ALIGNMENT AND MAPPING BETWEEN CDIO STANDARDS AND AUN-QA CRITERIA

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ABSTRACT

The ASEAN University Network-Quality Assurance (AUN-QA) Network, which was initiated since 1998, aims to develop a holistic quality assurance system to raise academic standards and enhance education, research and service among its member universities through the use of its policy and criteria. In rising to the challenges of the ASEAN Community, the AUN-QA Network has to be looking forward to advocating a harmonized framework for quality assurance in higher education within and outside ASEAN. There are 11 criteria which have been developed in the 3rd version of the AUN-QA model for programme level covering three dimensions on quality of input, quality of process and quality of output. This paper will present research and practice on alignment and mapping from CDIO standards as quality toolkits to meet the AUN-QA criteria in the view of outcome-based education (OBE) approach. First, the study outlines an in-depth literature review on the comparison between the AUN-QA criteria and the CDIO standards. Next, the mapping details of the AUN-QA criteria and the CDIO standards according to their alignment are presented. Third, the paper presents the CDIO implementation by The University of Danang - University of Science and Technology (UD-DUT) to fulfil aligned requirements of the AUN-QA assessment at the program level. It is concluded that the implementation of the CDIO framework has demonstrated a positive accelerating OBE implementation and, thus, to meet the AUN-QA expectation. Exploitation of CDIO standards implementation has reformed the UD-DUT educational system to leverage remarkably multi-dimensional quality of the university quality assurance system and study programs. A selected set of good practices on CDIO implementation are recommended for further discussion and possibly usage by the AUN-QA community for AUN-QA assessment effectiveness.

KEYWORDS

Outcome-based education, AUN-QA, Quality Assurance, Quality Assessment, Standards 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12

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INTRODUCTION

As previously reported by European Higher Education Area, the key challenges of opening up higher education, improving teaching and learning quality, and reforming assessment and recognition have remained the same for all countries in the last 20 years. In concerning the Sustainable Development Goals (SDGs) laid forth by the United Nations (UN, 2015), several aspects and targets of the SDG 4 have been addressed with an emphasis on the shifting of focus from content-based education to outcome-based education, and the utilization of learning outcomes to enhance academic quality. The Regional Report of Asia and the Pacific (UNESCO, 2003) has defined quality assurance (QA) in higher education as "systematic management and assessment procedures to monitor the performance of higher education institutions". Higher education quality is a multi-dimensional concept that embodies not only QA procedures, but also accessibility, employability, academic freedom, public responsibility, and higher education mobility. QA processes serve multiple purposes: enhance learning and teaching, build trust among stakeholders throughout the higher education system, and increase regional and international harmonization and comparability (Pham, 2019).

AUN-QA Quality Assurance and Open Issues

ASEAN University Network is a network of universities in ASEAN countries, established to promote higher education cooperation in the ASEAN community. To promote quality assurance within the region's universities, AUN has launched an initiative - AUN Quality Assurance (AUN-QA) sub-network - to assess the quality of higher education according to the ASEAN regional quality assurance framework. The AUN-QA models for higher education comprise strategically QA, systematically QA and functionally QA, and are subjected to both internal and external QA assessments (AUN, 2016). The AUN-QA Framework is redesigned as a transnational quality assurance framework to support the ASEAN Economic Community (ASEAN, 2015) and to promote cross-border mobility for students and faculty members and internationalisation of higher education (AUN, 2017). It is, therefore, developed to be aligned with the ASEAN Quality Assurance Framework (ASEAN, 2013) - a common reference framework, functions as a device to enable comparisons of qualifications across ASEAN member states, Standards and Guidelines for Quality Assurance in the European Higher Education Area (ESG 2015 – Part 1) (EURASHE, 2015) and Baldrige Performance Excellence Framework (Education) (NIST, 2015). This is the way that the AUN raises mutual trust in the quality of training among regional universities as well as with partner universities around the world, step by step contributing to promote recognized academic achievement and develop regional and international cooperation to benefit the ASEAN community.

Outcomes-based education (OBE) and the AUN-QA framework at programme level are principles-based quality assurance frameworks. The AUN-QA criteria at programme level do not focus on any specific disciplinary but focus on assessing the conditions to ensure the quality of a study programme. The obtained AUN-QA assessment results at programme level have shown the most critical issues which may be varied over different programmes in ASEAN countries:

- Programme learning outcomes (PLOs) do not fully reflect the needs of stakeholders (including students, alumni, employers, government, national and international experts, …). These learning outcomes are not specifically designed to be measurable for personal, interpersonal and professional skills of the learners.
- The curriculum has not been designed and developed in constructive alignment with the defined programme learning outcomes.

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- The teaching and learning activities are not properly developed to support student in obtaining learning outcomes, and assessed regularly, objectively during programme execution.
- Less effectively assessment methods and specific rubrics have been established to assess student progress and learning outcomes achievement.
- The professional development programs for academic staff and supporting staff are not standardized to improve and develop the faculty in terms of quantity and quality.
- The lack of policies at institutional and national level to develop an internal quality assurance system leads to challenges in assuring and continuously improving quality of education at programme level.

It is, therefore, important to have quality assurance tools to provide study programmes and higher institutions with a design, implementation, analysis and assessment that identifies strengths and shortcomings to improve quality as well as increase the accountability and commitment of the study programme and higher institution for quality.

CDIO Initiative as Quality Assurance Framework

One of the very first papers presented by Malmqvist (2009) addresses a comparison between CDIO Standards and EUR-ACE standards (ENAEE, 2015). The paper delivered several conclusions in 4 compared areas consisting of CDIO syllabus with EUR-ACE's, CDIO standards and EUR-ACE accreditation requirements, the proficiency levels of the CDIO and EUR-ACE, CDIO rating scale and EUR-ACE threshold value scale. Another research by Crawley (2011) has shown that the 12 CDIO standards meet standards and criteria set by accreditation bodies such as ABET. The adoption of the CDIO Initiative at the School of Engineering which contributed to the recent ABET accreditation of the Diploma in Aerospace and Aeronautical Engineering has been studied in (Wah, 2015). The authors share their experiences in using the 12 CDIO standards as guidelines for course evaluation and a framework for continuous improvement.

In the similar but wider approach, a report by Gray (2011) addresses how the CDIO Council promulgate quality assurance processes to assure internal and external stakeholders that member institutions and programs are adhering to the 12 CDIO standards. The five QA processes which have been developed by the CDIO Council begin with the application to become a CDIO Collaborator and include self-evaluation based on the CDIO Standards. The Diploma in Chemical Engineering program (Cheah, 2013) has shared the successful approach of "aligning its CDIO implementation and self-evaluation process to the institution's quality management systems and holistic education framework, as well as the requirement spelt out by the Institution of Chemical Engineers, UK. The CDIO initiative have been asking institutions and programmes to do a self-evaluation to support the continued improvement of the CDIO implementation at the institution/programme. The way forward selected was to make a self-evaluation concept, where an institution or a study programme could self-evaluate how well it was doing on a six-point scale (Bennedsen, 2014). Malmqvist (2015) has also conducted surveys of CDIO implementation and effects on educational quality. This projects aim to evaluate the effects on outcomes, the perceived benefits, the limitations, any barriers to implementation, and ascertain future development needs.

In the research by Aburatani (2019), NIT's Model Core Curriculum (MCC) is compared to the CDIO standard and syllabus to clarify the similarity and difference between NIT's KOSEN education and the CDIO initiative: "It is shown that the MCC well covers and matches with most of the items in CDIO standard and syllabus". Recently, the CDIO framework is integrated

as an important part of the new quality assurance system within the Faculty of Science and Engineering at Linköping University (Gunnarsson et al., 2019). As presented, the course matrices and program matrices are built upon an adapted and extended version of the CDIO Syllabus. Besides, the CDIO standards are used in the quality reports.

This paper will present a research and practice on alignment from CDIO standards as quality tools to meet the AUN-QA criteria in the view of outcome-based education (OBE) approach.

COMPARISON OF THE CDIO STANDARDS AND THE AUN-QA CRITERIA

AUN-QA Model at Programme Level

The quality assessment evaluates the operation of the institution or programme to determine whether it meets the agreed-upon or predetermined standards. Quality assessment has two main purposes: (i) To assess a study programme or institution to determine if it meets quality standards and (ii) To support and promote study programmes and institutions for continuous improvement of quality. The 3rd version of the AUN-QA model at programme level (Figure 1) is structured with different groups of QA factors named as input QA, process QA and output QA which follow a closed cycle of Plan-Do-Check-Act (PDCA) to continuously improve and gradually improve the quality of training.
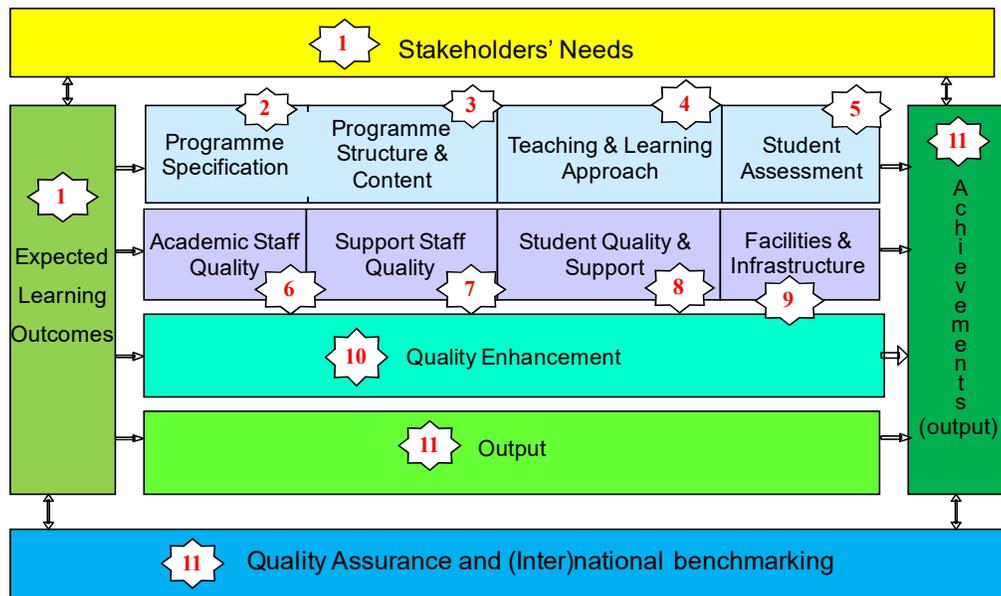
Figure 1. The AUN-QA criteria with 11 criteria and 50 sub-criteria

Mapping between AUN-QA criteria and CDIO standards

Throughout the world, CDIO Initiative collaborators have adopted CDIO as the framework of their curricular design and outcome-based assessment. In general, this framework overlaps with the AUN-QA framework as they both reply on outcome-based education principle. This section presents a comparison of the AUN-QA criteria and CDIO standards in terms of quality assurance system framework. The below study results show a strong correlation between the CDIO standards and the AUN-QA criteria.

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The CDIO Standards vs. AUN-QA Criteria

The AUN-QA model (AUN, 2015) starts with the input QA process consisting of expected learning outcomes (criterion 1), programme specification (criterion 2) and programme structure and content (criterion 3) which closely match to the CDIO syllabus (standard 2) and integrated curriculum (standard 3). Teaching and learning approach (criterion 4) and student assessment (criterion 5) are reflected in the integrated learning experiences (standard 7), active learning (standard 8) and learning assessment (standard 11). Correlation between the standards and the criteria is visually depicted in Table 1.

Table 1. Correlation between CDIO Standards 2.0 and AUN-QA Criteria 3.0

CDIO Standards 2.0	AUN-QA Criteria 3.0										
	1	2	3	4	5	6	7	8	9	10	11
1. The Context*	1.3			4.1							
2. Learning Outcomes*	1	2.2								10.1	
3. Integrated Curriculum*		2.1 2.2	3							10.2	
4. Introduction to Engineering	1.3	2.2	3.3								
5. Design-Implement Experiences*			3.2					8.4			
6. Engineering Workspaces									9		
7. Integrated Learning Experiences*	1.2		3.2 3.3	4.2							
8. Active Learning				4				8.5			
9. Enhancement of Faculty Competences*						6.4 6.5					
10. Enhancement of Faculty Teaching Competences						6.4 6.5	7.3 7.4				
11. Learning Assessment*		2.2			5						
12. Program Evaluation								8.3		10	11
Shading Explanation	Correlation with one or several sub-criteria					Correlation with whole criterion					
AUN-QA Criteria 3.0	1. Expected Learning Outcomes; 2. Programme Specification; 3. Programme Structure and Content; 4. Teaching and Learning Approach; 5. Student Assessment; 6. Academic Staff Quality; 7. Support Staff Quality; 8. Student Quality and Support; 9. Facilities and Infrastructure; 10. Quality Enhancement; 11. Outputs										

A focused mapping within the input QA process will be analyzed in the next CDIO syllabus and constructive alignment sub-section. Besides, it is noticed that the sub-criterion 3.3 which requires the logical, ordered curriculum structure shows the need delivering the "introduction to engineering" course that provides the framework for engineering practice in product, process, and system building, and introduces essential personal and interpersonal skills (standard 4). The sub-criterion 3.2 which emphasizes on "the contribution made by each course to achieve the expected learning outcomes" requests a sequenced and integrated Design and Build projects over semesters should be designed to support a student in obtaining these specific expected learning outcomes (standard 5).

The setting of the education, the skills we teach, and the attitudes we convey should all indicate that conceiving-designing-implementing-operating is the authentic role of engineers in their service to society (standard 1). This context is considered as a specific educational philosophy for engineering school which should be well-articulated and communicated to all stakeholders in sub-criterion 4.1. The engineering workspace is specifically required through five sub-criteria

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of the criterion 9 which matches to the standard 6. The provision of facilities, infrastructure, learning resources should be in line with the objectives of the programme to support education and research. Facilities are also connected to the teaching and learning approach (criteria 4).

The sub-criteria 6.4 and 6.5 emphasize on the quality of the academic staff which encompasses qualification, subject matter expertise, experience, teaching skills and professional ethics. Competences of support staff which are articulated in the sub-criteria 7.3 and 7.4 are identified and evaluated to ensure that their competencies remain relevant and the services provided by them satisfy the stakeholders' needs. The CDIO standards 9 and 10 provide support for the collective engineering faculty to improve its competence in the personal and interpersonal skills, and product, process, and system building skills. Besides, there is a strong need of providing support for faculty to improve their competences in integrated, active and experiential learning experiences, and student learning assessment.

A key function of program evaluation (standard 12) is to determine the program's effectiveness and efficiency in reaching its intended goals. Evidence collected during the program evaluation process also serves as the basis of continuous program improvement. Similarly, the criterion 10 requires the continuous search for improvement and best practices including all aspects of the AUN-QA criteria from 1 to 9. Criterion 11 focuses on evaluating the quality of output and its graduates. There should be a system to collect evidences and measure stakeholders' satisfaction. The information collected should be analyzed and benchmarked for making improvements to the programme, quality practices and quality assurance system.

The CDIO Syllabus vs. AUN-QA Requirements on Expected Learning Outcomes

The CDIO Syllabus (standard 2) has played a key role in the design of curriculum, teaching, and assessment in engineering education. In the curriculum and instructional design process, the CDIO Syllabus was adapted to diverse engineering programs to ensure that expected learning outcomes (ELOs) were aligned with institutional mission and vision, program objectives (Crawley et al., 2011). The CDIO Syllabus is therefore well aligned with the criterion 1 requiring the ELOs are formulated from the needs of stakeholders, engineering professional bodies, form the starting point of the programme design. The ELOs formulation must take into account and reflects the vision and mission of the institution, the goals, objectives of the programme (sub-criterion 10.1). Also, the current CDO syllabus support the ELOs structure required in the sub-criterion 1.2. The ELOs should cover both subject-specific outcomes that relate to the knowledge and hard skills of the subject discipline; and generic outcomes that relate to transferable skills which may cover personal skills, interpersonal skills, and product, process, and system building skills in enterprise, business, and societal contexts. In the instructional design process at the course level, the ELOs are used as a starting point for defining learning outcomes at the course level. This coincides with requirement on sub-criterion 1.1 which each course and lesson should be designed to achieve its expected learning outcomes which should be aligned to the programme ELOs.

Constructive Alignment in the CDIO Standards and AUN-QA Criteria

The integrated curriculum is critically required by the criterion 3 where the curriculum, teaching and learning methods and student assessment are constructively aligned to achieve the ELOs. As defined by the AUN-QA, "constructive" refers to the concept that students construct meaning through relevant learning activities; and "alignment" refers to the situation when teaching and learning activities and student assessment are aligned to achieve the expected learning outcomes. The sub-criteria 2.1 and 2.2 mention about a programme specification that

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helps students to understand the teaching and learning methods that enable the outcome to be achieved; the assessment methods that enable achievement to be demonstrated; and the relationship of the programme and its study elements. The curriculum design and development process that ensures the above constructive alignment must be established and periodically reviewed, evaluated as requested in the sub-criterion 10.2. All of these AUN-QA standards could be fulfilled by applying the standard 3 requiring exactly that disciplinary courses are mutually supporting when they make explicit connections among related and supporting content and ELOs. An explicit plan identifies ways in which the integration of skills and multidisciplinary connections are to be made.

Active learning (standard 8) is a key matching to the criterion 4. Quality learning is understood as involving the active construction of meaning by the student, and not just something that is imparted by the teacher. This process helps to increase students' motivation to achieve program ELOs and form lifelong learning skills which is also defined clearly in the sub-criterion 4.3. The sub-criterion 8.5 also promotes an establishment of constructive learning environments to support the achievement of quality student learning covering a physical, social and psychological environment that is conducive for education and research as well as personal well-being. Besides, integrated learning experiences (standard 7) are pedagogical approaches that meet the sub-criteria 1.2, 3.2, 3.3 and 4.2. The AUN-QA framework requires an appropriate curriculum design embedding all learning outcomes and corresponding pedagogical approaches that make dual use of student learning time that helps students to apply disciplinary knowledge to engineering practise and better prepare them to meet the demands of the engineering profession.

Assessment of student learning (standard 11) is the measure of the extent to which each student achieves specified learning outcomes. In the same manner, criterion 5 strongly articulates assessment types at admission, course study and exit test before graduation. It is therefore important that assessment is carried out professionally at all times and provides valuable information for institutions about the efficiency of teaching and learner support. In fostering constructive alignment, a variety of assessment methods should be adopted and be congruent with the expected learning outcomes. They should measure the achievement of all the expected learning outcomes of the programme and its courses.

The CDIO Self-Evaluation Model vs. AUN-QA Quality Assessment Process

The CDIO initiative provides a self-evaluation model to analyze the CDIO adoption level concerning 12 standards. This quality self-evaluation process could be organized around a Plan-Do-Check-Act (PDCA) cycle with the CDIO components in relevant phases as demonstrated in Enelund, (2008) and repeated in Malmqvist (2009). The determination of a program's progress towards fulfilment of the CDIO standards is accomplished through self-evaluation. The fulfilment of each standard is measured by a six-level scale, which is used to rate the progress towards the planning, implementation and adoption of each CDIO standard. The rubrics of the six-level scale are stated in Table 2.

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Table 2. CDIO standards self-evaluation general rating scale

Scale	Criteria
5	Evidence related to the standard is regularly reviewed and used to make improvements.
4	There is documented evidence of the full implementation and impact of the standard 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 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.

The AUN-QA quality assessment aims to determine if the institution, system or programme meets generally accepted quality standards. The AUN-QA self-assessment serves as preparation for a site visit by external experts and the self-assessment report (SAR) provides the external experts with the basic information about the institution, programme and quality assurance system (AUN, 2015). It also provides an opportunity for the institution and its staff to discover the quality of its quality assurance system. The approach for preparing SAR which encompasses the Plan-Do-Check-Act (PDCA) cycle. The PDCA is also adopted for quality assessment at the programme level, as well as for both the institutional level and IQA system.

All programmes are evaluated against the one set of 11 criteria. The results of an evaluation fall upon a scale between one and seven. As being shown in Table 3, the rating for each criterion ranged from Level 1 - not meeting the criterion to Level 7 - excellent performance, the typical model of the world. Overall scores above a four allow recognition as completing the AUN-QA program assessment.

Table 3. The 7-point rating scale of the AUN-QA standards

Rating	Description
1	Absolutely Inadequate
2	Inadequate and Improvement is Necessary
3	Inadequate but Minor Improvement Will Make It Adequate
4	Adequate as Expected
5	Better Than Adequate
6	Example of Best Practices
7	Excellent (Example of World-class or Leading Practices)

CDIO STANDARDS IMPLEMENTATION AT UD-DUT

The Certified AUN-QA – CDIO Programmes

UD-DUT has continuously implemented the CDIO approach to improve its education quality and adapt social needs as well as international integration by the following strategic actions:

- Systemic change: Regulations for updating expected learning outcomes and re-designing curriculum in accordance to CDIO Standards has been issued in 2016 and applied to all engineering and technology programmes since 2017.
- Implementation tools: Detailed procedures, templates and rubrics have been developed subjecting to programme self-assessment and development following

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outcome-based curriculum, outcome-based teaching and learning, outcome-based assessment, and outcome-based program evaluation.
- Quality culture establishment: CDIO context has been gradually built up based on the strong leadership commitment, professional attitude and skills of managers and volunteering efforts by academic staff in transforming all study programmes.
- There were a total of 9 study programmes certified with the AUN-QA quality standard as a consequence. There are 8 more programmes completed the self-assessment process. The university is now preparing for the AUN-QA Institutional quality assessment.

Good Practices on CDIO Implementation

Enhancement of Faculty Competences and Teaching Competences

A CDIO framework project had been launched between UD-DUT and Singapore Polytechnic in 2016 (DUT, 2016). This 3-year project aims to share the CDIO Framework to educate the students to become effective modern engineers as well as skilled workforces in various areas. The programme outputs and outcomes have been met as follows (Lee, 2017):

- Increased capability and capacity: There are 160 participants from 6 state university members of UD trained with new knowledge in the context of CDIO real-world systems and products. Some 70 of them have been further trained to form the specialists' team to incorporate the skills of conceiving, designing, implementing innovative user-centred solutions in engineering curricular. Some 20 of these specialists, had been carefully selected to undergo deeply training to become Master Trainers who can design and develop customized training programme.

Experiential Learning

Integrated learning experiences standard has been fully implemented at UD-DUT through the Learning Express (LeX) programme in collaborating with SPI. This is a multi-national, multi-cultural and multi-disciplinary program addressing local complex problems in complex settings (SPI, 2015). Students are required to apply cognitive and physical skills, use Design Thinking into solving a given issue. The programme outcomes have been met as follows:

- Implemented LeX: There are 5 LeX cohorts organized at UD-DUT since 2016 up to now. Many students from UD-DUT and SP had visited different villages in the countryside in Central region of Vietnam, interacted with local citizens to define problems.
- Impacts: The program helps students themselves to build their mindset in nurturing a sense of purpose and social innovation to sustainable development of society in ASEAN countries AUN-QA Program Assessment benefits

The Green Challenge

Design and build standard has been applied successfully at UD-DUT through "The Green Challenge" project launched by Bosch Vietnam together with some universities. The students were asked to develop a system to manage and operate a fleet of electrically powered and connected two-wheelers. The system had to be environmentally friendly and meet the technical requirements set by Bosch. The programme outcomes have been met as follows:

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- Project product: Students from various majors had worked in a team at UD-DUT, and together with other teams at other universities did a research to propose a shared usage model which best fit in the technical, environmental and economical outcomes.
- Social and technology outcomes: Students did learn and experience of doing research and business development which help enhance the competitiveness, build up a knowledge economy, and offer a smart and eco-friendly alternative to the community.

KEY LEARNING POINTS AND RECOMMENDATIONS

This part shares key learning points on the adaptation of CDIO Standards in building quality assurance framework and preparing for AUN-QA quality assessment at programme level.

One common experience shared by all CDIO programmes is that the programme's quality is continuously enhanced subjecting to the AUN-QA quality criteria. The CDIO self-evaluation process with the six-level rating scale support well the AUN-QA self-assessment report and the external quality assurance assessment using the 7-point rating scale. The C-D-I-O cycle pairs with the P-D-C-A cycle of the AUN-QA quality assurance framework which is useful for continuous quality improvement goal.

In the learning outcome development process, the CDIO syllabus provides a powerful framework for benchmarking outcomes covering personal skills, interpersonal skills, and product, process, and system building skills in enterprise, business, and societal contexts. However, there must be a clear procedure of re-designing learning outcomes to adopt properly stakeholder's needs in disciplinary knowledge, to omit a few of the personal, interpersonal, and CDIO skills found in the CDIO syllabus, or to add a few to emphasize specific demands of employers, requirements of national standards, national and regional qualification framework, and values of its institution.

In the curriculum and instructional development process, the curriculum is designed to meet the ELOs where the contribution made by each course in achieving the programme's ELOs is clear. Specifically, there is a critical need for designing a mapping matrix of the specified learning outcomes to courses and co-curricular activities that make up the curriculum.

Integrated learning experiences are pedagogical approaches that foster the learning of disciplinary knowledge simultaneously with personal and interpersonal skills, and product, process, and system building skills. It is important not only to have an appropriate curriculum design embedding all learning outcomes and corresponding pedagogical approaches but also the constructive learning assessment methods with relevant rubrics to measure achievement of the expected learning outcomes at the programme and courses level.

The quality assurance and enhancement of the programmes and institution won't be effectively achieved without well-trained faculties. The challenges faced by most faculties at an institution is to first understand the CDIO framework and how to implement the framework. It is, thus, so important to maximize resources for staff professional training on education quality assurance; strengthen the capacity of administrative staff in terms of quality assurance; promulgate mechanisms to recognize quality achievement by staff, programmes and units inside and outside higher institution.

An important learning point is that, due to the lack of policies on quality assurance and quality assessment, implementation of CDIO standards normally will not be carried out synchronously

by different administrative departments and faculties. There must be a need of establishing a concrete model of CDIO-based quality assurance framework subjecting to enhancement of internal quality assurance system and its effective operation. Also, CDIO context should be carried out as a commitment of leaders, administrative staff and faculty managers. It is a key point of successful CDIO implementation and transformation.

CONCLUSIONS

The twelve CDIO standards serve as a useful framework for quality assurance and quality assessment at the programme/ institutional level. The CDIO standards show very good alignment with other outcomes-based higher education frameworks developed by regional and international quality assessment and accreditation bodies. It is systematically recognized that there is a strong alignment between CDIO Standards and AUN-QA Criteria. It was found to be more comprehensive and more detailed for engineering and technology education.

Exploitation of the CDIO standards and their tools to design, implement, monitor and evaluate programmes and courses subjecting to the AUN-QA criteria requirements has been proven to be an effective approach. It helps to collect different types of information needed for continuous quality improvement and external quality assessment purposes.

While CDIO framework plays a key role in meeting the AUN-QA criteria, the success of the external AUN-QA quality assessment should be mainly reserved to the strategic effort of consistently adopting the CDIO standards into institution quality assurance framework. Moving forward, institutional quality development and assessment using the CDIO standards as self-evaluation tools will further strengthen the internal quality assurance system for building a quality culture of the university.

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BIOGRAPHICAL INFORMATION

Tuan Van Pham had been designated to Vice-Chair of Electronic and Telecommunication Engineering Faculty, DUT in 2010-2014; Deputy Director, Center of Excellence, DUT in 2011 - 2018. He has been appointed to Director of Educational Testing & Quality Assurance Department, DUT since 2014. Tuan has been certified as Vietnam Educational Quality Assessor since 2016 and then AUN-QA Assessor since 2017. Tuan was DUT Project Manager of HEEAP Program (Higher Engineering Education Alliance) in 2010 – 2018, VULII Program (Vocational and University Leadership and Innovation Institute) in 2012 – 2016, BUILD-IT Program (Building University-Industry Learning and Development through Innovation and Technology) in 2016 – 2020; UD-DUT Project Leader for CDIO framework project at UD-DUT in 2016-2019.

Anh Thu Thi Nguyen got her doctoral degree at The Catholic University of America, USA in 201. She is currently the Vice-dean of the Faculty of Advanced Science and Technology at DUT, UD, where CDIO-based innovation projects are actively applied. Anh Thu is also a vice-director of the Danang International Institute of Technology, UD conducting studies in IoT, AI engineering solutions for smart city, health care, etc. Loving creativity and high quality of education, from 2016 she has also joined Fablab Danang (one of 600 Fablabs over the world established by MIT) as a Senior vice-president and focusing on academic leading of innovation projects in STEAM (STEM+Art) for K-12 students and community and has founded L.Y.D.I.N.C Ltd. company with LYD3D brand for 3D printing development and LYDEdu brand for consultancy in Quality Assurance on STEAM Education.

Hong Hai Nguyen received Dr Technical Degree in Civil Engineering from the University of Nantes (France) in 2012. During the thesis, he was granted with a Temporary Lecturer and Research Assistant position at University Institut of Technology of Saint-Nazaire – The University of Nantes in 2011 - 2012. Hai has been promoted to Associate Professor at UD-DUT since 2017. He has been designated to Dean of Road & Bridge Engineering Faculty, DUT in 2013-2018 and appointed to Director of Academic Affairs Department, DUT since 2018. He is a member of the Scientific and Training Council, DUT in 2017-2022. From 2018, Hai was one of the DUT leading members for CDIO Outcomes-based Curriculum Training and Development project.

Minh Duc Phan finished his PhD degree in Mechanical Engineering at Chulalongkorn University, Thailand in 2007. Before being the Director of Academic Affairs Department in March 2010, he had taken Senior Lecturer at Transportation Mechanical Engineering Faculty of DUT. Dr Duc has actively participated in many HEEAP, VULII and BUILD-IT activities, particularly in teaching and learning, quality assurance, and leadership. Since 2018, Duc has been promoted to Vice-Rector in charge of Education and Quality Assurance at UD-DUT

Tan Kay Chuan is Expert trainer for ASEAN universities in Training Courses for Accomplishing Programme and Institutional Assessment, and Training Courses to be Assessors, 2010 – present; Key author in producing the AUN-QA Guide to Actual Quality Assessment at Programme Level, Versions 2.0, 3.0, and 4.0, June 2011 onwards; AUN-QA Council Member, February 2013 – January 2015; Chief Quality Officer representative from the National University of Singapore to the ASEAN University Network-Quality Assurance (AUN-QA) program, 2007 – present.

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