Examples of Evidence of Compliance with the CDIO Standards v 2.0

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This document accompanies a document called "The CDIO Standards", revised January 4, 2010, which describes each standard and provides a rationale and rubric for assessing compliance with each standard. The focus of this document is on types of evidence that may be used to determine compliance with each standard.

The CDIO Standards

The CDIO Standards address 12 characteristics of engineering education that define the CDIO approach:

Standard 1	The Context
Standard 2	Learning Outcomes
Standard 3	Integrated Curriculum
Standard 4	Introduction to Engineering
Standard 5	Design-Implement Experiences
Standard 6	Engineering Workspaces
Standard 7	Integrated Learning Experiences
Standard 8	Active Learning
Standard 9	Enhancement of Faculty Competence
Standard 10	Enhancement of Faculty Teaching Competence
Standard 11	Learning Assessment
Standard 12	Program Evaluation

Evidence

In general, the types of evidence needed to document compliance with the CDIO Standards are similar for each standard. The specific nature of the evidence is influenced by the focus of the standard as well as local practices, resources, and needs. These examples of evidence are drawn from self-evaluation reports of CDIO programs conducted in 2005 and 2008. Evidence is given for each level of the rubrics described in "The CDIO Standards" document.

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

Scale	Examples of Evidence
5	The CDIO principle is recognized within the program and institution as the basis for the periodic program review process. The CDIO principle is recognized as a legitimate basis for periodic external accreditation by governmental and professional bodies.
4	Descriptions of CDIO appear in university publications and web sites. The CDIO principle was adopted by program management and faculty, and has been documented in the program goal document.
3	The School of Engineering has adopted the CDIO approach for all its programs. The CDIO context is formulated in the program plan and has been the focus of the program board for the last few years. The CDIO context is presented and explained to students in the first semester.
2	CDIO has been accepted as part of the program's educational reform plan. The academic council has approved a new curriculum plan based on CDIO principles. CDIO principles are stated in the department mission and vision.
1	There is general agreement among faculty members that the CDIO principle is desirable as a basis for program renewal. We have initiated a faculty orientation to CDIO through participation in CDIO meetings and the Introductory CDIO Workshop.
0	There is no plan to adopt the CDIO principle as the program context.

Standard 2 – Learning Outcomes

Specific, detailed learning outcomes for personal and interpersonal skills, and product, process, and system building skills, as well as disciplinary knowledge, consistent with program goals and validated by program stakeholders

Scale	Examples of Evidence
5	Faculty regularly use evidence related to specific, detailed learning outcomes to evaluate program success and guide improvement were needed. Our program advisory group periodically examines direct and indirect evidence of program learning outcomes as the basis of program review and improvement.
4	Taking into account the results of the CDIO Syllabus surveys, specific learning outcomes have been implemented in 1st- and 2nd-year courses, and developed for 3rd- and 4th-year courses. Learning outcomes are aligned with our institutional mission and with national accreditation criteria.
3	The CDIO Syllabus has been validated with program stakeholders. There are learning outcomes at three levels: the program plan, the track plan, and individual course plans. The detailed CDIO Syllabus was customized for the institution's context.
2	We plan to adapt our program objectives and learning outcomes to fit the CDIO Syllabus. Learning outcomes are being mapped onto ABET EC2000 Criterion 3a – 3k.
1	We recognize the need to specify outcomes for our new education model. We need to write learning outcomes in our programs consistent with CDIO and the Bologna process.
0	There are no explicit program learning outcomes for personal and interpersonal skills.

Standard 3 -- Integrated Curriculum

A curriculum designed with mutually supporting disciplinary courses, with an explicit plan to integrate personal and interpersonal skills, and product, process, and system building skills

Scale	Examples of Evidence
5	Internal faculty curriculum committees regularly review the integrated curriculum and make recommendations for adjustments as needed. Governmental and professional bodies base their review of the program in part on the congruence of the integrated curriculum with accreditation criteria.
4	We now have a completely integrated curriculum as shown by the course syllabi. An integrated curriculum was planned for Fall 2003; a gap analysis in 2005 identified the actual implementation and suggested a revision to the integration plan.
3	Several courses at the basic level integrated personal, interpersonal, and product, process, and system building skills with disciplinary content; integrated curriculum is being planned for the advanced levels. A framework for integrating personal, interpersonal and system building skills is found in the sequence of project courses, with more explicit skills progression under development. Existing courses were reorganized and linked to demonstrate that engineering practice is multidisciplinary and to integrate personal, interpersonal, and product, process, and system building skills.
2	Every course has a plan outlining the skills that should be integrated, as well as the degree of implementation. The curriculum design is complete and has been approved at all levels. A multidisciplinary curriculum is being planned, with competencies that include personal and interpersonal skills and values.
1	We have initiated a mapping of personal, interpersonal and system building related learning outcomes onto the curriculum. We have held workshops to examine the curriculum and the intended program outcomes.
0	There is no integration of supporting disciplines or program learning outcomes.

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

Scale	Examples of Evidence
5	Our first-year course is documented and evaluated yearly by students and instructors, guiding necessary improvements. We improved our existing introductory course based on findings from the CDIO Initiative.
4	After three years, evaluation evidence is excellent regarding courses that include instruction on various professional and personal development issues as part of a simple team I-O project. Our first-year course is fully implemented and is documented in the CDIO book. First-year and second-year courses include projects executed in small diverse groups and competition, both of which provide evidence of student achievement.
3	The inclusion of cross-curricular, practice-oriented projects in the 1st and 2nd years has contributed greatly to this Standard. Students now get a 'taste' of the future profession right from the beginning. In a field trip in the 1st-year course, students investigate the design sector and the entire manufacturing process. An introductory engineering course has been implemented since 2002, with the goals of introducing the role of the engineer, written and oral communication, and the use of the project model.
2	A new yearlong introductory course has been approved to start next year. First-year project courses are planned for the new curriculum.
1	We are defining an introductory course that includes a project in all our degree programs.
0	There is no introductory engineering course that focuses on elements of practice.

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

Scale	Examples of Evidence
5	Feedback provides direction for revision of our cross-curricular, practice-oriented projects in order to improve student performance. The design-implement experiences are regularly evaluated and revised, based on feedback from students, instructors, and other stakeholders.
4	All students undertake a team, 60-hour D-I-O project in Year 1, and a team 450-600-hour C-D-I-O project in their final two years (capstone), which provide the basis for evaluating their accomplishment of learning outcomes. Student performance is also evaluated in other D-I projects of varying complexity depending on the program. In addition to evaluating DBE skills in all courses supporting these DBEs, there is a competency module in which students are evaluated with respect to personal, communication, presentation, ethics, law, and project management knowledge and skills. Evaluations have shown that in projects and other course units, students have acquired the intended learning outcomes through design-build experiences that have increasing difficulty through the years.
3	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. Two compulsory design-build-test experiences are now being offered, and there are many optional design-build-test experiences that have been implemented. The cross-curricular, practice-oriented projects increase in difficulty each year. This is achieved by including gradually more core competencies in the project and by expecting a higher level of performance.
2	There is a plan for all 1st-year students to take an introductory design course.
1	We have realized that some design-implement experiences are needed in the first years. Basic design experiences are included in 1st- and 2nd-year aerospace courses. However, more advanced design experiences need to be offered to 3rd-year students.
0	There are no design-implement experiences in the engineering program.

Standard 6 -- Engineering Workspaces

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

Scale	Examples of Evidence
5	As part of periodic review processes, the adequacy of workspaces is reviewed to determine if there are additional needs and related budget implications. Design workspaces, workshops and laboratories are now available across the curriculum. Program evaluations indicate that they encourage hands-on learning of product and system building, disciplinary knowledge, and social learning.
4	Our learning laboratory provides support for hands-on learning of 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. A prototyping lab, machine shop, computer room for simulations, and other workspaces are available; workspaces are also available to students for extracurricular activities. Our active learning laboratory has been designed specifically to support design-implement projects for 250 students at a time. It has been equipped with state-of-the-art equipment.
3	Workshops were newly renovated to create flexible learning spaces equipped with wireless capabilities. Most of the in-depth specializations have workspaces and laboratories to support design-build experiences with more in the works.
2	Our focus over the next few years will be to develop a better infrastructure for workspaces. A plan was approved to refurnish a small lab (approx. 80-student capacity) for group work. Workspaces exist in limited quantity; new spaces are being planned for the coming year.
1	According to the members of the program, the equipment needs improvement. It is also desirable to have more small-group meeting rooms and to have more and newer technologies in the laboratories. We have identified the following: inadequate space; lab safety is a concern; engineering tools are out-of-date, workspaces are not student-centered and user friendly; low levels of satisfaction among faculty, students, and staff.
0	Engineering workspaces are inadequate or inappropriate to support design-implement activities.

Standard 7 -- Integrated Learning Experiences

Integrated learning experiences that lead to the acquisition of disciplinary knowledge, as well as personal and interpersonal skills, and product, process, and system building skills

Scale	Examples of Evidence
5	Instructors regularly evaluate courses regarding the impact of integrated learning experiences on student outcomes, and use the information to make adjustments. During external accreditation and review visits, the efficacy of integrated learning experiences is evaluated, and recommendations are made regarding any needed changes.
4	All courses seek to improve the integration of skills development and disciplinary learning by deploying more practical work, active learning methods, role play, simulations, case studies, Problem-Based Learning, and Competency-Based Learning. The program has an integrated curriculum featuring the integration of communication and group dynamics in project courses, as well as collaboration between the mathematics and engineering science courses. Project work, typical of industrial applications, incorporates communication and teamwork and is evaluated using criteria and standards based on industry models.
3	Integrated learning experiences that lead to the acquisition of disciplinary knowledge, as well as personal and interpersonal skills, and product, process, and system building skills are part of almost every course today. Integrated learning in found in project courses, in projects within courses, and in a large number of laboratory exercises. Integrated learning is prevalent in our first-year program.
2	Integrated learning experiences, devoted to the acquisition of personal and interpersonal skills, are envisaged in courses placed in the 2nd and 3rd years. Most course plans include learning outcomes that address personal and interpersonal skills assigned to them in the curriculum plan.
1	Through a needs assessment, we have identified experimental and design projects in the research and capstone courses that are typical of those encountered in industry. Integrated learning is at the planning stage.
0	There is no evidence of integrated learning experiences.

Standard 8 -- Active Learning

Teaching and learning based on active experiential learning methods

Scale	Examples of Evidence
5	Courses are regularly evaluated regarding the impact on student learning of active learning methods and are revised as suggested by the results in order to enhance their effectiveness. Course evaluations provide evidence of the effectiveness of active learning methods. The number of instructors using active learning has increased since the adoption of the CDIO approach though its use is uneven across the department.
4	In lecture-based courses, instructors use 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.
3	A number of active learning experiences exist in project and lab courses; there is a strong emphasis on student activity in mathematics courses; a mentoring system is in place to help students develop good study habits. All programs feature some excellent experiential learning opportunities. Current efforts are focused on making all courses more active through the introduction of active learning methods: jigsaw classroom, think-pair-share, recitation, role play, simulations, case studies, Problem-Based Learning, and Competency-Based Learning. Active experiential learning methods include laboratory work, design activities, experimental learning projects, and self-assessment exercises.
2	Active, self-instructed, competency-based learning is one of the action items in the educational development plan of our university. Active experiential learning methods are planned for many courses.
1	It is clear to us that active learning methods are needed. Some courses with projects use active learning, but more focus needs to be put on this standard.
0	There is no evidence of active experiential learning methods.

Standard 9 -- Enhancement of Faculty Competence

Actions that enhance faculty competence in personal and interpersonal skills, and product, process, and system building skills

Scale	Examples of Evidence
5	Collective faculty competence in personal, interpersonal, product, process, and system-building skills is regularly evaluated as part of periodic internal program and course review processes.
4	Course evaluations provide evidence of the effectiveness faculty regarding the development of personal, interpersonal, product, process, and system-building skills among students.
3	We have a program with a large manufacturing company that allows faculty to make extensive study visits (at least one week). The program has a quality development system in which faculty meet regularly to discuss personal and interpersonal skills, and product, process, and system building skills, among other topics. Courses are offered for faculty in English communication, environmental issues, teamwork, and practical product development. Personal, interpersonal and system building skills are enhanced by education in the project model, participation in research projects in cooperation with industry, and supervision of thesis projects carried out in industry.
2	Currently, the engineering 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. There is a plan for other teacher courses that focus on communication, project management, and student diversity. There is a plan for part of our personnel to move to industry for three months and look, learn, and work there.
1	We realize that new training programs need to be launched by the university's educational and staff development department. Each academic year, we conduct a survey indicating which lecturers undertake which further training. An annual budget is developed based on the faculty's estimate for the staff's needs for further professionalization that are revealed by the survey.
0	There are no programs or practices to enhance faculty competence in personal and interpersonal skills, 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

Scale	Examples of Evidence
5	Faculty competence in teaching, learning, and assessment methods is regularly evaluated as part of an ongoing review process, and suggestions are made for faculty development. A faculty development process is used to monitor and improve faculty competence in teaching, learning, and assessment methods.
4	Faculty are expected to provide evidence of 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. Course evaluations provide evidence of individual faculty competence in teaching, learning, and assessment methods.
3	One or more faculty members were appointed within each department to start the process of educational innovation. The department has plans and activity reports proving which actions were drawn up to that purpose. All lecturers received training with accompanying course materials and guidance with respect to: the organization of project education, assessment within project education, coaching of project groups, and conflict management between students in project groups. The university faculty and staff development department conducts workshops on active and experiential learning and designing assessments for personal skills and attitudes, teamwork and communication.
2	The professionalization of the teaching staff in educational innovation is an action item within the educational development plan. Teaching competence and teacher training are mandatory parts of our teaching positions.
1	An annual survey is used to indicate which lecturers undertake which further training. We realize that new training programs need to be launched by the university's educational and staff development department.
0	There are no programs or practices to enhance faculty teaching competence.

Standard 11 -- Learning Assessment

Assessment of student learning in personal and interpersonal skills, and product, process, and system building skills, as well as in disciplinary knowledge

Scale	Examples of Evidence
5	Instructors regularly assess student learning outcomes in their courses and use the results to guide the improvement of teaching, learning, and assessment methods. We include assessment of personal, interpersonal and system building skills in our annual program evaluation, each year focusing on one area under CDIO Syllabus topics 2.x, 3.x, and 4.x. The program has adopted a quality development system based on student learning outcomes in which the faculty meets regularly and discusses these types of issues, and as a result recommends improvements.
4	The assessment of personal, interpersonal and product, process and system building skills are supported and documented by the use of the project model LIPS. Within many courses, faculty members 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.
3	Since the adoption of CDIO standards, it is clear that much more emphasis is given to learning assessment in the wider sense. There is assessment in project courses that separates course and project objectives. Assessment to a large extent is carried out using the project model. Peer and self-assessment are used in courses with project-based learning activities.
2	Work is underway to align assessment tools with persona, interpersonal and system building related learning outcomes. There is ongoing assessment in basic-level courses and assessment is to be extended to the 3rd-year project course. Planned student learning assessment methods include oral exams, concept questions, peer assessment of projects and presentations, and reflective portfolios.
1	A small group analyzed our assessment and produced suggestions on how to develop assessment in our school. This work followed ideas outlined in the CDIO book. Assessment in the final-year project course has begun, but a more comprehensive plan is needed.
0	Learning assessment methods are inadequate or inappropriate.

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

Rubric Scale	Examples of Evidence
5	The Undergraduate Committee examines data from course evaluations, baseline interviews, exit interviews, and surveys for continuous process improvement. Evidence of achievement of personal, interpersonal and system building skills is inferred from senior interviews and surveys. Feedback on the program is obtained through different types of qualitative and quantitative data collections methods including the self-assessment report, the educational group, and measuring student workload. The results are used to guide program improvement.
4	We have a yearly graduation survey system designed to provide program evaluation information. 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. Program evaluation methods include web-based course evaluations, student-administered course evaluations, evaluation of the specializations, longitudinal studies of student expectancies, entry surveys, and alumni surveys.
3	Evaluation evidence from students is gathered from entrance, periodic, and exit surveys. Methods to capture and communicate evidence from other stakeholders, and methods to analyze changes in student attainment are being considered. Methods include course evaluations, entry surveys, and a new exit survey launched in 2004. The program is regularly evaluated by a national higher education agency. Regular linkage meetings are held to review courses.
2	Program evaluation related to the adoption of the CDIO approach that is intended to feed a continuous quality improvement is slowly starting to take form. This is one of our major objectives over the next year. The department has a comprehensive plan for program evaluation and well as several tools in place. An evaluation of the implementation of the CDIO approach in the 12 programs has been planned.
1	National accreditation evaluates programs on ten outcomes. There is a need to align the related national evaluation plan with the CDIO standards. We have done the evaluation a 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.
0	Program evaluation is inadequate or inconsistent.