REPORT OF CDIO COLLABORATOR SURVEY CONDUCTED SPRING 2008

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A survey of CDIO collaborators was authorized by the CDIO leadership as a follow up to an earlier study, *Evaluation of CDIO Programs Based on the CDIO Standards 2000 to 2005*(Brodeur, June 2006). "This report provides a rationale for the CDIO standards in reforming engineering education, and summarizes the program self-evaluation results of CDIO programs from 2000 to 2005" (p.1).

The current study was conducted during 2008 and surveyed 27 collaborating institutions, which may be found in Appendix A. Twenty-one institutional representatives responded to the survey.

The survey has three main sections. The first includes demographic items about CDIO collaborating institutions and programs. The second includes a rating of the extent to which CDIO Standards have been implemented as well as a request for descriptions of any major improvements with respect to the standards since the adoption of the CDIO approach. And the third asks questions about the use of the CDIO Standards related to quality assurance. The results are summarized in the set of slides in Appendix B. The full set of results is available from the CDIO leadership.

Demographics

Among the 21 collaborating institutions there are over 60 degree programs represented, which typically require 3 – 4 years for completion. Overall there is a fairly even distribution of programs related to their duration of involvement with CDIO, ranging from 1 to 5 years plus. In addition, there are typically 10 or fewer CDIO instructors out of 20 or more program instructors.

The number of students per cohort over the last 5 years has ranged from under 50 to over 4,700. However, most programs have 200 or fewer students in future cohorts with typically fewer than 100 graduates per cohort thus far.

Rating of CDIO Standards

A rating scale ranging from 0 (No initial program-level plan or pilot implementation) to 4 (Complete and adopted program-level plan and comprehensive implementation at course and program levels, with continuous improvement processes in place) was used to quantify the extent that the CDIO Standards had been implemented. As shown in slide 7, *ratings of use* consistently rise from institutions with 2 years or less experience with CDIO to those with 5 or more, except for the Standard 10 -- Enhancement of Faculty Teaching Competence.

Improvement Related to the Standards

There were many excellent examples of improvement that are related to the adoption of the CDIO Standards. Examples are provided in Slides 8 – 19. The full list of responses may be found in Appendix C.

Use of Standards for Quality Assurance

The last set of items asked about the extent and nature of the use of the standards regarding various quality assurance purposes. As shown in slide 20, quality assurance within a program and for external accreditation were the two most often cited uses.

CDIO COLLABORATOR SURVEY

This survey is designed to gather information about existing CDIO programs worldwide. Please identify your CDIO program or course of study and answer the survey questions in relation to that program. If you have more than one CDIO program or course of study at your institution, and you would like them included in the survey results, please copy the survey and use it to describe each program separately. If someone else is in a better position to describe your CDIO program(s), please forward the survey to him or her.

A. CDIO DEMOGRAPHICS

1. Institution: _____
2. College, school or faculty within the institution: _____
3. Program or course of study adopting CDIO: _____
4. How may years has your program/course of study been involved in adopting CDIO?

   1 or less 2 3 4 5 or more
5. How many years are required to complete your CDIO program/course of study?

   fewer than 3 3 4 5 more than 5
6. How many students are currently enrolled in your CDIO program/course of study?

Year of Graduation	**2008**	**2009**	**2010**	**2011**	**2012**
Fewer than 50					
50 – 99					
100 – 199					
200 – 299					
300 – 399					
400 or more					

7. How many students have completed (graduated from) your CDIO program/course of study?

Year of Graduation	**2007**	**2006**	**2005**	**2004**	**2003**
Fewer than 50					
50 – 99					
100 – 199					
200 – 299					
300 – 399					
400 or more					

8. How many teacher (all ranks) are involved in your CDIO program/course of study?

   a. Number of teachers involved in ***project-based courses***:

   Fewer than 5 5-9 10-14 15-19 20 or more

   b. Number of ***all other*** teachers in your CDIO program/course of study:

   Fewer than 10 10-19 20-29 30-39 40-49 50 or more

CDIO COLLABORATOR SURVEY

B. CDIO STANDARDS

In what year did you begin adopting CDIO? _____

Please rate your CDIO program/course of study with respect to each of the CDIO Standards using the following scale. (See the sample metrics for evaluating implementation of the CDIO standards for additional guidance.)

Rating Scale:

0. No initial program-level plan or pilot implementation
1. Initial program-level plan and pilot implementation at the course or program level
2. Well-developed program-level plan and prototype implementation at course and program levels
3. Complete and adopted program-level plan and implementation of the plan at course and program levels underway
4. Complete and adopted program-level plan and comprehensive implementation at course and program levels, with continuous improvement processes in place

RATING	STANDARD
	Standard 1 – The Context Adoption of the principle that product, process, and system lifecycle development and deployment -- Conceiving, Designing, Implementing and Operating -- are the context for engineering education
	Standard 2 – Learning Outcomes Specific, detailed learning outcomes for personal, interpersonal, and product, process, and system building skills, consistent with program goals and validated by program stakeholders
	Standard 3 -- Integrated Curriculum A curriculum designed with mutually supporting disciplinary subjects, with an explicit plan to integrate personal, interpersonal, and product, process, and system building skills
	Standard 4 -- Introduction to Engineering An introductory course that provides the framework for engineering practice in product, process, and system building, and introduces essential personal and interpersonal skills
	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
	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
	Standard 7 -- Integrated Learning Experiences Integrated learning experiences that lead to the acquisition of disciplinary knowledge, as well as personal, interpersonal, and product, process, and system building skills

	Standard 8 -- Active Learning Teaching and learning based on active experiential learning methods
	Standard 9 -- Enhancement of Faculty Skills Competence Actions that enhance faculty competence in personal, interpersonal, and product, process, and system building skills
	Standard 10 -- Enhancement of Faculty Teaching Competence Actions that enhance faculty competence in providing integrated learning experiences, in using active experiential learning methods, and in assessing student learning
	Standard 11 -- Learning Assessment Assessment of student learning in personal, interpersonal, and product, process, and system building skills, as well as in disciplinary knowledge
	Standard 12 -- Program Evaluation A system that evaluates programs against these twelve standards, and provides feedback to students, faculty, and other stakeholders for the purposes of continuous improvement

Please describe the major improvements to your program/course of study, with respect to the CDIO Standards, since adopting the CDIO approach. For example,

Std 5 – We now have a basic design-implement experience in Years 1 and 2, and an advanced design-implement experience in Years 3 and 4. The Year 4 experience existed before, but now is greatly improved with the addition of teamwork and communication requirements.

CDIO Collaborator Survey

C. CDIO Standards and Quality Assurance

Please indicate whether the CDIO Standards have been used for each of the following purposes. (Please attach any materials that will help to explain or elaborate on your responses.)

Have the CDIO Standards been used:

1. for program review and/or improvement by those internal to the program or course of study itself?

   _____ Yes _____ No If yes, in what ways?

2. for program review external to the program or course of study, but within the institution, for example, by an institutional review panel?

   _____ Yes _____ No If yes, in what ways?

3. to guide a review by a panel of outside experts?

   _____ Yes _____ No If yes, in what ways?

4. to meet program review requirements external to the institution, for example, disciplinary or other accreditation groups?

   _____ Yes _____ No If yes, in what ways?

5. for other evaluation purposes?

   _____ Yes _____ No If yes, in what ways?

6. Other Comments:

Please return your completed survey(s) no later than 16 May 2008. Email your responses to Peter Gray: pgray@usna.edu

CDIO Collaborator Survey 2008

Dr. Peter J. Gray

USNA

CDIO Annual Meeting
June 2009

Survey Sections

- Demographics
- Standards
- Quality Assurance

Demographics

23 out of 27 collaborators responded

- Arizona
- Auckland
- Calgary
- Chalmers
- Daniel Webster
- DTU
- Ghent
- KTH
- Linköping
- Liverpool
- Northridge
- MIT
- Milano
- Montreal
- Pretoria
- Porto
- Queen's Canada
- Queensland (QUT)
- Singapore
- Turku
- Umeå
- USNA
- Wismar

Demographics *cont*

- Even spread of 2 to 5+ years with CDIO
- Over 30 faculties
- ~ 70 degree programs
- Majority are 3 to 4 year programs
- Typically fewer than 15 CDIO instructors out of approximately 10-50 total instructors

Demographics *cont*

- Number of students per cohort ranges from fewer than 50 to over 4,700
- Most programs have 200 or fewer students in a given cohort
- Total number of CDIO students in a given year is close to10,000
- Except for Pretoria, most programs have graduated fewer than 100 students thus far

5

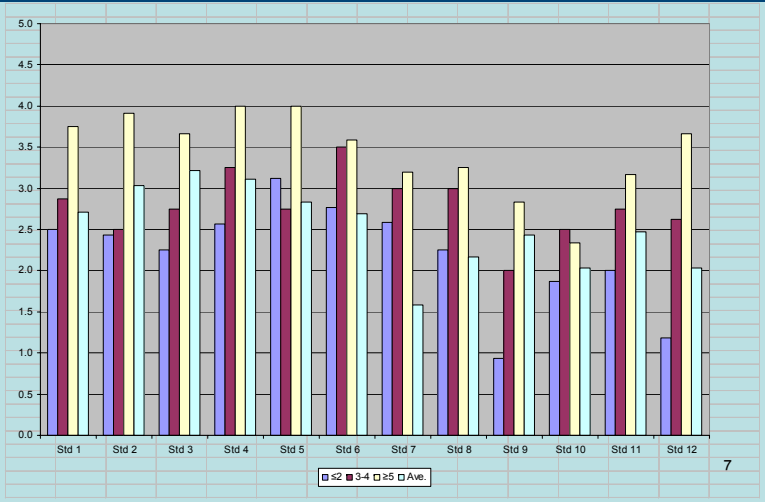
Adoption of the Standards

Rating Scale

0. No initial program-level plan or pilot implementation
1. Initial program-level plan and pilot implementation at the course or program level
2. Well-developed program-level plan and prototype implementation at course and program levels
3. Complete and adopted program-level plan and implementation of the plan at course and program levels underway
4. Complete and adopted program-level plan and comprehensive implementation at course and program levels, with continuous improvement processes in place

6

Adoption of the Standards



7

Major Improvements re. Standards

Standard 1 – The Context

- CDIO has been decided to be our common framework for our development actions. We still need to plan the implementation in more detail.
- CDIO principle is embodied within several module descriptions, all programme descriptions and in the Departmental L&T 10-year strategy document
- The CDIO context is used throughout. We are now implementing the continuous improvement process.

8

Major Improvements re. Standards

Standard 2 – Learning Outcomes

- We now have well formulated learning outcomes for both program and courses that covers disciplinary as well as personal, interpersonal, and product, process and system building skills.
- Specific and detailed learning outcomes for selected courses were revised to explicitly incorporate the development of CDIO skills of personal and professional skills and attributes, interpersonal skills of teamwork and communication, and system and product building skills. The detailed CDIO syllabus was customized for the institution's context.

9

Major Improvements re. Standards

Standard 3 – Integrated Curriculum

- Our curriculum now includes integrated learning between projects and fundamental courses. More work is required to integrate more courses.
- We now have a completely integrated curriculum.
- Existing courses in the 12 programs identified were reorganized and linked to demonstrate that engineering practice is multidisciplinary and to integrate personal, interpersonal, and product, process, and system building skills. Some courses were restructured and new courses introduced as a result of the reorganization.

10

Major Improvements re. Standards

Standard 4 – Introduction to Engineering

- A course including a simple team I-O project, a more complex team D-I-O project, an industry standard 3D CAD training course, a sustainable development project, instruction on various professional / personal development issues and PDP has been running for 3 years.
- The (D-)I-O projects and the CAD course are immersive – the timetable is cleared of all other activity so the students work full time on these projects – assuming roles of professional engineers.
- Evaluation evidence is excellent.

11

Major Improvements re. Standards

Standard 5 – Design-Implement Experiences

- We now have a basic design-implement experience in Year 1. An intermediate design-implement-test experience in Year 2, and several advanced design-implement-test experiences in Years 4 and 5.
- All students undertake a team, 60 hour D-I-O project in Yr1, and a team 450-600 hr C-D-I-O project in their final two years (Capstone). Students undertake other D-I projects of varying complexity depending on their programme.

12

Major Improvements re. Standards

Standard 6 – Engineering Workspaces

- We have analyzed our learning environment and the way we use labs and other resources.
- A 9 million GBP Active Learning Laboratory has been designed specifically to support CDIO projects for 250 students at a time. It has been equipped with 1.5 million GBP state-of-the-art equipment.

13

Major Improvements re. Standards

Standard 7 – Integrated Learning Experiences

- This is introduced in almost every course today, and is something we definitely learned from the CDIO Initiative.
- All taught courses are seeking to improve integration between skills development and disciplinary learning by deploying more practical work, active learning methods, role play, simulations, case studies, PBL and CBL.
- The focus of the project is specifically going to be on CDIO and better workspaces including three CDIO workspace areas for group work (150 students each).
- No big change because of CDIO, we used to have quite much of these.

14

Major Improvements re. Standards

Standard 8 – Active Learning

- New active teaching methods have been introduced, eg in a reformed mathematics course in which the use of simulation has been brought forward.
- Role play is utilized in the Industrial production & organization course, and a “supply chain game” in the Logistics course.
- Most courses in year 1 and 2 have some kind of formative assessment (computer exercises, hand-in assignments, design tasks/projects, lab reports, in-course exams).
- Two courses have individual grading in team-based projects.

15

Major Improvements re. Standards

Standard 9 – Enhancement of Faculty Skills Competence

- The program relies on the university’s teacher development program, in which faculty are now required to complete a diploma of teaching in higher education (400 hours study time) in order to gain tenure. Other teacher courses focus on communication, project management and student diversity.
- Recent department hires brought significant industry experience to the faculty. We deliberately sought candidates with experience in the CDIO skills.

16

Major Improvements re. Standards

Standard 10 – Enhancement of Faculty Teaching Competence

- Faculty are expected to show personal development in teaching, learning, and assessment methods during their annual performance review.
  Moreover, faculty are expected to write reflective memos that map specific plans for improving teaching, learning, and assessment in their undergraduate courses.
  Presentations, demonstrations, and short courses are available, both in the department (though that is reduced from previous years) and through MIT's Teaching Learning Lab.

17

Major Improvements re. Standards

Standard 11 – Learning Assessment

- Assessment of student learning in personal, interpersonal, and product, process, and system building skills, as well as in disciplinary knowledge have been incorporated, where appropriate, in the revised courses.
- We include assessment of CDIO skills in our annual program evaluation, each year focusing on one area (CDIO 2.x, 3.x, and 4.x.).

18

Major Improvements re. Standards

Standard 12 – Program Evaluation

- The CDIO Standards are now the basis for all program reviews and evaluation of the program against these standards is regularly undertaken.
- Our CDIO self study formed the basis for our ABET self study in our most recent ABET evaluation.

19

Use of Standards for QA

For Program Review	Yes
• w/in program	83%
• w/in institution	35%
• by external experts	39%
• for accreditation	65%
• other	22%

20

2008 CDIO COLLABORATOR SURVEY
MAJOR IMPROVEMENTS TO PROGRAMS/COURSES OF STUDY,
WITH RESPECT TO THE CDIO STANDARDS, SINCE ADOPTING THE CDIO APPROACH

General/Overall

The program at DWC is a new program. We just graduated our first aeronautical engineering class last month. In two years we will graduate our first mechanical engineering class. I've only included data above for the aeronautical engineering program at this time. Note that the first two years of both programs are identical. We are attaching Word files for the course sequences for both programs as well as our engineering philosophy statement. These have been strongly influenced by CDIO. As you can see, the programs have a five-semester design sequence. In addition, many of the engineering courses are 3.5 credits and meet an extra hour per week. This allows for extra interactive work and student presentations in the classroom, as well as hands-on activities/labs/design projects in addition to the five-semester design sequence. All five of our engineering faculty and our engineering laboratory manager attended the CDIO conference held at MIT last June. We have had many discussions about the CDIO book, syllabus, and standards. This summer we are working on a self-study report and plan to have a practice visit by a former ABET evaluator in August 2008. We hope to be ready to have a formal ABET visit in fall 2009. Although we have frequently considered the CDIO materials, in our initial self-study pass we are focusing on the ABET materials and a-k criteria. We find the CDIO materials to be more detailed, challenging, and complex and hope to make gradual progress each year towards reaching their ideals.

Electrical Engineering
For many years the Bachelor of engineering education at DTU has contained elements of CDIO, especially within the field of Design Implement Experiences and as a consequence hereof good engineering workspaces exists, the curriculum were also designed to support this.
Now the CDIO is implemented in the curriculum for the first 2 semesters and the CDIO educational concept will be rolled out from September 2008 for students starting on their first semester. The CDIO is a great improvement of the study and further improvements are underway however as the CDIO concept starts in September 2008 there is no improvements to report at this time.

We (Calgary) have been delayed in implementing CDIO as we are in the process of changing one of our degree programs (Manufacturing Engineering) into a Minor program. This change has gone through the faculty approval process (Dec 2008) and it is now before the provincial government pending approval. This change will provide the opportunity to integrate CDIO into the revised program. This change process is underway and it will take at least three years before it comes to completion.

Standard 1 – The Context

Std 1 – The program has a purpose statement which emphasizes the CDIO context
Std 1 – CDIO is now the context of the program.
Standard 1 – The Context
CDIO principle is embodied within several module descriptions, all programme descriptions and in the Departmental L&T 10-year strategy document

Major Improvments

Standard 1: The mission of the A-A Department is to prepare engineers for success and leadership in the conception, design, implementation, and operation of aerospace and related engineering systems (Strategic Plan, 1998) The mission was adopted in 1998 and provides the framework for subsequent curriculum reform. Descriptions appear in MIT publications and web sites.
Standard 1 – The Context
The CDIO has been accepted as part of the Department educational plan. A pilot experimentation is planned to start next year.
Std 1 – The CDIO context is used throughout. We are now implementing the continuous improvement process.
Std 1: Up to late 2006, only one program had adopted the CDIO approach. Implementation was minimal and slow. In late 2006, a decision was made to adopt the CDIO approach in more programs in an organized and structured manner. Since then, four schools have adopted the CDIO approach in 12 programs and have redesigned their programs accordingly. The redesigned curriculum was implemented in April 2008 starting with first-year students.
Std. 1 - CDIO has been decided to be our common framework for our development actions. We still need to plan the implementation in more detail.
Std 1 – The CDIO Vision is incorporated as part of the department mission statement.

Standard 2 – Learning Outcomes

Std 2 – A comprehensive program goal statement has been developed
Std 2 – We now have well formulated learning outcomes for both program and courses that covers disciplinary as well as personal, interpersonal, and product, process and system building skills.
Standard 2 – Learning Outcomes
All module and programme specifications explicitly state many learning outcomes associated with CDIO Syllabus sections 2, 3 & 4. The process of stakeholder validation is ongoing.
Std 2: Program and course goals are formulated based on the CDIO Syllabus. The program started in autumn 2006.
Standard 2: The CDIO Syllabus was created which focuses on personal, interpersonal, and product and system building skills, and includes disciplinary fundamentals appropriate for aerospace and related engineering systems. The Syllabus was validated with program stakeholders in 1999 and 2000.
Standard 2 – Learning Outcomes
Institutional stakeholders approved the new study program. We intend to contact enterprise stakeholders but the list of questions to be submitted is not yet ready.
Standard 2: Desired learning outcomes are now much more clearly defined.
Std 2: Specific and detailed learning outcomes for selected courses were revised to explicitly incorporate the development of CDIO skills of personal and professional skills and attributes, interpersonal skills of teamwork and communication, and system and product building skills. The detailed CDIO syllabus was customized for the institution's context.
Std 2. - Based on the Bologna process we have defined learning outcomes in our programs, but CDIO showed us that we need to focus more on defining the learning outcomes and connect them better with curriculum and the assessment.

Major Improvments

Std 2 – Our program objectives and learning outcomes are adapted to fit the CDIO Syllabus. Objectives are also mapped into ABET A-K program objectives.

Standard 3 – Integrated Curriculum

Std 3 – The program has an integrated curriculum featuring, eg integration of communication and group dynamics in project courses, as well as collaboration between the mathematics and engineering science courses
Std 3 – We now have a completely integrated curriculum.
Standard 3 -- Integrated Curriculum
Lecture based courses are being re-developed to address skills development alongside theoretical learning – by deploying active learning methods in the classroom, or by introducing Active Learning Experiences (practical problem solving). Project based courses are being enhanced to more explicitly address skills development. A number of optional extra-curricular activities are to be offered to allow students to target their own development.
Std 3: The connection between courses is part of the continuous program evaluation process. Special workshops with faculty members about this topic have been held.
Standard 3: A curriculum that weaves personal, interpersonal, and product and system skills into disciplinary courses was designed in 2002 for pilot implementation in Fall 2002 and full implementation in Fall 2003. Every course has a plan outlining the CDIO skills that should be integrated, as well as the degree of implementation.
Standard 3 -- Integrated Curriculum
The new curriculum has been organized to grant the acquisition of a mix of technical knowledge, accounting for the multidisciplinary environment typical of the aerospace, aircraft and spacecraft engineering: differently engineering disciplines have been engaged together with specific topics of aerospace engineering.
Std 3 – Our curriculum now includes integrated learning between projects and fundamental courses. More work is required to integrate more courses.
Std 3: Existing courses in the 12 programs identified were reorganized and linked to demonstrate that engineering practice is multidisciplinary and to integrate personal, interpersonal, and product, process, and system building skills. Some courses were restructured and new courses introduced as a result of the reorganization.
Std 3. - We have had these kinds of ideas in the later years, but lacking them in the first two years. Since CDIO we have been discussing how to change this.
Std 3 – Curriculum benchmarked and CDIO Syllabus topics mapped into curriculum. Individual courses explicitly describe CDIO objectives within the context of course objectives.

Standard 4 – Introduction to Engineering

Stds 4 & 6 Students from several years of study collectively engage in projects covering all the skills required in CDIO, by regularly participating in the FSAE competition. This has resulted in a dedicated workshop being established for this purpose.
Std 4 – The introductory course has been re-designed to include a design-build-test project
Std 4 - We did improve our existing introductory course based on findings from the CDIO Initiative.

Major Improvments

Standard 4 -- Introduction to Engineering
A course including a simple team I-O project, a more complex team D-I-O project, an industry standard 3D CAD training course, a sustainable development project, instruction on various professional / personal development issues and PDP has been running for 3 years. The (D-)I-O projects and the CAD course are immersive – the timetable is cleared of all other activity so the students work full time on these projects – assuming roles of professional engineers. Evaluation evidence is excellent.
Std 4: An introductory course is running since 2007.
Standard 4: The introductory engineering subjects in our curriculum occur in two manners. First, all students are required to take Unified Engineering I and II. Unified Engineering I and II is a yearlong sophomore (2nd year) course of 48 units (approx. 12 sem. cr.) that includes fluid mechanics, structures and materials, signals and systems, thermodynamics, and propulsion. A series of systems problems introduces students to the practice of engineering. The deliberate teaching of CDIO skills began in Fall 2002. Evidence of integration was found in students' Reflective Portfolio Activity of February 2003. Second, the department is involved in teaching two 1st year subjects introducing engineering concepts, specifically 16.00 (taught solely by our department) and 16.00a (taught jointly with other engineering departments). While neither of these subjects is a required part of our program, most of our students take 16.00.
Standard 4 -- Introduction to Engineering
A course is present at first year devoted to the first insight of the aerospace environment. The technical focus is on basic flight mechanics but linked to many environmental aspects: technology from the technical point of view, regulations for design, regulations for operating, market considerations, … .
Standard 4: A new Introduction to Engineering has been introduced in the first year.
Std 4: All 12 programs created an Introduction to Engineering course to stimulate students' interest in, and strengthen their motivation for, the field of engineering. Basic design-implement experiences were introduced and personal and professional skills and attributes and interpersonal skills of teamwork and communication integrated. In the Schools of EEE and MM, for example, existing first-year courses were redesigned and renamed “Introduction to Engineering”.
Std. 4 - We have defined an Introduction course to all our degree programs. Earlier such a course did not existed in most of our programs.
Std 4 – Introductory course contains two significant team, design-build-fly projects

Standard 5 – Design-Implement Experiences

Std 5 – We now have a basic design-implement experience in Years 1 and 2, and an advanced design-implement experience in Years 3 and 4. The Year 4 experience existed before, but now is greatly improved with the addition of teamwork and communication requirements.
Std 5 – Two compulsory design-build-test experiences are now included, and there are many optional design-build-test experiences
Std 5 - We now have a basic design-implement experience in Year 1. An intermediate design-implement-test experience in Year 2, and several advanced design-implement-test experiences in Years 4 and 5.
Standard 5 -- Design-Implement Experiences
All students undertake a team, 60 hour D-I-O project in Yr1, and a team 450-600 hr C-D-I-O

project in their final two years (Capstone). Students undertake other D-I projects of varying complexity depending on their programme.
Std 5: DBT-courses in year 3 starts autumn 2008.
Standard 5: In Unified Engineering I-II (described above), second-year students design, build and fly radio-controlled electronic propulsion aircraft. In capstone courses, third-and fourth-year students design, experiment, test, and build complex systems that integrate engineering fundamentals in a multidisciplinary approach. This CDIO-inspired capstone sequence (which grew out of our previous capstone subjects) first began in astronautics applications. Then, an aeronautics version was offered for the first time in Fall 2003.
Standard 5 -- Design-Implement Experiences
Basic design experiences are included first and second year aerospace courses. More advanced design experiences are being planned to be offered to third year students.
Std 5 – We are implementing our second design-build project in the last year of our program for all our students in the fall of 2008/05/26
Standards 5 and 7 – We now have a curriculum structure that contains DBEs in all of the first five semesters. These DBEs have been developed in such a sequence that students evolve from small-scale, small groups (3), simple and closed problems to large-scale, large groups (5-6), complex and open-ended problems. In the last (6^{th}) semester the students do a capstone project in an external organization with teacher's mentoring. In all courses supporting these DBEs there is a competency module (personal, communication, presentation, ethics & law, project management). These courses and capstone represent 30% of degree credits.
Standard 5: There are now design-implement experiences in all four years of the program.
Std 5: All first-year students take a compulsory design course, Innovation, Design and Enterprise in Action (IDEA). The linkage between the content of IDEA and the engineering concepts and learning activities in the Introduction to Engineering course was improved. In addition to the first year IDEA and Introduction to Engineering courses, all final-year students are required to do a substantial third-year project.
Std. 5. - We have realized the some design-implement experiences are needed in the first years.
Std 5 – Curriculum has team projects in the introductory course plus design-build-fly projects in the capstone design course.

Standard 6 – Engineering Workspaces

Stds 4 & 6 Students from several years of study collectively engage in projects covering all the skills required in CDIO, by regularly participating in the FSAE competition. This has resulted in a dedicated workshop being established for this purpose.
Std 6 – A prototypic facility enabling the manufacturing of mechanical and mechatronic prototypes has been constructed and is used in courses in all program years
Std 6 – Most master programs on the advanced level have some type of engineering workspaces, but there is still some work to do.
Standard 6 -- Engineering Workspaces
A 9 million GBP Active Learning Laboratory has been designed specifically to support CDIO projects for 250 students at a time. It has been equipped with 1.5 million GBP state-of-the-art equipment.
Std 6: Several high class learning workspaces are used within the program.

Major Improvments

Standard 6: The Learning Laboratory for Complex Systems that opened in 2000 and the renovations in Building 33 provide support for hands-on learning of CDIO skills, with a special emphasis on product and system building. Spaces are designated for each of the four phases of product and system building: C-D-I-O. In exit interviews, students identified the lab spaces as a major contributing factor to their sense of community rapport and their satisfaction with the A-A program

Standard 6 -- Engineering Workspaces

Workspaces exist in limited quantities and freely accessible by students. Students are allowed to attend Department labs when engaged in guided didactic activities (experiments, design workshop, …).

Std 6 – Our new projects workspaces and integrated laboratories will be completed this fall, ready for January 2009.

Std 6 – Our focus over the next few years will be to develop better infrastructure for workspaces. We have refurnished a small lab (80 student capacity approx) for group work in 2007. It was a huge success and is a pilot for a major (CDIO) buildings project of US$50 - 60 million. The focus of the project is specifically going to be on CDIO and better workspaces (including three CDIO workspace areas for group work (150 students each).

Standard 6: The Integrated Learning Centre has opened and is widely used.

Std 6: Design workspaces, workshops and laboratories are available to encourage hands-on learning of product and system building, disciplinary knowledge, and social learning. Workshops in EEE were newly renovated to create flexible learning spaces equipped with wireless capabilities.

Std. 6 - We have analyzed our learning environment and the way we use labs and other resources.

Standard 7 – Integrated Learning Experiences

Std 7 - Same as Std 3. The program has an integrated curriculum featuring, eg integration of communication and group dynamics in project courses, as well as collaboration between the mathematics and engineering science courses

Std 7 – This is introduced in almost every course today, and is something we definitely learned from the CDIO Initiative.

Standard 7 -- Integrated Learning Experiences

All taught courses are seeking to improve integration between skills development and disciplinary learning by deploying more practical work, active learning methods, role play, simulations, case studies, PBL and CBL.

Standard 7: Experimental and design projects in the research and capstone courses are typical of those encountered in the aerospace industry. Design problems are chosen to encourage original solutions and applications. Consequently, finding new projects each year is a challenge. Efforts are underway to improve this through the proposed NASA CDIO project led by Ed Crawley.

Standard 7 -- Integrated Learning Experiences

Integrated learning experiences, devoted to the acquisition of personal and interpersonal skills, are envisaged in courses placed at second and third year. The second year will start next academic year.

Standards 5 and 7 – We now have a curriculum structure that contains DBEs in all of the first five semesters. These DBEs have been developed in such a sequence that students evolve from

small-scale, small groups (3), simple and closed problems to large-scale, large groups (5-6), complex and open-ended problems. In the last (6^{th}) semester the students do a capstone project in an external organization with teacher's mentoring. In all courses supporting these DBEs there is a competency module (personal, communication, presentation, ethics & law, project management). These courses and capstone represent 30% of degree credits.
Std 7: The 4 schools have incorporated integrated learning experiences into their programs. For example, in the School of EEE, all first-year students apply the concepts learnt in four courses (Principles of Electrical and Electronic Engineering, Digital Electronics, Teamwork and Communication Skill, IDEA and Introduction to Engineering) in a realistic project. In addition, activities utilising teamwork and communication skills are integrated into selected EEE courses.
Std 7. - No big change because of CDIO, we used to have quite much of these.

Standard 8 – Active Learning

Std 8 – New active teaching methods have been introduced, eg in a reformed mathematics course in which the use of simulation has been brought forward. Role play is utilized in the Industrial production & organization course, and a "supply chain game" in the Logistics course. Most courses in year 1 and 2 have some kind of formative assessment (computer exercises, hand-in assignments, design tasks/projects, lab reports, in-course exams). Two courses have individual grading in team-based projects.
Std 8 – A number of major design-implement-test experience exist as indicated above. Particularly those on the advanced master level contain major aspects of active learning. We have also introduced a number of activities aiming at changing the way students work with their active learning.
Standard 8 -- Active Learning: All programmes already feature some excellent experiential learning opportunities. Current efforts are trying to make all taught courses more active through the introduction of active learning methods (jigsaw classroom, think-pair-share, recitation etc) as well as role play, simulations, case studies, PBL and CBL.
Standard 8: In lecture-based courses, instructors are using reading quizzes, muddiest-point-in-the-lecture cards, concept tests, personal response systems, turn-to-your-partner discussions, and demonstrations. In laboratory, research, and design courses, instructors use demonstrations, inquiry, projects, problem solving, and experimentation. Course evaluations provide evidence of the effectiveness of these active learning teaching methods. The number of instructors using active learning has increased since the adoption of CDIO though its use is uneven across the department.
Standard 8 -- Active Learning
Some of the third year courses are designed to engage students with problems defined in new contexts to stimulate the capabilities of conceiving and implementing engineering solutions based on the available competences without the knowledge of the possible solutions.
Std 8 – More work is required to disseminate active learning techniques to all professors in the department.
Std 8: Practiced by teaching staff individually in many programs. A manual containing active learning strategies and practices was produced for teaching staff involved in implementing CDIO. Teaching staff are also encouraged to incorporate active learning activities requiring the use of notebook PCs. Professional development workshops on designing lessons with notebook activities and active learning are available.

Major Improvments

Std 8. - We are starting an active learning training program for our teachers.

Standard 9 – Enhancement of Faculty Skills Competence

Std 9 – The program relies on the university's teacher development program, in which faculty are now required to complete a diploma of teaching in higher education (400 hours study time) in order to gain tenure. Other teacher courses focus on communication, project management and student diversity.
Std 9 – We have a program with the Swedish truck manufacturer SCANIA which allows faculty to make extensive study visits (at least one week). The program has adopted a quality development system in which faculty meet regularly and discusses (among others) these type of issues.
Standard 9 -- Enhancement of Faculty Skills Competence
Between 25 – 50% of staff are enhancing their own CDIO skills by developing and implementing innovative approaches. Many are attending CDIO events, some are attending CPD, and some are undertaking formal training (in 3D CAD for example). A significant amount of staff development comes from peer-peer learning – particularly in those courses that are team taught. Our teaching is supported by 5 ex-industry visiting professors and an active Industrial Liaison Board – the involvement of professional engineers is helping academic staff to upskill. Our aim is to formalize and enhance staff development.
Standard 9: The A-A Department has taken a number of actions to enhance faculty competence in CDIO skills: hiring new faculty with CDIO expertise, sponsoring faculty's working in industry, sabbaticals in engineering practice. Further, our faculty have quite strong ties to industry in their research which naturally influences and informs our teaching at both the undergraduate and graduate levels.
Standard 9 -- Enhancement of Faculty Skills Competence
No activities planned in this field
Std 9: Professional development workshops have been designed and conducted for teaching staff on personal and professional skills and attributes, and interpersonal skills of teamwork and communication. The main objectives of the workshops are
Identify key underpinning knowledge
Integrate selected CDIO skills into program structure and course documents
Identify a range of learning designs (including activities) for developing CDIO skills
Produce a range of assessment items for assessing CDIO skills
An internal website to share information on the CDIO skills and good practices was made available to teaching staff.
Std. 9. - We had a project where part our personnel moved to industry for three months and looked, learned and worked there.
Std 9 – Recent department hires brought significant industry experience to the faculty. We deliberately sought candidates with experience in the CDIO skills.

Standard 10 – Enhancement of Faculty Teaching Competence

Std 10 – Some efforts, e.g., a course in group dynamics for teachers, and a development program for young research leaders

Major Improvments

Std 10 – KTH offers pedagogical courses that are STRONGLY influenced by CDIO. The program also encourages faculty to present their findings at engineering education conferences.
Standard 10 -- Enhancement of Faculty Teaching Competence
Between 25 – 50% of staff are enhancing their own CDIO skills by developing and implementing innovative approaches. Many are attending CDIO events, some are attending CPD, and some are undertaking formal training (in 3D CAD for example). A significant amount of staff development comes from peer-peer learning – particularly in those courses that are team taught. Our teaching is supported by 5 ex-industry visiting professors and an active Industrial Liaison Board – the involvement of professional engineers is helping academic staff to upskill. Our aim is to formalize and enhance staff development.
Standard 10: Faculty are expected to show personal development in teaching, learning, and assessment methods during their annual performance review. Moreover, faculty are expected to write reflective memos that map specific plans for improving teaching, learning, and assessment in their undergraduate courses. Presentations, demonstrations, and short courses are available, both in the department (though that is reduced from previous years) and through MIT's Teaching Learning Lab.
Std 10: The Educational and Staff Development Department (ESDD) and the School of Communication, Arts and Social Sciences conduct workshops on active and experiential learning and designing assessments for personal skills and attitudes, teamwork and communication.
Std. 10 - Teaching competence/teaching training is a mandatory part of our teaching positions. Maybe starting the above mentioned Active learning is also an answer to here...improving teaching competences.

Standard 11 – Learning Assessment

Std 11 – Included in the relevant courses
Std 11 – A lot has been done since introduction of CDIO, but there is still some work to do. The program has adopted a quality development system in which faculty meet regularly and discusses (among others) these types of issues.
Standard 11 -- Learning Assessment
Work is underway to better align assessment tools with the CDIO driven learning outcomes. A number of new approaches are at pilot stage.
Std 11: The assessment of personal, interpersonal and product, process and system building skills are supported by the use of the project model LIPS.
Standard 11: Within courses, faculty use traditional and newly designed tools to assess student achievement of course learning outcomes, including oral exams, concept questions, peer assessment of projects and presentations, and reflective portfolios.
Standard 11 -- Learning Assessment
Assessment is fragmented within courses. Methods include oral and written exams, peer assessment of project and presentations.
Std 11: Assessment of student learning in personal, interpersonal, and product, process, and system building skills, as well as in disciplinary knowledge have been incorporated, where appropriate, in the revised courses.
Std. 11. - A small group analyzed our assessment and produced a suggestion how to develop assessment in our school. This work followed pretty much CDIO ideas.

Major Improvments

Std 11 – We include assessment of CDIO skills in our annual program evaluation, each year focusing on one area (CDIO 2.x, 3.x, and 4.x.)

Standard 12 – Program Evaluation

Std 12 – The CDIO standards self-assessment model has been applied at four occasions since 2003
Std 12 – We have a yearly graduation survey system. Students and faculty in each course meet regularly. Faculty teaching courses in the same academic year meet every second week as part of activities in the quality management system (management-by-means) etc.
Standard 12 -- Program Evaluation
Evaluation evidence from students is gathered from entrance, periodic and exit surveys – these address programmes and their component modules. Methods to capture and communicate evidence from other stakeholders, and methods to analyse changes in student attainment are being considered.
Std 12: A number of program evaluation activities are used.
Standard 12: The department has a comprehensive plan for program evaluation and well as several tools in place. The Undergraduate Committee examines data from subject evaluations, baseline interviews, exit interviews, and surveys for continuous process improvement. Evidence of achievement of CDIO skills is inferred from senior interviews and surveys. The department also participates in program evaluation by ABET, EBI, COFHE and other external evaluation agencies.
Standard 12 -- Program Evaluation
Program evaluation is at the planning stage (the last evaluation occurred three years ago)
Standard 12: The CDIO Standards are now the basis for all program reviews and evaluation of the program against these standards is regularly undertaken.
Std 12: An evaluation of the implementation of CDIO in the 12 programs has been planned. The aims of the evaluation are to determine the following:
Are the learning outcomes, learning activities and assessments aligned and integrated?
How has the changes in the curriculum, learning activities and assessments impacted the students' competencies in CDIO skills, interest and learning?
What is the perception of the teaching staff to curriculum changes and their impact on students' competence in the selected CDIO skills and interest in subject?
Are students able to integrate the knowledge and skills learnt across courses?
Std. 12. - We have done the evaluation couple of times now. It has shown where we are and what we need to do next. However, we still lack a detailed plan for the evaluation and we need to improve the documentation of our evaluations.
Std 12 – Our CDIO self study formed the basis for our ABET self study in our most recent ABET evaluation.