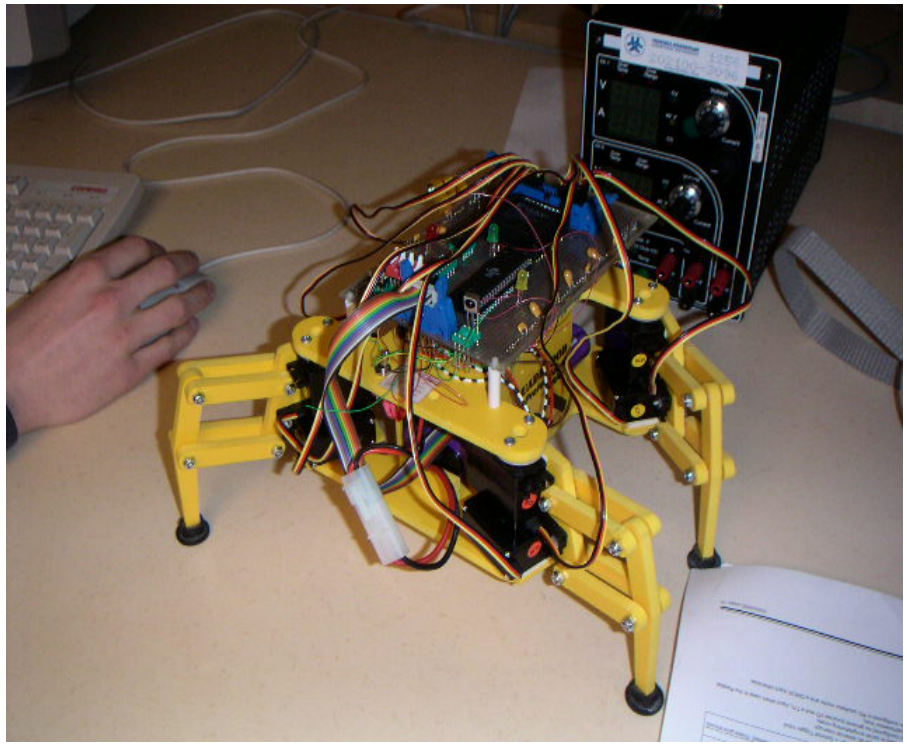


Courtesy of the United States Naval Academy

LEVEL OF COMPLEXITY #3

Building a robot

Activity	**D-I-O**
Structure	Structured
Solution	**Unknown**
Team	Small Team
Duration	**Weeks/Months**

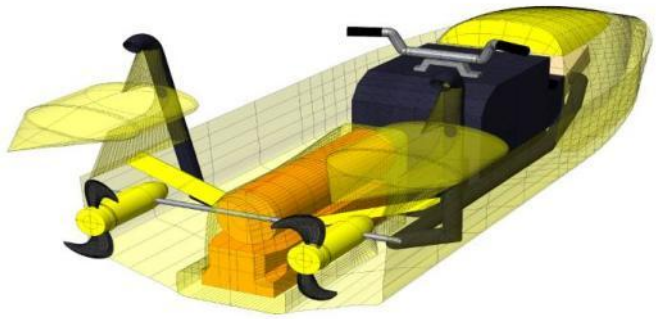


Courtesy of Linköping University

LEVEL OF COMPLEXITY #4

Sub-skimmer

underwater/overwater craft



Activity	**C-D-I-O**
Structure	**Unstructured**
Solution	Unknown
Team	**Large Team**
Duration	**Months**

Courtesy of KTH

WHAT LEVEL OF COMPLEXITY?

Model Racing Car

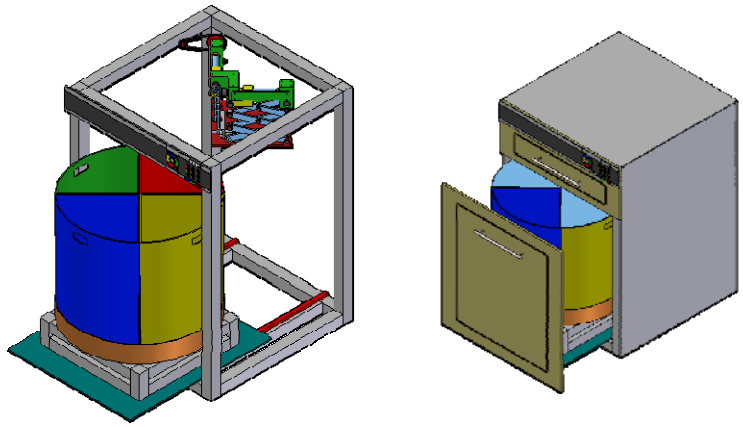
Level ?

Activity	(D)-I-O
Structure	Structured
Solution	Known
Team	Small Team
Duration	Days

Courtesy of Queen's University Belfast

WHAT LEVEL OF COMPLEXITY?

Domestic Recycling Device



Level ?

Activity	C-D-I-O
Structure	Unstructured
Solution	Unknown
Team	Small Team
Duration	Months

Courtesy of Queen's University Belfast

BEST PRACTICE

CDIO Standard 6 - Engineering Workspaces

Workspaces and laboratories that support and encourage hands-on learning of product, process, and system building, disciplinary knowledge, and social learning

- Students are directly engaged in their own learning
- Settings where students learn from each other
- Newly created or remodeled from existing spaces

(See Handbook, p. 9)

WORKSPACE USAGE MODES

Reinforcing Disciplinary Knowledge

Knowledge Discovery

Learning Lab

Hangaren

System Building

Community Building

WORKSPACE CONSIDERATIONS

- Flexibility
- Connectivity
- Safety
- Hours of operation
- Staffing
- Security
- Scheduling and use
- Ownership
- Display devices and areas
- Storage of equipment, materials, and works in progress
- Social space
- Furnishings
- Public address areas and systems
- Cost

Chalmers University of Technology

SAMPLE CDIO WORKSPACE

Queen’s University, Canada

ACTIVITY: DISCUSSION

1. Describe at least one basic and one advanced design-implement experience in your curriculum
2. Identify the challenges to implementing these experiences for students
3. What evidence do you have that these experiences are effective and beneficial?

ACTIVITY: RATING THE CHALLENGES

What are the main challenges to designing and integrating design-implement experiences in your program?

CHALLENGE	A BIG CHALLENGE	A MODERATE CHALLENGE	NOT SO DIFFICULT
Assessing success in products separately from success in learning			
Finding projects that are at the right level -- complex, but within students' ability to succeed			
Finding appropriate teaching and assessment methods for project-based courses			
Enhancing faculty competence in design-implement skills and in new teaching roles			
Providing relevant experiences in a cost-effective way			