CREATING AND DEPLOYING AN ELECTRONIC ENGINEERING MASTER PROGRAM BASED ON CDIO FRAMEWORK

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ABSTRACT

Electronic engineering is an indispensable major for development in the Industry 4.0 era. The demand for human resources in this industry is increasing to meet the progressive requirements in smart systems for not only the world but also Vietnam. The graduate level of Electronic Engineering has been playing an important role in creating highly qualified human resources to meet the creative requirements in this Industry 4.0 era. Faculty of Electrical and Electronic Engineering (FEEE), Duy Tan University (DTU) has been developed and deploying a master's degree education program in electronic engineering based on the requirements of meeting human resources for Industry 4.0. At the same time, to ensure the effectiveness, we have built this education program based on the CDIO framework with its outcomes that closely follow the output standards of CDIO. This curriculum consists of 45 credits for 3 semesters with 12 courses that help learners to have the ability to conceive, design, implement and evaluate project results and/or products in the field of electronic engineering. These works are very necessary in doing research, developing, manufacturing smart systems, and operating in industrial production line which must consider the impact of engineering solutions in global, economic, environmental, safe, sustainable and societal contexts. In addition, the results of student's thesis are requested to present at the scientific conference of Duy Tan university to show their contribution. To evaluate the effectiveness of the training program implemented at Duy Tan University, in addition to assess its outcomes, we also base on the CDIO framework evaluation criteria, especially the evaluation of employers. The evaluation results have shown that the training program meets the requirements of human resource training for Industry 4.0.

KEYWORDS

CDIO framework, Industrial 4.0, Electronic Engineering, Master Degree, Education Program, Standards: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12.

INTRODUCTION

The Industry 4.0 concept was introduced in 2011 in Germany to enhance traditional industries' competition. It quickly became a strategic program in many developed countries, including the US, France, Korea, and China. Industry 4.0 has since spread worldwide, driven by significant developments in AI, intelligent machines, VR systems, 3D printing, IoT, biotechnology, and nanotechnology. This revolution is considered the most significant step forward since the advent of computers and the Internet. Combining big data analytics, cloud computing, and IoT will drive innovative development, and AI and cybernetics will enable remote control and faster, more accurate interaction. Industry 4.0 could fundamentally change the way people live, work, and interact with each other, promoting labor productivity, raising income levels, and improving quality of life.

However, the article (Erik Brynjolfsson & Andrew McAfee, 2014) has shown that this revolution could bring about greater inequality, especially the potential to disrupt the labor market. Many traditional business models in different fields are in danger of being overturned when automated lines and robots replace too many jobs done by humans. A report at the World Economic Forum shows that companies expect to restructure their workforces in response to new technologies. In particular, surveyed companies indicated that they are also looking to transform components in their value chain (55%), further automate, reduce existing workforce (43%) or workforce expansion as a result of deeper technology integration (34%), and expanding use of contractors for specialized jobs (41%). A similar study by the International Labor Organization also predicts that, in the next two decades, about 56% of low-skilled workers in five Southeast Asian countries, including Vietnam, are at risk of losing their jobs to robots (International Labour Office, 2018). More specifically, 86% of workers in the textile industry and 75% of workers in the electrical-electronic industry in Vietnam are at risk of losing their jobs due to automation (Jae-Hee Chang & Phu Huynh, 2016). Many studies at https://www.skillsdevelopmentscotland.co.uk/ have shown that the workforce is low- or medium-skill, working in low-productivity, low-wage jobs, with poor working conditions (e.g., assembly line workers, manual laborers, etc.) will be the most affected.

Industrial 4.0 raises concerns about unemployment as machines take on more tasks, but some researchers argue that reducing total employment is unlikely. Hyper-automation and hyper-connectivity can enhance productivity in existing jobs and create demand for new ones. Developed countries with a higher-quality workforce are expected to see declining unemployment rates and fewer workers in vulnerable sectors. However, high-quality jobs require a more educated workforce with advanced skill sets, challenging many developing countries like Vietnam. Education 4.0 is the future of general and higher education, emphasizing learner-centered, peer-to-peer, and project-based learning, flexibility in time and place, and real-world experience. Catching up with this educational trend will ensure quality human resources for the future. Accordingly, Duy Tan University is implementing the Education 4.0 model, becoming a leader in education reform in Vietnam (Truong V Truong et al., 2019) (Binh D Ha, 2019). The Faculty of Electrical and Electronic Engineering at DTU has developed a master's degree program in electronic engineering to meet human resource requirements for Industry 4.0.

ELECTRONIC ENGINEERING MASTER PROGRAM BASED ON CDIO FRAMEWORK DESCRIPTIONS

In this section, we will detail the application of the CDIO framework in the master's program in electronic engineering at FEEE. By sticking to CDIO standards 3.0 (Malmqvist et al., 2020), we build the program according to 12 standards, specifically as follows.

Standard 1: The Context

The Electronic Engineering (EE) master program at DTU serves the socio-economic needs of Central and Highlands Vietnam in the context of Industry 4.0. It is offered in traditional lecture and laboratory formats, occasionally with evening courses. E-learning resources are widely used in a blended mode to support the program, built based on the CDIO framework with 45 credits and 12 courses. Students complete a graduation project, and internships are optional. The program is designed for completion within 1.5 years, and its outcomes closely follow the standards of CDIO. The Program Educational Objectives (PEO) of the program are focused on career and professional achievements for graduates are as follows:

- PEO 1. Excel in individual and teamwork efforts for the development of electronic engineering solutions for local and global problems.
- PEO 2. Become successfully employed in the electronic engineering industry or related areas.

- PEO 3. Expand knowledge and capabilities through continuing education or advanced graduate study or other life-long learning experiences.
- PEO 4. Serve their communities either locally, nationally, or globally.

Standard 2: Leaning Outcomes

The EE master program at DTU's FEEE utilizes the EAC criteria of Learning Outcomes (LOs) to define specific statements that outline the knowledge and skills students should acquire by graduation from the program.The LOs of this program are as follows:

- LO 1. an ability to identify, formulate, and solve complex engineering problems by applying principles of electronic engineering, science, and mathematics.
- LO 2. an ability to apply electronic engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
- LO 3. an ability to communicate effectively with a range of audiences.
- LO 4. an ability to recognize ethical and professional responsibilities in electronic engineering situations and make informed judgments, which must consider the impact of electronic engineering solutions in global, economic, environmental, and societal contexts.
- LO 5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
- LO 6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use electronic engineering judgment to draw conclusions.
- LO 7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Based on the LOs, more detailed Performance Indicators (PIs) were identified in Table 1.

Table 1. Learning Outcomes and corresponding Performance Indicators

Learning Outcome	Performance Indicator
1. an ability to identify, formulate, and solve complex engineering problems by applying principles of electronic engineering, science, and mathematics	1.1 Ability to identify a complex engineering problem by using scientific principles.
	1.2 Ability to develop a hardware/software/math model for a complex engineering problem.
	1.3 Ability to solve a complex engineering problem using mathematics, science and/or electronic engineering principles.
	1.4 Ability to assess the performance of a solution to a complex engineering problem.
2. an ability to apply electronic engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	2.1 Ability to recognize and distinguish important real-world constraints for a particular design or design component.
	2.2 Ability to translate practical quantitative constraints to appropriate design parameters.
	2.3 Ability to implement a design and verify that it meets the specified constraints.
	3.1 Ability to use effective oral and body language with various audiences.

3. an ability to communicate effectively with a range of audiences	3.2 Ability to prepare a well-planned and well-organized oral presentation or written report for various audiences.
	3.3 Ability to use effective electronic communication.
4. an ability to recognize ethical and professional responsibilities in electronic engineering situations and make informed judgments, which must consider the impact of electronic engineering solutions in global, economic, environmental, and societal contexts	4.1 Ability to describe ethical and professional responsibilities in the job.
	4.2 Ability to evaluate the ethical dimensions of a problem in the discipline.
	4.3 Ability to realize social values as well as environmental, economic and global impacts of an engineering design to make informed decisions or judgments.
	4.4 Ability to identify global, economic, environmental, and societal trends in related industries.
5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	5.1 Ability to perform individual tasks in a timely manner in conjunction with the team plans and schedules.
	5.2 Ability to integrate input from team members and to make decisions that meet predefined criteria and planned tasks.
	5.3 Ability to create an environment for team members to effectively participate and collaborate in team activities to meet objectives.
6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	6.1 Ability to set up an experiment using readily-available components, tools, and test equipment for the right design parameter measurement.
	6.2 Ability to find errors and adjust experimental data and setups.
	6.3 Ability to analyze and interpret experimental data, features, and outcomes.
	6.4 Ability to use engineering judgment for the purpose of modeling, prediction, or conclusion.
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies	7.1 Ability to identify relevant information and additional knowledge for a certain design solution.
	7.2 Ability to select modern and appropriate tools and techniques for a specific engineering task and to compare results from alternative approaches.
	7.3 Ability to independently select the right learning strategy for a certain project or study.

Standard 3: Integrated Curriculum

The EE master program requires the completion of 45 credit hours, which can be completed in 3 semesters or 1.5 academic years. The curriculum breaks down the courses into three categories of (1) General Education (GE) courses, (2) Fundamental (F) courses, and (3) and Advanced (A) Engineering courses as Table 2. The courses developed in the approach of CDIO 3.0 allows us to build and practice a set of necessary skills for learners, ensuring to meet new requirements in Industry. 4.0. Our target audience is quite diverse, from recent electrical and electronic engineering graduates, technical staff at enterprises, or researchers and teaching assistants at universities.

Table 2. Curriculum of Electronic Engineering

Course (Department, Number, Title)		Course is Required, Elective or a Selected Elective.	Subject Area (Credit Hours)		
			General Education	Fundamental	Advanced
PHY 550	Philosophy	R	3		
PHY 600	Scientific Research Methods	R	2		
CR 651	Advanced Computer Architecture	R		3	
EE 603	Information and Coding Theory	R		3	
EE 608	Random Signal Processing	R		3	
CR 686	VLSI Design	R		3	
EE 684	Digital Communications	R		3	
EE 682	Wireless Communications	E			3
CS 677	Encryption and Network Security	E			3
EE 702	Analog IC Design	E			3
EE 743	Fast Logic Technique	E			3
CS 715	Image Processing and Multimedia Technique	E			3
EE 723	Microwave Circuits	E			3
EE 725	Optimization Methods and Applications	E			3
EE 735	Mobile Communications	E			3
CR 733	Embedded System Design	E			3
EE 754	DSP Designs and Applications	E			3
EE 745	CDIO Project 1	SE			1
EE 746	CDIO Project 2	SE			1
EE 747	CDIO Project 3	SE			1
EE 749	Graduation Thesis	R			15

Table 3 describes the PIs covered by the subject combinations. It is not challenging to see that almost subjects complement the master student's Cognitive Analytics Abilities and Complex Problem Solving Skills, namely Cognitive Flexibility, Creativity, Logical Reasoning, Problem Sensitivity, Mathematical Reasoning, and Visualization (LO 1). Meanwhile, the subjects PHY 550, PHY 600, CR 651, EE 684, EE 686, EE 725, EE 745, and EE 749 help learners perfect Resource Management Skills, such as Managing financial resources & material resources, People management, Time management (LO 2). Some subjects are implemented in the form of discussion, presentation, and information exchange for students to achieve Content Skills (Oral expression, Reading comprehension, Written expression, and Social Skills (Persuasion) (LO 3). We cover ethical and professional responsibilities in EE situations in subjects PHI 550, EE 686, EE 745, and especially in EE 749 - Graduation Thesis (LO 4). Teamwork and leadership ability allows learners to gain Social Skills in Coordinating with others, Negotiation, and Training & teaching others (LO 5). The subjects CR 651, EE 754, EE 745, and EE 749 ensure Technical Skills such as Equipment maintenance, Programming, and Troubleshooting; and the ability to work with data such as analyzing data and information obtained from machines, understanding visual data output (LO 6). Finally, we must emphasize that students practice skills to choose appropriate learning methods and keep the lifelong learning mindset in mind (LO 7).

We built three CDIO projects to summarize the knowledge of the learning process before implementing the graduation thesis, including circuit design and fabrication (CDIO Project 1), optimal circuit design (CDIO Project 2), and wireless network design (CDIO Project 3). CDIO Project 1 draws on knowledge from EE 743, EE 723, CR 733, and EE 754, while CDIO Project 2 is supported by knowledge from CR 651, EE 684, EE 725, and CR 686. Similarly, CDIO Project 3 is supported by knowledge from EE 603, EE 682, EE 735, and EE 608. These areas of knowledge are suitable for meeting practical requirements in the Central and Highlands regions of Vietnam. Moreover, the program aims to instill the spirit and skills of CDIO in its students, which will contribute to improving the quality of their output.

Students can choose one of two directions to implement the research or application-oriented CDIO project. For research orientation, the outcome of the course is usually an academic paper, suitable for those who wish to continue their higher level of study or work as a senior technical advisor. We often create an online forum monthly moderated by experienced engineers and educators so students can discuss CDIO-related topics and share their experiences, and expand networking opportunities. For application orientation, the output is usually a technical report or a complete prototype design. This orientation is often chosen by students from the business that we refer to as "Kinesthetic learners." They always have technical issues that need to be solved. We provide hands-on activities for them, such as lab work, advanced simulation, and prototyping, combined with self-study hours from online resources.

Table 3. Mapping of essential Courses of EE program and Performance Indicators (PIs)

PIs	Courses Alignment to Performance Indicators (PIs)											
	PHI 550	PHI 600	CR 651	EE 603	EE 608	EE 684	EE 686	EE 723	EE 725	EE 754	EE 745	EE 749
1.1		X	X	X	X				X	X	X	X
1.2		X			X		X	X	X		X	X
1.3		X		X		X			X	X	X	X
1.4		X							X		X	X
2.1	X	X					X		X		X	X
2.2			X			X	X				X	X
2.3			X			X	X				X	X
3.1		X						X			X	X
3.2		X						X			X	X
3.3		X						X			X	X
4.1	X							X			X	X
4.2	X							X			X	X
4.3	X							X			X	X
4.4		X						X			X	X
5.1							X	X			X	
5.2											X	
5.3							X				X	
6.1			X				X			X	X	X

6.2			X								X	X
6.3			X							X	X	X
6.4			X								X	X
7.1									X			X
7.2						X			X			X
7.3							X					X

Standard 4: Introduction to Engineering

The EE master program at our institution emphasizes the importance of catering to diverse learners. This is achieved by ensuring that students have a solid understanding of EE concepts and standards, enabling them to easily absorb advanced knowledge. The program framework is designed to outline the tasks and responsibilities of an engineering master, as well as the use of disciplinary knowledge to execute these tasks. To increase student interest and motivation, we allocate 1 to 3 hours in each subject to provide an overview of the subject matter. This includes exciting and hot topics such as quantum computers, 5G and beyond-5G networks, chip design, and encryption techniques. Throughout the program, students engage in electronic design exercises and complex problem-solving tasks, both individually and in teams. The courses also include personal and interpersonal knowledge, skills, and attitudes that are essential for students at the start of the program, to prepare them for more advanced product, process, system, and service-building experiences.

Standard 5: Design-Implement Experiences

The EE master program has four courses that provide the integrating experience that draws from diverse curriculum elements and helps develop student competence by focusing on technical and non-technical skills in CDIO. Those four courses are CDIO Project 1, 2, 3, and Graduation Project, which are designed to provide practical and rigorous training in Interdisciplinary Projects, Problem-Solving Methodologies, Team-Building Skills, and Oral, Graphical and Written Communication Skills. These Design-Implement experiences help prepare students for engineering practices; awareness of engineering standards, consideration of ethics and its effect on society; and designing procedures based on real-world constraints. This process can be seen in CDIO Project 1: circuit designs are set up with industry-standard design tools such as Altium or Cadence, which are optimized for performance and cost. Next, the test benches are designed to ensure their design meets the functional and performance requirements. In-house and online discussions with experts are implemented to optimize the design before fabricating the circuit. Finally, testing and verification are implemented to evaluate the prototype.

Standard 6: Engineering Learning Workspaces

The learning environment at DTU provides learners with tools and facilities such as Libraries, the Internet, and labs to easily access learning resources, valuable opportunities, and experiences. Precisely, the learning environment parallels two real and virtual learning environments. In particular, the real learning environment helps students get closer to reality, while the virtual environment forms new experiences, stimulating learners to innovate and create. The learning environment also has a system of FabLab manufacturing laboratories equipped with various machine tools such as 3D printers, CNC machines, and electronic control devices... for students to make and test the prototypes, as shown in Figure 2. In particular, at DTU FabLab, there is a course called "How you can make (almost) anything" built in the direction of CDIO, providing the necessary knowledge and skills to form an idea to realize an actual product and do a scientific research project process. The Course Learning Outcomes (CLO) of this course are also very suitable and complement the EE master program, which is:

- CLO 1. Proficiently use equipment and software for the ideation, design, and manufacture of products.
- CLO 2. Proficient in scientific research methods.
- CLO 3. Ability to evaluate aspects of an idea or solution.
- CLO 4. Improve logical thinking capacity, teamwork skills, and communication skills.

Figure 2. Creative workspace at DTU FabLab

We continue to specifically present Engineering Learning Workspaces at FEEE, DTU as follows:

Laboratories: Besides the natural science and the computer labs being jointly used by faculties in the Division of Technology & Sciences (DTS), the EE program operates five major laboratories: (1) Basic Electronic Laboratory (as Figure 3), (2) Logical Controller Laboratory, (3) Processor/Microcontroller Laboratory, (4) Electrical Machinery Laboratory, and (5) Advanced Electronics-Telecommunication Laboratory. These laboratories are open for use to students under the guidance of laboratory technicians. The working hours of these laboratories are from 7:00 AM to 11:00 AM, from 1:00 PM to 5:00 PM during weekdays, and from 7:00 AM to 11:00 AM on Saturday mornings. For Saturday afternoon and Sunday, these laboratories are only open according to the requirement from the Dean of the FEEE. Each laboratory has its computer system for processing experimental data, conducting statistics, and writing reports related to the experimental results.

Figure 3. Basic Electronic Laboratory at FEEE, DTU

Computing Resources: The Center of IT Lab Management of DTU operates 16 computer laboratories for students from different faculties in the university. There are 710 desktop and workstation computers in these computing laboratories. These computers are primarily Windows-based with a comprehensive set of essential computing software besides LAN connection to a printer and scanner in each laboratory. Out of the 16 computer laboratories, one iMac computing laboratory is mainly used for teaching graphics and sound design courses. All the computers on campus are connected to the DTU fiber optics-based LAN, which in turn also offers access to the Internet. The computing labs are open daily from 7:00 AM to 9:00 PM and offer support to students. The data center is also accessible to Electrical & Electronic Engineering teaching staff from 7:00 AM to 9:00 PM daily for heavy computing processing. Permission is required for students to access the data center for assignments or projects, and it is equipped with 14 Dell blade servers, 7 Cisco routers, 11 Cisco switches, and 2 EMC storage arrays. FEEE provides five workstations in its administrative office for students and teaching faculty members to access the DTU network or the Internet. Faculty members can also access the DTU network with their laptops on campus or remotely through VPN.

Guidance: FEEE faculty members prepare laboratory manuals for each assigned course. These manuals include references, equipment descriptions, safety notifications, and procedures. Safety codes are displayed on posters in labs, and students receive an orientation on safety and general instructions. Faculty and/or lab staff must be present during lab sessions, and students cannot work alone in labs.

Standard 7: Integrated Learning Experiences

As mentioned above, CDIO-based courses are designed to provide practical and strict training in interdisciplinary projects, problem-solving methodologies, team-building skills, and oral, graphical, and written communication skills. For instance, in CDIO Project 2, besides the requirement to design a complete industrial circuit, students must also pay attention to the design optimization factors in terms of cost, performance, energy efficiency, reliability, size, and weight. Not only that, but the design must also ensure the issues of industrial and national environmental standards. Another example is in Graduation Project, students will apply the accumulated knowledge throughout their whole learning process for the design, implementation, or improvement of a particular product or prototype, or process. This should be the novelty of what companies and enterprises in the real world are working on. Its formulation and improvement are always based on serious consideration of global, cultural, environmental, social, economic, ethical, and professional factors. The project is expected to help students consolidate deep knowledge while gaining advanced know-how in their specialty areas through self-training and lifelong study. To achieve that goal, except for supporting tools, students can collaborate with scholars, experts, and industry to learn knowledge from them. Furthermore, students are encouraged to publish or present their work at the conference and journal to obtain more comments for improvement of work.

Standard 8: Active Learning

Active Learning in CDIO typically involves students working in teams on real-world problems and projects and participating in hands-on activities such as design challenges, prototyping, testing, and evaluation. This approach emphasizes collaboration, communication, and critical thinking skills and encourages students to take ownership of their learning. It also involves using various teaching methods and technologies, such as flipped classrooms, case studies, project-based learning, and simulation tools. These methods help to create an engaging and interactive learning environment that encourages students to think creatively, solve problems, and apply their knowledge and skills in real-world situations.The project also encourages students to work independently and collaborate closely with their supervisor(s) and colleagues in the industry to enhance their expertise, communication skills, and vision in Electronic Engineering for later career development.

Standard 9: Enhancement of Faculty Competence and Standard 10: Enhancement of Faculty Teaching Competence

In order to teach this master's program, the lecturer has to have Ph.D. Degree and experience in this EE field. There are several major tracks for professional development for FEEE faculty members, specifically as follows:

FEEE encourages faculty members to attend national and international conferences or workshops, and will financially support those who present at such events. Even if they do not present, faculty members can still take leave with pay if they obtain outside grants for their expenses. The EE master program faculty members have participated in various workshops, including CDIO International Conferences. FEEE supports scientific research expenses, and promotes policies for international publications in well-recognized journals. DTU provides full or partial support for publication fees and awards bonuses or salary increases for research papers published in high-impact journals. FEEE collaborates with local and international companies, enterprises, and societies, and faculty members are required to visit industry companies and enterprises for at least ten days per year, as per DTU policy.

Standard 11: Learning Assessment

The teaching faculty members of FEEE directly assess a student’s achievement of certain LOs based on his or her performance in their courses. Students’ feedbacks before their graduation are also taken into account for the indirect assessment of those LOs. On a semester basis, the Accreditation Committee of FEEE will collect both direct and indirect assessment data from the teaching faculty members, the students, and the university web portal of myDTU, and the AMS of DTU. The Accreditation Committee of FEEE will discuss the assessment statistics, comments and suggestions for decision making on which improvements and corresponding course of action to be carried out. We have also implemented the DTU Testing Service system, which is synchronized with the LMS and LCMS systems, serving smoothly in questions, exams, and grading afterward. The system automatically links the graded items of each learner in each class to the full scoreboard of all subjects in the school.

The essential courses of the EE master program are mapped to the set of LOs and Pis as demonstrated in Table 1. In order to check the extent to which a specific course has met LOs and PIs, there are two assessment processes:

- Direct Assessment: through schoolwork in a regular course (i.e., Attendance & Discussion in Class (through Pop-Quiz), Quiz, Homework, Practical Application, Midterm Exam, Individual Project, Group Project, Final Exam), Graduation (Capstone) Project report/prototype, Peer review and Graduation (Capstone) Project Defense Session.
- Indirect Assessment: through Exit Survey and Employer Survey.

Standard 12: Program Evaluation

Each LO would be analyzed one after another with the following rounds or phases of work:

- Assessment Results at the end of Spring 2022.
- Improvements & Actions being implemented in Spring 2024.

Each round of general assessment includes the outcome assessment and the following evaluations. The results will include an outcome table followed by the trend line for each outcome throughout the last three general assessments. Each outcome table carries out the benchmarking based on individual PIs and the corresponding host LO alongside the mapped basic courses, assessment methods, data source, timetable, and performance target. The trend lines that follow are on cycles of two years each for both individual PIs and the corresponding host LO.

All the data for the general assessment cycles were already available in the AMS of DTU, which collects and processes students' grades on a semester basis. Students' grades collected ranged from the schoolwork assignment/test question levels to the overall course grade level.

Through the annual Faculty Advisory Board Meetings (once or twice a year with recorded meeting minutes) and other communication channels like email, phone, video conferencing, regular mail, etc., members of the Advisory Board of FEEE help refine the PEOs, and update the curriculum of the EE master program, specifically by:

- Providing advice on ways to revise the PEOs,
- Identifying the right set of capabilities and tools needed for various Electronic Engineering career tracks,
- Offering insights into the current conditions of the local and global markets of the electrical and electronic engineering industry,
- Making recommendations on the course of action to improve the EE master program and its curriculum.

CONCLUSION

In this article, we have presented the EE master program of Duy Tan University in the Industrial 4.0 context. We have described the CDIO framework to assist our students in acquiring the desired knowledge and skills to meet future human resource needs for the Industry 4.0 trend. In addition, we present the level of implementation of this framework of this EE master program according to 12 CDIO standards. Through the implementation of the CDIO project, the outputs are technical reports, design prototypes, and articles published by students that have proven the effectiveness of our EE master program. In future work, we will present this program's continuous improvement to clarify the deployment's effectiveness.

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BIOGRAPHICAL INFORMATION

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