The use of CDIO methodology in creating an integrated curriculum for a new degree programme

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Background

- Programme Director for Product Design and Development degrees (MEng and BEng)
- First intake of students in 2004
- Accredited by IMechE for the first time in 2009
- Stage 1 intake September 2009 was 36 students
- 20 – 25% of students are female

Rethinking Engineering Education

CDIO is an international network of more than 50 collaborating universities from 25 countries worldwide.
www.cdio.org

Next international meeting 5-9 Dec 2010 in Sydney
Coincides with AAEE conference

12 CDIO Standards

1. CDIO as Context *
2. CDIO Syllabus Outcomes *
3. Integrated Curriculum *
4. Introduction to Engineering
5. Design-Build Experiences *
6. CDIO Workspaces
7. Integrated Learning Experiences *
8. Active Learning
9. Enhancement of Faculty CDIO Skills *
10. Enhancement of Faculty Teaching Skills
11. CDIO Skills Assessment *
12. CDIO Program Evaluation

* essential

CDIO as Context

A CDIO programme is based on the principle that product and system lifecycle development and deployment are the appropriate context for engineering education. Conceiving, Designing, Implementing, Operating is a model of the entire product lifecycle.

The Conceive stage includes defining customer needs; considering technology, enterprise strategy, and regulations, developing conceptual, technical, and business plans. The second stage, Design, focuses on creating the design; the plans, drawings, and algorithms that describe what will be implemented. The Implement stage refers to the transformation of the design into the product, including manufacturing, testing and validation. The final stage, Operate, uses the implemented product to deliver the intended value, including maintaining, evolving and retiring the system.

CDIO Syllabus (XX level)

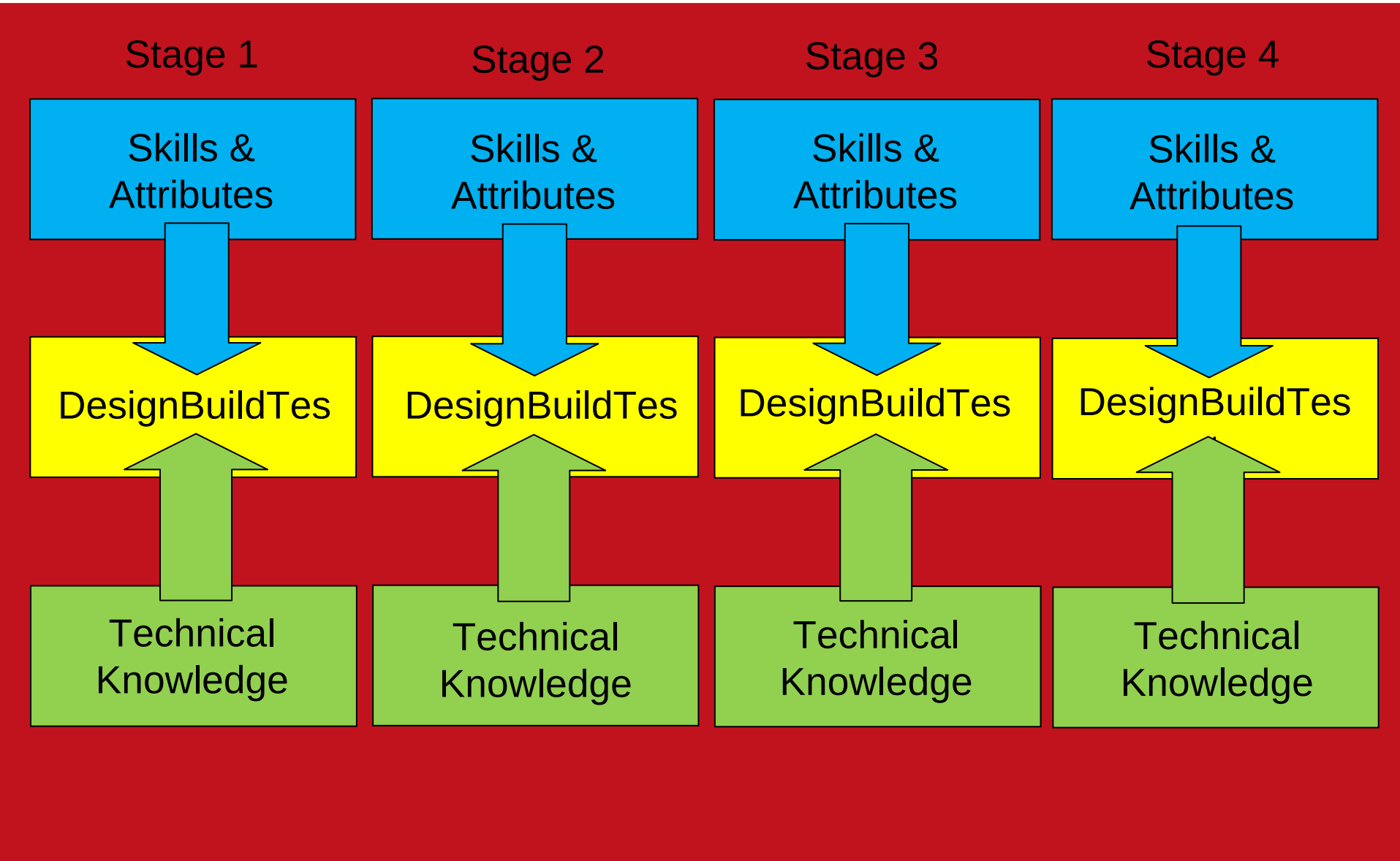
1. Technical Knowledge (associated with the specific Engineering discipline)

2. Personal & Professional Skills
   - 2.1 Eng. Reasoning and Problem Solving
   - 2.2 Experimenting and Knowledge Discovery
   - 2.3 System Thinking
   - 2.4 Personal Skills & Attributes
   - 2.5 Professional Skills & Attitudes

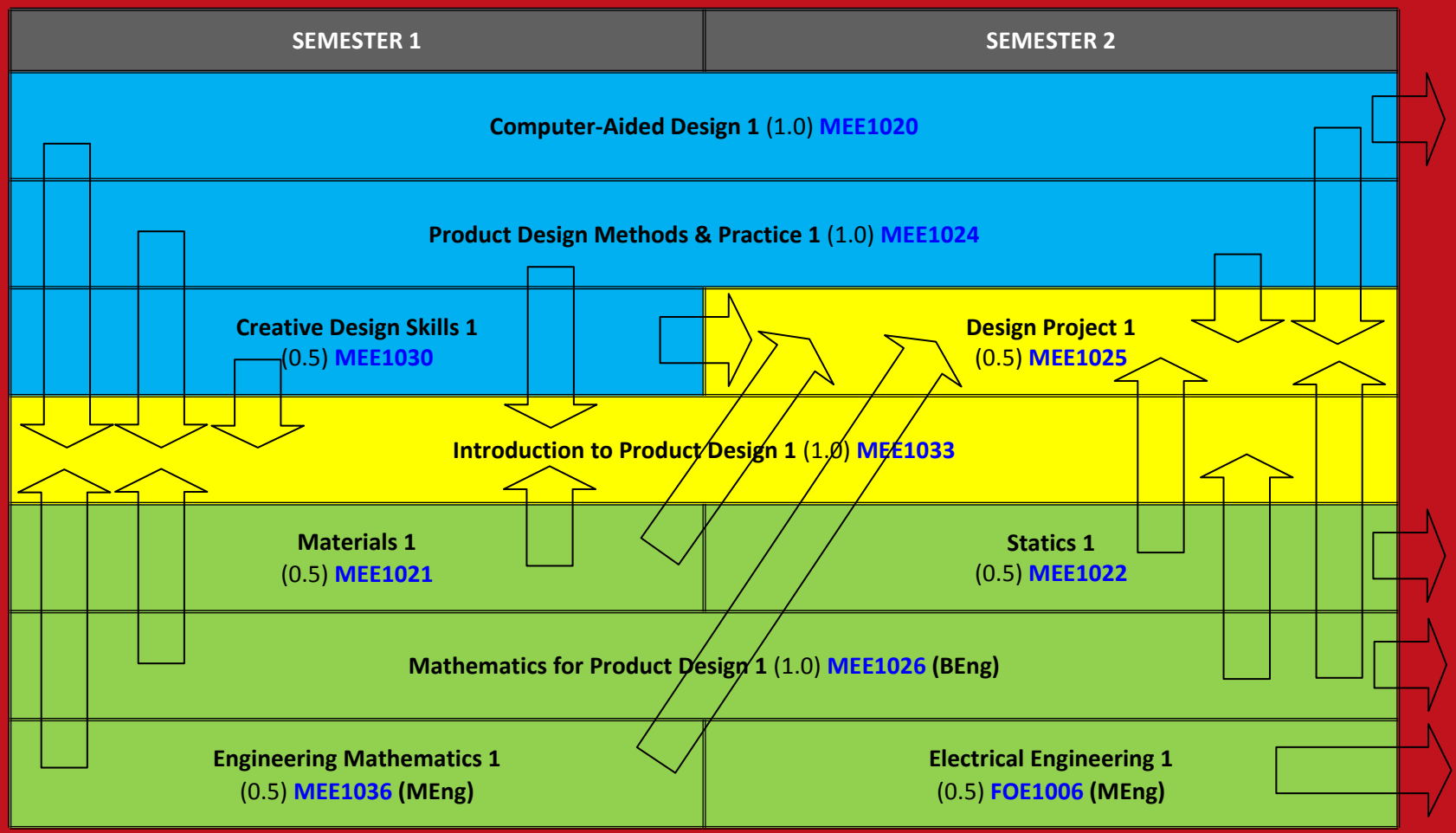
3. Interpersonal Skills
   - 3.1 Teamwork and Leadership
   - 3.2 Communications

4. Product & System Building
   - 4.1 External & Societal Context
   - 4.2 Enterprise & Business Context
   - 4.3 Conceiving
   - 4.4 Designing
   - 4.5 Implementing
   - 4.6 Operating

CDIO Integrated Curriculum



CDIO Integrated Curriculum – Stage 1 PDD



CDIO Integrated Curriculum – Stage 2 PDD

SEMESTER 1	SEMESTER 2
Manufacturing Processes and Systems (1.0) **MEE2025**	
Computer-Aided Design 2 (0.5) **MEE2036**	
Design & Prototyping Projects 2 (1.0) **MEE2026**	
Polymer Properties for Design 2 (1.0) **MEE2033**	
Design & Manufacturing Studies 2 (0.5) **MEE2022**	**Electronics 2B** (0.5) **ELE2032**
Mathematics for Product Design 2 (0.5) **MEE2035 (BEng)**	**Fluids & Thermodynamics (P) 2** (0.5) **AER2020**
Solids & Structures (P) 2 (0.5) **MEE2027 (MEng)**	**Dynamics (P) 2** (0.5) **MEE2037**

Bloom's Taxonomy (revised)

Cognitive Level	Appropriate Verbs
6: Create	adapt, anticipate, compare, compose, contrast, create, design, devise, formulate, generalize, generate, integrate, model, modify, plan, reconstructs, revise, structure, synthesize, validate.
5: Evaluate	assess, compare, conclude, criticize, critique, decide, discriminate, evaluate, interpret, judge, justify, recommend, reframes, select, summarise, support, test.
4: Analyse	analyse, classify, compare, connect, divide, explain, infer, order, separate.
3: Apply	apply, assess, calculate, compute, construct, control, demonstrate, determine, develop, establish, examine, illustrate, modify, relate, show, solve.
2: Understand	contrast, convert, describe, differentiate, discuss, distinguish, estimate, extend, generalizes, give examples, interpret, paraphrase, predict, summarize.
1: Remember	define, describe, enumerate, examine, identify, label, list, name, quote, reproduce, select, show, state, tabulate.

Staged Development of CDIO Skills and Attributes

Create

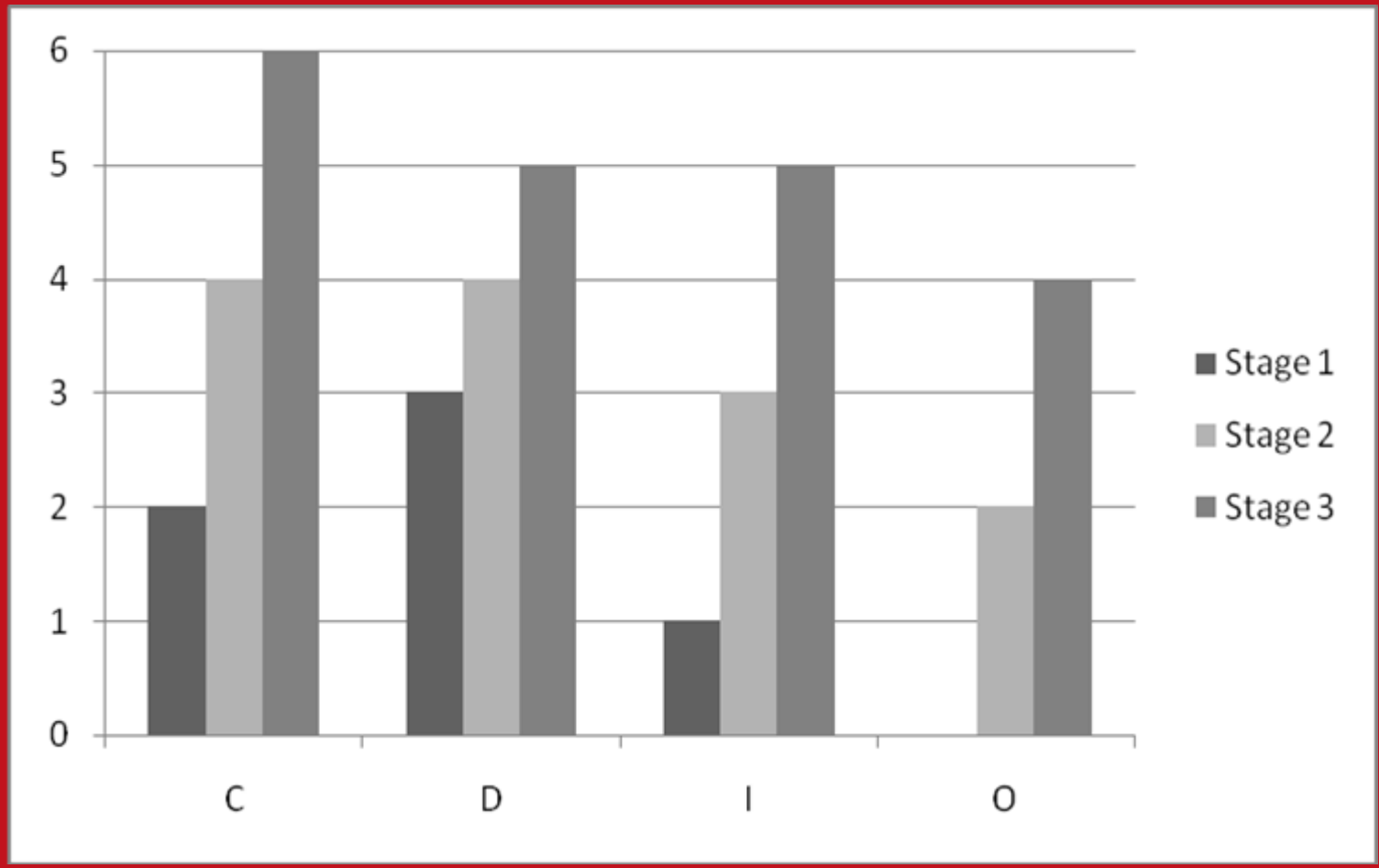
Evaluate

Analyse

Apply

Understand

Remember



Staged Development of DBT Projects

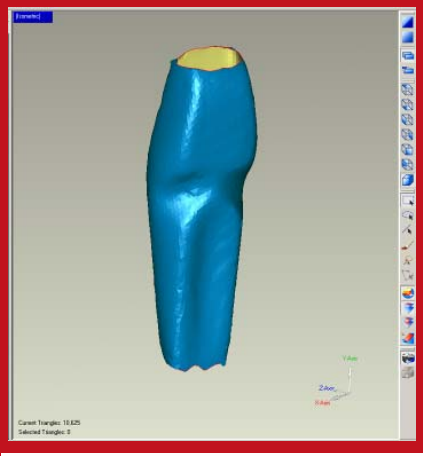
Stage 1 - MEE1025 – Design Project1 (1 group project, 12 weeks duration)
Students are required to design improvements to something which already exists. Conceptual models / maquettes produced. Detailed time line with several intermediate target deliverables provided. Team working skills developed.
Stage 2 - MEE2026 – Design and Prototyping Projects 2 (3 group projects, 8 weeks each)
The theme of the project is provided but students define the solution. Develop viable physical prototypes involving a number of assembled components. Use a range of Rapid Prototyping and virtual prototyping hardware and software tools along with physical testing. Plan and organize project timeline.
Stage 3 - MEE3052 – Project 3P (1 group project, 24 weeks duration)
Original and unique solutions to problems are sought. Identify an unfulfilled customer need and assess the potential for a viable new product in the market. Design and plan a project and manage the time involved to complete all tasks to the respective deadlines. Critically review all aspects of the completed design build and test project.

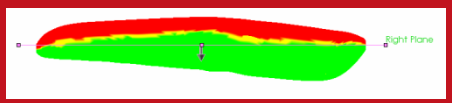
Example of Stage 2 PDD Project (8 week duration)
PVR Remote Control Redesign

Week 2 – sculpting in foam

Week 3 – ergonomic evaluation

Week 4 – 3D laser scan





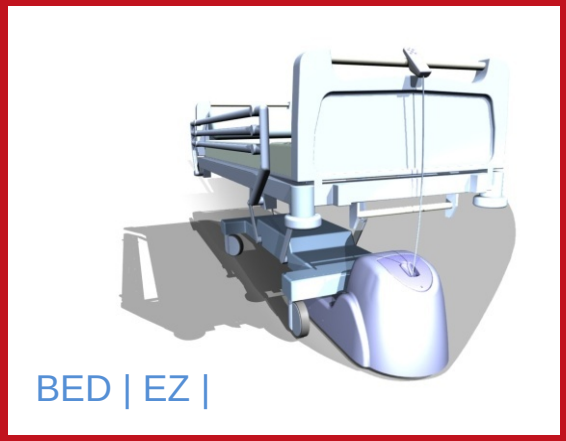
Week 5 – reverse engineering

Week 6 – CAD design & assembly

Week 7 – 3D printing

Week 8 – finished prototype

Examples of Stage 3 Projects (24 week duration)



Hospital bed pusher - guided vehicle

aircraft seat footrest to prevent DVT

Lime – “The last delivery you will ever sign for”

Innovative beer fridge – “3˚ every time”

Folding boat that fits in a car boot

Summary

- Engineering taught in the context of Conceiving, Designing, Implementing and Operating real world products or systems
- Integrated curriculum based on CDIO standards and syllabus with DBT experiences at core
- Opportunities to apply technical knowledge, skills and attributes in context and immediately
- Learning outcomes defined using Bloom’s taxonomy to provide an environment for staged development

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