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Compliance of Engineering Programs to CDIO Standards: A Case of a State College in the Philippines

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RESEARCH ARTICLE

Abstract
CDIO (Conceive, Design, Implement, and Operate) emphasizes new approaches in engineering education, and provides students better learning experiences which will prepare them into the real-world of engineering works. This CDIO approach has been adopted by several universities around the world. In the Philippines, this approach has been introduced to several universities and colleges more specifically to engineering programs. Engineering programs at Camarines Sur Polytechnic has been in its third-year since its introduction of CDIO in 2017. This study was developed to evaluate the current state of the engineering programs on how well it lines up with the 12 CDIO standards using the CDIO's 6-level self-evaluation rubric. Results showed that there are improvements on the ratings in 2020 as compared in 2017 where CDIO framework was first introduced in engineering programs. Standards 4, 5, 9, 10 and 11 were rated 4 which confirmed that the engineering program complies with the standards. Standards 1, 2, 3, 6, 7, 8 and 12 were rated 3 which confirmed that further development and improvement in these standards are sought. Compliance and alignment of CDIO standards to Commission on Higher Education (CHED) standards and quality assurance systems including Accrediting Agency of Chartered Colleges and Universities in the Philippines (AACCUP) and Philippine Technological Council (PTC) has been presented and found that CDIO standards conforms with the various quality assurance systems. Plans of action were developed for continuous improvement processes.

Keywords: CDIO, CDIO Standards, Engineering Education, Extent of Compliance, Self-evaluation

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1 Introduction

Conceive, Design, Implement, and Operate (CDIO) is a new standard and approach based on the theory and methodology of outcome-based education. It was started for engineering technology programs, but nowadays, it is used for many different programs in several universities in the world, such as engineering, economy, and management (Norinpel, Gonchigsumlaa, Tungalag, & Purevdorj, 2018). It is a globally recognized framework as an enabler for engineering education reform (Campbell, et al., 2009).

CDIO is an international initiative to reform education. CDIO framework has been the current trend, influencing the reformation of engineering education (Terano, 2019). The framework provides students with an education stressing engineering fundamentals set in the context of

Conceiving – Designing – Implementing – Operating (CDIO) real-world systems and products (Welcome to CDIO, n.d.). CDIO encompasses various thoughts that engineering students should develop throughout their learning experiences in school. Engineers must possess the ability to use three major thought modes: engineering, scientific, and system thinking (Personal and Professional Skills & Attributes, n.d.). For these visions to become a reality in applications, it is essential to equip these engineering graduates with the necessary knowledge, skills, and values in their respective fields.

CDIO framework in engineering education remains relevant and is anchored on what knowledge the industry needs, skills, and values for their engineers. With the advent of industry 4.0, in which computers and automation will come together in an entirely new way, with robotics connected remotely to computer systems equipped with machine learning algorithms that can learn and control the robotics with very little input from human operators (Marr, 2016), it is important to change the nomenclature of engineering education. CDIO framework is still relevant to Industry 4.0. However, the required curriculum and the way learning takes place in the future will be quite different (Cheah & Leong, 2018).

A basic CDIO premise is that hands-on experience is a vital foundation for base theory and science. To address this, CDIO programs seek to improve how engineering is taught and learned in four significant ways. Namely, they increase active and hands-on learning, emphasize problem formulation and solution, thoroughly explore the underlying concepts of the tools and techniques of engineering, and institute innovative and exciting ways of gathering feedback (Teaching and Learning Reform: The CDIO Method, n.d.). CDIO-based engineering education is rich with student projects, features a simulation base for teaching mathematics, and integrates the learning of technical knowledge and generic skills (Malmqvist, 2015). In general, the CDIO framework strengthens the student-centered learning approach.

The CDIO framework consists of 12 CDIO standards (CDIO Standards 2.0, n.d.). Standard 1 focused on program philosophy. Standards 2, 3, and 4 are on curriculum development. Standards 5 and 6 are on design-build experiences and workspaces. Standards 7 and 8 are on new methods of teaching and learning. Standards 9 and 10 are on faculty development. And standards 11 and 12 are on assessment and evaluation.

In the Philippines, CDIO was first introduced with the partnership of Singapore Polytechnic and Temasek Foundation. One of the nine State Universities and Colleges in the Philippines is the Camarines Sur Polytechnic Colleges to be known as the Polytechnic State University of Bicol(Barandon, Bustamante, Luzon, Pontillas. Sotto, & Terano, 2021) which underwent a series of training and seminars in the Philippines and Singapore on the CDIO Framework. Six faculty members of the College of Engineering were trained to become Master Trainers, with the role of cascading CDIO not just in the college but to all Colleges and Universities in the Philippines (Terano, 2019). With the implementation of the CDIO in the college, various challenges were experienced by the faculty. With these challenges, the researchers decided to conduct this study which will focus on a detailed analysis and evaluation of the current state of the compliance of engineering programs to the CDIO standards. With the results of the study, the researchers can develop recommendations that can be beneficial for the full implementation of CDIO, which is a requirement of the institution for its application as a Worldwide CDIO Collaborator, a worldwide network of academic professionals, industry representatives, and engineering leaders who have a passion for engineering education and engineering leadership.

This study was focused on analyzing the compliance of CSPC's engineering programs to CDIO standards. The alignment of CDIO standards with Philippine quality assurance systems like CHED PSGs, AACCUP, and PTC was evaluated. The improvement in CDIO's compliance using the self-evaluation instrument for the last 3 years was also evaluated. Recommendations and a plan of action were developed based on the results of the evaluation analysis. Lastly, this study has its aim in giving impetus on quality education as an important aspect in delivering of learning to the students (Terano, 2018)

2 Literature Review

In each country, numerous organizations and agencies are responsible for the external auditing of HEIs. The efficacy of external quality assurance is highly dependent on an institution's internal quality system and quality culture (Kristensen, 2010). Self-evaluation of programs is important to determine the readiness for quality assurance. In a self-evaluation, an institute systematically reviews and reflects on the quality of instructional and related educational services and the outcomes they produce (OECD, 2011).

The Conceive-Design-Implement-Operate (CDIO) approach supports engineering education and students who can develop knowledge, skills, and values relevant to preparation for future works of engineers. The CDIO Standards act as guiding principles for designing and developing a degree programme (Kontio, et al., 2012).

In January 2004, the CDIO Initiative adopted 12 standards to describe CDIO programs. These guiding principles were developed in response to program leaders, alumni, and industrial partners who wanted to know how they would recognize CDIO programs and their graduates. As a result, these CDIO Standards define the distinguishing features of a CDIO program, serve as guidelines for educational program reform and evaluation, create benchmarks and goals with the worldwide application, and provide a framework for continuous improvement. The standards may also be used as a framework for certification purposes (The CDIO Standards v 2.0, 2010).

The 12 CDIO standards have the following objectives: define the distinguishing features of a CDIO program, serve as guidelines for educational program reform and evaluation, create benchmarks and goals with the worldwide application, and provide a framework for continuous improvement (Worldwide CDIO Initiative Standards, n.d.).

The 12 CDIO Standards address program philosophy (Standard 1), curriculum development (Standards 2, 3, and 4), design-build experiences and workspaces (Standards 5 and 6), new methods of teaching and learning (Standards 7 and 8), faculty development (Standards 9 and 10), and assessment and evaluation (Standards 11 and 12). Seven of these 12 standards are important because they distinguish CDIO programs from other educational reform initiatives. The five supplementary standards significantly enrich a CDIO program and reflect best practices in engineering education (CDIO Standards, 2004).

A paper describes a standards-based approach to program evaluation and provides a rationale for the CDIO standards in reforming engineering education. The twelve standards developed by the CDIO Initiative serve as a useful framework for program self-evaluation. The Chalmers University of Technology, the Royal Institute of Technology, Linkoping University, and the Massachusetts Institute of Technology have used this self-evaluation model since October 2000. New collaborators – more than a dozen engineering programs – conduct similar self-evaluations as they begin their reform process and project their desired status in two to five years. In Sweden, academic groups responsible for evaluating higher education programs have adopted the CDIO standards as the basis of their evaluation processes. The standards are also consistent with evaluative criteria in the United States, Canada, the United Kingdom, and South Africa. With its emphasis on continuous program improvement, the CDIO standards-based approach enhances accreditation reviews. At least annually, a CDIO program identifies specific tasks related to each standard to improve the program overall (Brodeur & Crawley, 2005).

The main goal of the Nordic project Quality Assurance in Higher Education was to develop and implement a self-evaluation model in the participating Higher Education Institutes (HEIs) to support their quality assurance work and continuous curriculum development. Furthermore, the project aimed at strengthening the cooperation of HEIs in quality assurance (QA) and disseminating good practices of QA. The development framework is based on the CDIO approach and the CDIO self-evaluation process. The main results are a detailed definition of the self-evaluation process, well-documented self-evaluations of the participating degree programmes, and the identification of the main development areas and actions in each participating degree programme. Furthermore, the project has increased the partners' understanding of other partners and their challenges. Finally, quality assurance has been enhanced in each participating programme, and new ideas and support for quality assurance work in other higher education institutes have been produced (Kontio, et al., 2012).

Adopting the CDIO Initiative at the School of Engineering, Nanyang Polytechnic, Singapore, contributed to the ABET accreditation of the Diploma in Aerospace and Aeronautical Engineering. The CDIO played a key role in meeting the ABET criteria; the success of the accreditation within a short period is shaped by the strategic foundation for NY organizational excellence – Culture, Concept, Capability, and Connection/Collaboration (Wah, Tan, & S., 2015).

CDIO standards are accepted to be compliant with the Washington accord. With the CDIO process, the CDIO Standards, and the CDIO Syllabus, many scholarly contributions have been made around cultural change, curriculum reform, and learning environments. The CDIO Syllabus is cast into the Australian context by mapping it to the Engineers Australia Graduate Attributes, the Washington Accord Graduate Attributes, and the Queensland University of Technology Graduate Capabilities (Campbell, et al., 2009).

The Tomsk Polytechnic University analyzed the existing Academic Standard to understand whether it requires some changes and to identify the possibilities for its improvement. The analysis aimed to develop a basis for a new TPU Standard edition in the CDIO context (Chuchalin, Petrovskaya, Kulyukina, & Tayurskaya, 2012).

An evaluation of the mechanical engineering programs at the University of Ontario Institute of Technology was conducted. The study examined the program with its compliance with the CDIO standards. Results of the evaluation found that the program continues to develop and improve each year to ensure that it delivers the necessary learning outcomes sought by industry and accreditation boards. The program, as it is today, complies very well with the CDIO standards (Platanitis & Pop-Iliev, n.d.).

3 Methodology

3.1 Research Method

This study employed a qualitative approach. Data processing does not involve mathematical and statistical calculations but emphasizes interpretative studies (Onwuegbuzie, 2017; Nguyen, Thai, Pham, & Nguyen, 2020). Qualitative data used for program evaluation are obtained from three sources (Patton, 2002): in-depth interviews that use open-ended questions, direct observation, and document analysis.

3.2 Data Collection Method

The study adopted the sample evidence and data collection method aligned with the CDIO standards (Brodeur & Crawley, 2005). Multiple data collection methods were used to gather data from students, faculty, existing documents, and other institutional sources.

3.3 Self-Evaluation Rubric

On the self-evaluation, a 6-level rating scale was used to indicate progress toward the planning, implementation, and adoption of each CDIO standard. Table 1 shows the rubric (Self Evaluation by the CDIO Standards (template), n.d.). All programs in the CDIO initiative use this rubric for self-evaluation against the twelve standards.

Table 1. **Self-Evaluation Rubric**

Level	Rubric
5	Evidence related to the standards is regularly reviewed and used to make improvements.
4	There is documented evidence of the full implementation and impact of the standards across program components and constituents.
3	Implementation of the plan to address the standard is underway across the program components and constituents.
2	There is a plan in place to address the standard.
1	There is an awareness of the need to adopt the standard, and a process is in place to address it.
0	There is no documented plan or activity related to the standard.

Each CDIO program described the evidence that was the basis for the rating of each standard. Evidence of progress towards the 12 standards and the corresponding evaluation rating for the engineering programs was presented. Specific recommendations and a plan of action was given to accelerate progress for a program that is not completely satisfied with its rating.

4 Results and Discussions

4.1 Alignment of CDIO Standards, CHED PSGs, AACCUP, and PTC standards

CDIO standards are a useful framework for internal program self-evaluation and external Quality Assurance. The founding members of CDIO have used this self-evaluation model since October 2000 (Brodeur & Crawley, 2005). Key quality assurance questions aligned with the CDIO standards can be applied to any program in any discipline (Brodeur & Crawley, 2009). This section compares the CHED PSGs, AACCUP, PTC, and CDIO standards. Table 2 shows the mapping of CDIO standards against the various standards and quality assurance systems.

Table 2. **Mapping of CDIO Standards, CHED PSGs, AACCUP, and PTC standards**

CDIO Standards	CHED PSGs	AACCUP	PTC
1. CDIO as Context	Program Specifications (Introduces Outcomes-Based Education for the Implementation of the PSGs)	Area 1: Vision, Mission, Goals, and Objectives	Criterion 1: Programs Educational Objectives
2. CDIO Syllabus Outcomes	Program Specifications (Program Educational Objectives; Institutional and Program Outcomes; Performance Indicator)	Area 1: Vision, Mission, Goals, and Objectives	Criterion 1: Programs Educational Objectives Criterion 2: Student Outcomes
3. Integrated Curriculum	Curriculum (Curriculum Map)	Area 3: Curriculum and Instruction	Criterion 5: Curriculum
4. Introduction to Engineering	Curriculum (Course Syllabus and Course Specifications)	Area 3: Curriculum and Instruction	Criterion 5: Curriculum

5. Design-Build Experiences	Curriculum (Curriculum Delivery)	Area 3: Curriculum and Instruction Area 5: Research Area 6: Extension and Community Involvement	Criterion 5: Curriculum Criterion 8: Program Linkages
6. CDIO Workspaces	Required Resources (Laboratory and Physical Facilities)	Area 7: Library Area 8: Physical Plant and Facilities Area 9: Laboratories	Criterion 6: Program Resources and Learning Environment
7. Integrated Learning Experiences	Curriculum (Curriculum Delivery)	Area 3: Curriculum and Instruction Area 5: Research Area 6: Extension and Community Involvement	Criterion 5: Curriculum Criterion 8: Program Linkages
8. Active Learning	Curriculum (Curriculum Delivery)	Area 3: Curriculum and Instruction Area 5: Research Area 6: Extension and Community Involvement	Criterion 5: Curriculum Criterion 8: Program Linkages
9. Enhancement of Faculty CDIO Skills	Required Resources (Faculty)	Area 2: Faculty Area 10: Administration	Criterion 4: Faculty and Support Staff Criterion 7: Leadership and Institutional Support
10. Enhancement of Faculty Teaching Skills	Required Resources (Faculty)	Area 2: Faculty Area 10: Administration	Criterion 4: Faculty and Support Staff Criterion 7: Leadership and Institutional Support
11. CDIO Skills Assessment	Curriculum (Curriculum Delivery)	Area 3: Curriculum and Instruction	Criterion 5: Curriculum
12. Program Evaluation	Program Specifications (Program Assessment and Evaluation; Continuous Quality Improvement) Compliance of HEIs	Area 3: Curriculum and Instruction	Criterion 5: Curriculum Criterion 9: Continuous Quality Improvement

Standards 1 and 2 are CDIO as the context of engineering programs and CDIO syllabus outcomes, respectively, highlighting outcomes-based education as specified in CHED PSGs.In AACCUP, the VMGO covers all the principles supporting CDIO and engineering programs' established educational objectives and student outcomes per PTC criteria.

Standards 3, 4, and 11 of CDIO are the integrated curriculum, introduction to engineering, and CDIO skills assessment, respectively. These standards supported the standards of CHED under curriculum and AACCUP and PTC requirements on curriculum. Courses on introduction to engineering were incorporated in engineering programs in the first ladder of their 4-year degree program. Assessment methods being used by faculty are included as part of the curriculum of engineering programs.

Standards 5, 7, and 8 are design-build experiences, integrated learning experiences, and active learning, focusing on students' learning experiences. These standards support CHED requirements on curriculum, areas under AACCUP, which are the curriculum and instruction, research and extension, and community involvement, and criteria 5 and 8 of PTC, which are curriculum and program linkages. Design-build experiences are included as part of the curriculum. Students are immersed in various activities such as research, extension, community involvement, and industry linkages.

Standard 6 is CDIO workspaces. This standard focuses on the required resources, such as laboratory and physical facilities, as requirements of CHED. Areas 7, 8, and 9 of AACCUP pertain to this CDIO standard as it addresses the needs of students in terms of library, physical plant and facilities, and laboratories. Criterion 6 of PTC which is Program Resources and Learning Environment, generally covers all the requirements stated in standard 6 of CDIO.

Standards 9 and 10 focused on enhancing faculty CDIO skills and teaching skills. As per CHED requirements on required resources, including faculty, these CDIO standards conformed with CHED standards. Area 2 (faculty) and area 10 (administration) under AACCUP, and criterion 4 (faculty and support staff) and criterion 7 (leadership and institutional support) under PTC generally cover these CDIO standards. The administration's support to faculty through enhancement training is necessary to ensure that faculty are competent enough in their respective fields.

Standard 12 is program evaluation. CHED requires program assessment and evaluation for continuous quality improvement, which addresses this CDIO standard. On AACCUP, program evaluation forms part of area 3 (curriculum and instruction), while on PTC, this is under criterion 5 (curriculum) and criterion 9 (continuous quality improvement).

It is noted that the CDIO standards conform with the various standards/requirements of different accrediting agencies and organizations. This supports that the CDIO Standards and self-evaluation process have provided the foundation for meeting accreditation expectations (Cheah & Leong, 2018). Also, accreditation ensures that engineering programs meet a minimum standard; hence, accreditation criteria are the threshold (Armstrong, Bankel, Gunnarson, Keesee, & Oosthuizen, 2006).

4.2 Current State of Engineering Programs

The CDIO standards self-evaluation is an important process in determining the current status of an educational program in terms of its alignment with CDIO standards. This program evaluation focuses on outcomes, particularly student learning outcomes and student satisfaction, and processes, notably teaching, learning, and assessment in a design-build environment, compared to an explicit set of expectations (Brodeur & Crawley, 2005). The standards and self-evaluation, therefore, provide opportunities to rate current status and plan specific actions for continuous program improvement (Gray, 2011). Table 3 shows the result of the self-evaluation conducted to determine the current state of engineering programs against the CDIO standards.

Table 3. **Self-Evaluation based on CDIO Standards**

Std. No.	Name	Short Description	2017 rating	2020 rating	Status/ Remarks
1	The Context*	Adoption of the principle that product, process, and system lifecycle development and deployment – Conceiving, Designing, Implementing, and Operating – are the contexts for engineering education	1	3	CSPC started the concept of CDIO as the framework in engineering education in 2017. 100% of faculty members had started integrating the various teaching and learning strategies in different courses.
2	Learning Outcomes	Specific, detailed learning outcomes for personal and interpersonal skills, product, process, and system-building skills, as well as disciplinary knowledge, consistent with program goals and validated by program stakeholders.	2	3	Faculty member per program in the college of engineering conducted research/validation of program learning outcomes with key program stakeholders, including faculty, students, alumni, and industry representatives.
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	1	3	Personal, interpersonal, product, process, and system-building skills are incorporated/ integrated into the curriculums.
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	1	4	Introduction/ Orientation to Engineering course was incorporated into the new curriculums. It is now being implemented, and there is documented evidence that students have achieved the intended learning outcomes of the introductory engineering course.

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	3	4	Curriculums of Engineering programs involved courses relevant to the field. They have their respective design-implement experiences. Outputs such as designs and projects show that students have achieved the intended learning outcomes.
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	2	3	Continuous procurement to comply with the Commission on Higher Education (CHED) standards regarding laboratory and other facilities.
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	2	3	Integrating learning experiences are seen through various learning activities such as industry immersion/on-the-job training, out-of-school activities, research/thesis, etc.
8	Active Learning	Teaching and learning based on active, experiential learning methods	2	3	Active learning methods are seen in students as they are immersed in various teaching-learning strategies.
9	Enhancement of Faculty Competence	Actions that enhance faculty competence in personal and interpersonal skills, and product, process, and system-building skills	3	4	Faculty members were sent to various seminars and training relevant to their specializations. Evidence shows that collective faculty is competent in personal, interpersonal, product, process, and system-building skills.
10	Enhancement of Faculty Teaching Competence	Actions that enhance faculty competence in providing integrated learning experiences, using active, experiential learning methods, and assessing student learning	3	4	Engineering faculty members show competence in teaching, learning, and assessment methods. These were shown through students' and supervisors' evaluations of teaching effectiveness.

11	Learning Assessment	Assessment of student learning in personal and interpersonal skills, product, process, and system-building skills, as well as disciplinary knowledge	3	4	Various assessment methods are shown through documents submitted to the Dean's office, such as TOS, rubrics, and others for students' assessment.
12	Program Evaluation	A system that evaluates programs against these twelve standards and provides feedback to students, faculty, and other stakeholders for continuous improvement	1	3	Program evaluation methods are shown through the results of tracer studies on graduates, student satisfaction, and evaluation of stakeholders.

The table shows that the institution's engineering programs significantly improved in most areas. It is found that improvement as rated in 2020 considerably enhanced compared to ratings in 2017 when the CDIO framework was first introduced in engineering programs. Standards 4, 5, 9, 10, and 11 were rated 4. These results confirmed that the engineering program complies with the standards. While standards 1, 2, 3, 6, 7, 8, and 12 were rated 3. These results confirmed that further development and improvement in these standards are sought.

4.3 Recommendation and Plan of Actions

Based on the self-evaluation results, a plan of action was proposed for further improvement in the compliance of engineering programs against CDIO standards, as shown in Table 4.

Table 4. Proposed Plans of Action

CDIO Standards	Proposed Plan of Actions
1. CDIO as Context	- Review the curriculum regularly with stakeholders and make recommendations and adjustments as needed.
2. CDIO Syllabus Outcomes	- Regularly evaluate and review course syllabi to ensure clarity of learning outcomes.
3. Integrated Curriculum	- Introduce more teaching- learning strategies and modes of delivery which can further enhance students' personal and interpersonal skills. - Introduce activities that are multi- disciplinary in nature. - Review the curriculum regularly with stakeholders and make recommendations and adjustments as needed.
4. Introduction to Engineering	- Continue to monitor the understanding of engineering fields to first- year engineering students. - Regularly review the introductory course based on the current trends in engineering, especially with the advent of industry 4.0.
5. Design- Build Experiences	- Introduce more activities in courses to enhance the design-build skills of students further. - Integrate design- thinking skills.
6. CDIO Workspaces	- Seek the administration's support for laboratories, workspaces, and other learning resources to comply with CHED's requirements fully.

7. Integrated Learning Experiences	- Incorporate learning experiences through industry/community immersion and research collaboration.
8. Active Learning	- Expand learning experiences through various teaching-learning modalities such as role- playing, think- pair- share, etc.
9. Enhancement of Faculty CDIO Skills	- Conduct enhancement training on CDIO for faculty members. - Regularly update appropriate skills of faculty members relevant to CDIO and address needs of the industry 4.0.
10. Enhancement of Faculty Teaching Skills	- Conduct training needs analysis. - Identify training opportunities for faculty members to undergo training to enhance teaching skills further and cope with new challenges in engineering education.
11. CDIO Skills Assessment	- Incorporate new assessment methods to newly identified skills based on the current engineering education needs.
12. Program Evaluation	- Conduct regular program evaluations.

5 CONCLUSION

The twelve CDIO standards are a useful framework for quality assurance. It aligns with outcomes-based education as required for higher education institutions. The CDIO standards conform to the various quality assurance mechanisms and standards required by the various accrediting agencies and organizations in the Philippines. The CSPC engineering programs were self-evaluated through documentary analysis and observation on the current status and compliance against the 12 CDIO standards. The self-evaluation results served as the basis for developing a plan of action for continuous improvement of programs per CDIO standards requirements.

6 RECOMMENDATIONS

Continuous evaluation of engineering programs should be conducted to ensure that the curriculums appropriately incorporate the requirements. A curriculum review every year is sought to drive continual improvement efforts. Establishing a concrete model of a CDIO-based quality assurance framework is needed to enhance further the internal quality assurance systems and their effective operation. Support and commitment of administrators, faculty, and staff are key to a successful CDIO implementation and transformation.

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