

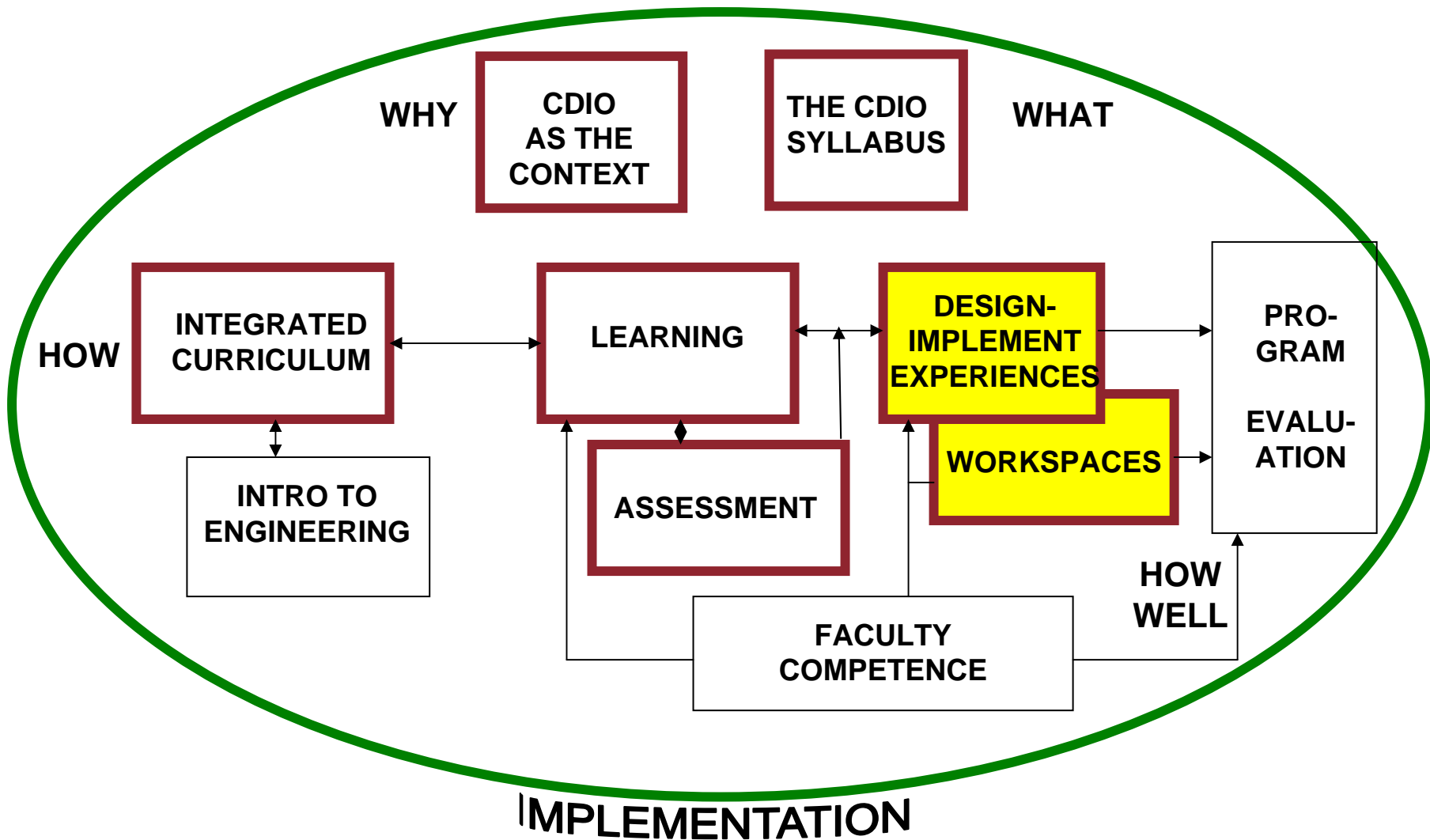


THE CDIO APPROACH TO ENGINEERING EDUCATION: 4. Designing and Integrating Design-Implement Experiences

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INTRODUCTION



**Explain the rationale for
design-implement experiences**

**Give examples of
design-implement experiences in
representative CDIO programs**

**Propose ideas for effective
design-implement workspaces**

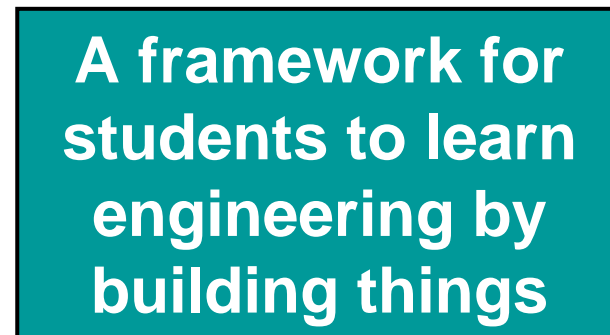
Design-implement experiences are instructional events in which learning occurs through the creation of a product, process, or system

- 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

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



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

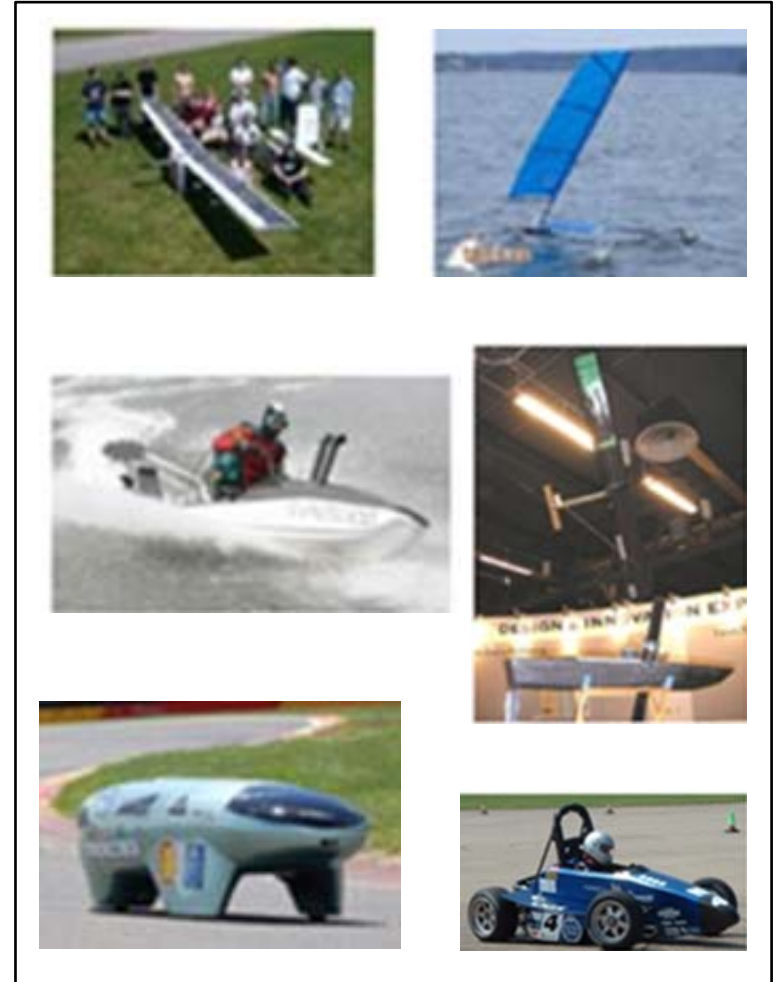
Learn how to make estimates

Develop concepts

Use acquired knowledge

Assess the quality of work

...



Courtesy of KTH

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)

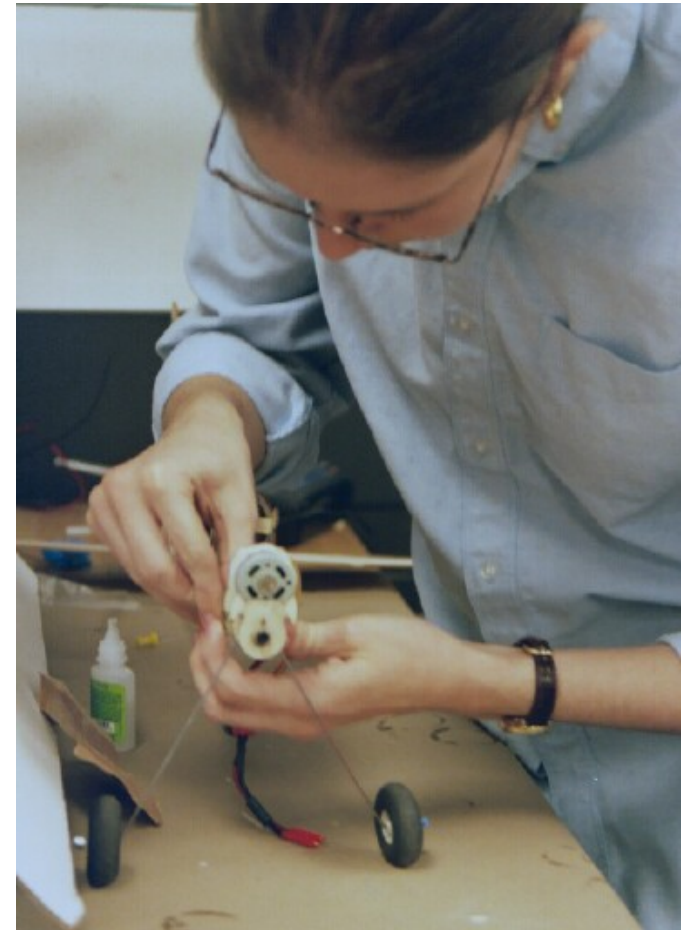
LEVELS OF COMPLEXITY



| | 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 |

Building a model airplane from a kit

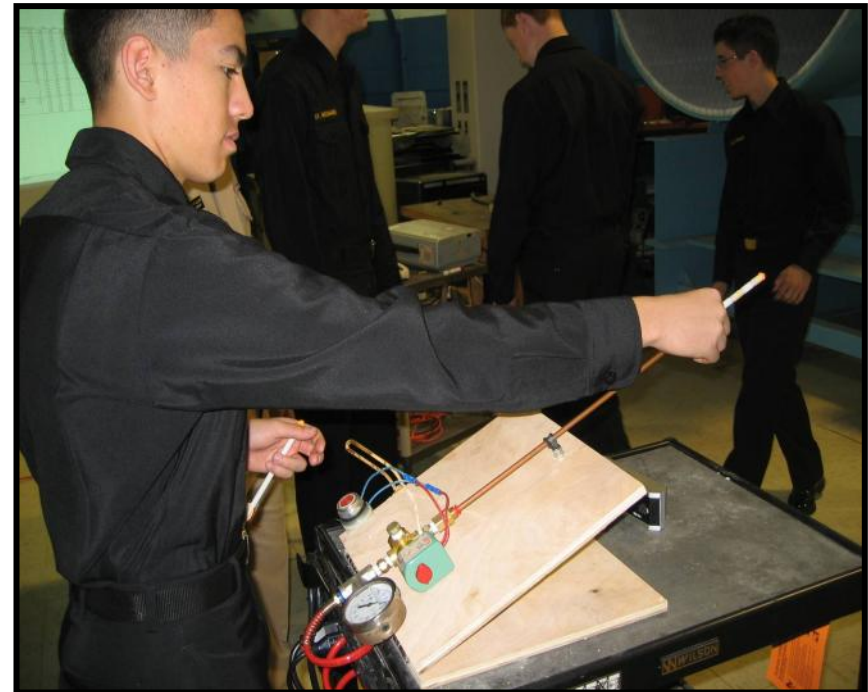
| | |
|------------------|------------|
| Activity | I-O |
| Structure | Structured |
| Solution | Known |
| Team | Individual |
| Duration | Days |



Courtesy of MIT

Building a model rocket from soda straws

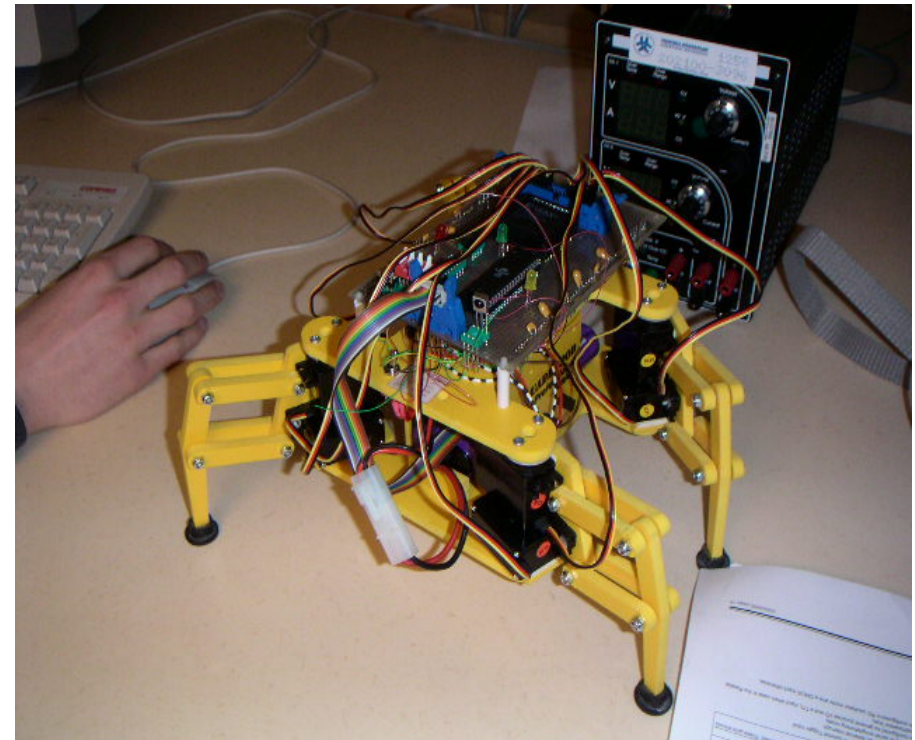
| | |
|------------------|-------------------|
| Activity | (D)-I-O |
| Structure | Structured |
| Solution | Known |
| Team | Small Team |
| Duration | Days |



Courtesy of the United States Naval Academy

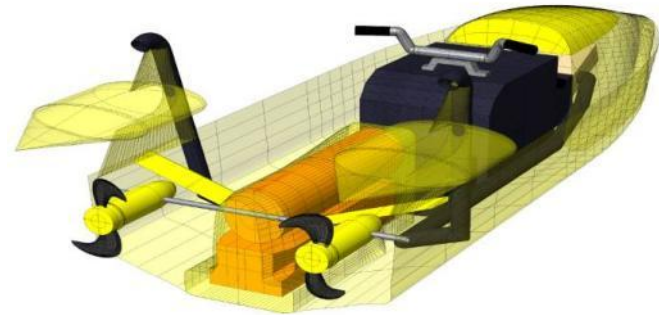
Building a robot

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



Courtesy of Linköping University

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 ?



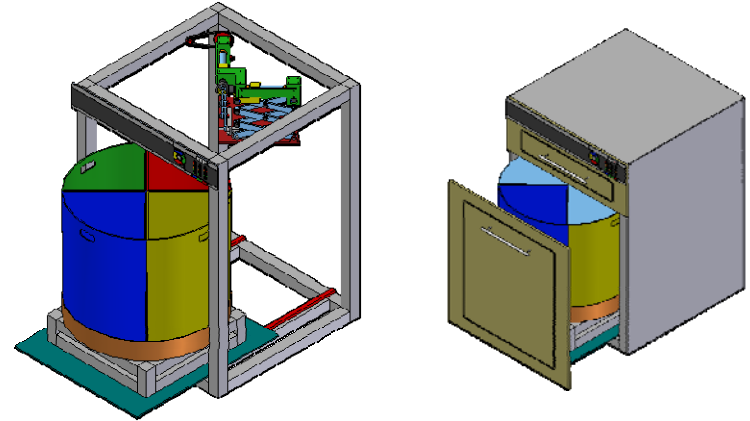
| | |
|------------------|------------|
| Activity | (D)-I-O |
| Structure | Structured |
| Solution | Known |
| Team | Small Team |
| Duration | Days |



WHAT LEVEL OF COMPLEXITY?

Domestic Recycling Device

Level ?



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



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



KTH

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 WORKSPACES



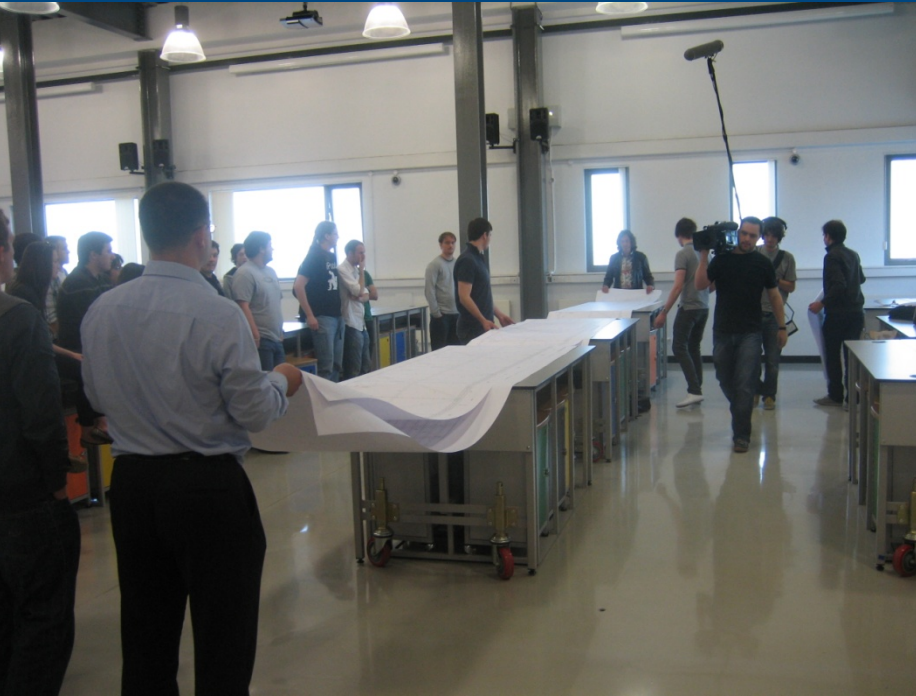
Queen's University, Canada

FLEXIBLE CDIO WORKSPACE



University of Liverpool

BIG PROJECT FROM CDIO WORKSPACE



Meccano bridge

Full scale plans



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 | | | |