

THE COLLABORATION BETWEEN ACADEMIA AND INDUSTRY FOR ENHANCING EMPLOYABILITY AND FACULTY DEVELOPMENT

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ABSTRACT

The aim of this paper is to share an academia-industry collaboration experience at a Soil and Water Engineering (SWE) Program, the Department of Agricultural Engineering (AE), Faculty of Engineering, Rajamangala University of Technology Thanyaburi (RMUTT), Thailand. The program has been launched since 2003. The program committee has a high ambition to popularize this program for relevant Thai agricultural-based industries. In 2015, the program name was changed to Irrigation Engineering and Water Management (IRE). The department has adopted the CDIO framework, especially CDIO standard 3, 5, 7, 9 as a strategic plan for creating collaboration with the industry.

A system of academia-industry collaboration at SWE and IRE has 5 steps. The first step is a university visit. The department invites managers/key persons from companies as guest lecturers, invited speakers and project co-advisors. The second step is to send SWE and IRE students for an industry internship at those companies. The university offers a 2-month on-the-job training (OJT) and a 4-month co-operative education (Co-op) courses for all students. The third step is an industry visit by the faculty member while the students are having their internship. This visit allows the faculty members to share their expertise with real-life problems the industry is facing. The fourth step is an industry-based co-research where the faculty members work closely with the industry to solve specific problems, form a research group, enhance professional skills, and transfer real-world experience to students. The fifth step is to co-create curriculum development for SWE and IRE to better educate future engineers entering the industry.

The result of this collaboration enhances student employability after graduation. Most of them receive job offers from those companies immediately. From 2012-2017, 52 students had co-operative education in 6 companies, and 17 of them (32.70%) were recruited. Moreover, academia-university collaboration has enhanced the faculty professional development regarding the knowledge and skills required to work successfully in the industry. In addition, the collaboration also reveals the knowledge and skills that graduates should have that resulting in revising curriculum supporting the industry's needs.

KEYWORDS

Academia-industry collaboration, soil and water engineering, irrigation engineering and water management program, standards: 3, 5, 7, 9.

INTRODUCTION

Soil and Water Engineering (SWE) program has started since 2003, considered as the first and the newest program in Thailand at that time. It is an undergraduate program at the Department of Agricultural Engineering (AE), Faculty of Engineering, Rajamangala University of Technology Thanyaburi (RMUTT). The program objectives are:

- 1) To produce SWE graduates
- 2) To design and implement farm irrigation system techniques and
- 3) To fulfill the industry's needs on SWE engineers

Since it was a new program, the program committee has a high ambition to popularize it to serve Thai agricultural-based industries. This paper aims to share an academia-industry collaboration experience that benefits both parties. Participating companies contribute their human resources; such as managers, key-persons, engineers, to be guest lecturers, invited speakers and project co-advisors. Examples of delegates from the industry are the Director of Ground Water Department, the CEO of Kongsanguan-Engineering Co., Ltd. and a lecturer from Sukhothai Thammathirat Open University. In addition, the participating companies accept SWE students for 2-month on-the-job (OJT) training. The students are required to work at a public or private organization in order to get experience according to SWE. Examples of participating companies are Kongsanguan-Engineering1993 Co., Ltd., Power Engineering Trading Co., Ltd, and Inter Tech Consultants Co., Ltd. Usually, the graduates are employed as consultants, hydroponic entrepreneurs, irrigation engineers, sale engineers and government officers.

Kuptasthien et al. (2014) presented that RMUTT, as the first CDIO collaborator in Thailand, has started introducing and applying the Conceive-Design-Implement-Operate (CDIO) Framework for Re-Thinking Engineering Education since 2013 through a collaboration with Singapore Polytechnic (SP), supported by Temasek Foundation International (TFI). The institution is fully committed to the adoption and implementation of CDIO framework. RMUTT has established the quality management framework with CDIO as a foundation to produce hands-on professional graduates. Currently, 12 programs from 5 faculties: Engineering, Business Administration, Mass Communication Technology, Architecture and Thai Traditional Medicine College, have fully adopted the CDIO framework. The Industrial Engineering was the pioneer program to adopt CDIO. Tangkijviwat et al. (2018) discussed the CDIO principal was presented and promoted to all faculty members in the annual seminar in 2014 at the faculty of Mass Communication Technology. In 2015, the Soil and Water Engineering (SWE) program was modified into Irrigation Engineering and Water Management (IRE) program. The AE department has adopted the CDIO framework, especially CDIO standard 3, 5, 7, 9 as a strategic plan for creating a collaboration with the industry. The integrated curriculum (CDIO standard 3) design ensures that the new graduates meet the industry expectation. There are courses that enhance the student's experience on design and build (CDIO standard 5) project. The integrated learning experiences (CDIO standard 7) with 2-month OJT and 4-month cooperative education (Co-op) strengthen the linkage with the industry. Lastly, faculty members enhance their competencies (CDIO standard 9) by working closely with the industry.

A number of literatures show that many universities apply CDIO framework in enhancing the collaboration between faculty and industry. Male et al. (2016) stated that the CDIO standards provide an excellent framework for the engagement of industry stakeholders in the development and operation of professional engineering degrees. The principal found from the consultation with industry are very strong drivers for engagement in terms of industry and

company visibility for recruiting and brand promotion, internal staff development, relationship development, and social (corporate and professional) responsibility. Kamp and Verdegaal (2015) reported that an internship enables the university to include authentic practical experience (CDIO Standard1) and make an integrated curriculum (CDIO Standard 3) with an intensive integrated learning experience (CDIO Standard 7). The intern is able to experience how it is to work as an engineer in the industry and develops a good sense of ethical accountability and social responsibility. Moreover, Mejtoft (2015) summarized that a higher level of engagement from both the students and the industry and actual valuable results can be achieved by integrating the teaching of professional skills into the curriculum. Active learning in a real context of design-implement-test projects make the students more aware of actual problems, work harder and have a more professional attitude towards the project and the results.

Several literatures show that there are various types of industry/university collaborations, for example, student internships, faculty exchanges and industry capstone projects to complete a degree program (Mead et al., 1999). Lee (2000) examined the sustainability of the collaboration experience by focusing on the actual “give-and-take” outcome between university faculty members and industrial firms. This study found that faculty members collaborating with industry bring with them a set of personal objectives for which they are willing to commit time, energy and intellectual resources. Liévana (2010) presented the relationship between industry and universities by reviewing the historical development of research and development labs in order to classify the linkages and strengths that emerged between universities and industry. Guimon (2013) reviewed that the most appropriate approach to promoting university-industry collaboration depends on the country’s technological and institutional endowment. The challenge for government is to select policy programs to support university-industry collaborations in developing countries.

Further, Pittayasophon and Intarakumnerd (2016) investigated the influence of firm characteristics on the decision to collaborate with universities and collaboration modes. The study findings have crucial implications for stimulating university-industry collaboration.

Based on the information above, the CDIO framework is one of the strong tools which can be used to manipulate the program effectively. Most of the collaboration between faculty and industry were considered in this study.

ACADEMIA-INDUSTRY COLLABORATION PROCESS

Collaboration between academia and company is important for skills development (education and training), acquisition, job offers, improvement of knowledge (innovation and technology transfer), promotion of curriculum and promotion of entrepreneurship. AE Department has set up an academia-industry collaboration system. There are 5 steps; namely, 1) university visit 2) student internship 3) industry visit 4) industry-based co-research and 5) co-create the curriculum development as shown in Figure 1.



Figure 1. AE-RMUTT academia-industry collaboration system

University Visit

In order to start an industry-university collaboration, the first step is to introduce the department to the industrial companies. Managers and key persons from selected companies are invited to contribute as guest lecturers, invited speakers and project co-advisors. This step allows the industry to get familiar with the SWE and IRE programs, as well as the faculty members. Recently in a seminar course, “Modeling for Irrigation System and Water Management Project in Thailand” lectures were given by a senior engineer whose expertise is an irrigation system from Southeast Asia Technology Co., Ltd. and a CEO from InterTech Consultants, Co., Ltd. respectively. Moreover, the department invited a guest lecturer from the Royal Irrigation Department (RID) to give a lecture in the Water Resource Development subject. Figure 2 shows photos taken from those events.



Figure 2. University visits from the industry

Student Internship

The second step is to send SWE and IRE students for internships at partner companies. There are more than 30 companies in the suggestion list preparing for students. RMUTT provides 2 types of internship to the student, as following:

Co-operative Education (Co-op)

Practice in a government organization, a state enterprise or a company in the relevant field of engineering as a temporary full-time employee with certain responsibility, under assigned job supervisor who will advise the student during the entire period of the training, required at least 16 weeks. The training will be also advised, followed up, and evaluated systematically by co-

op advisor and/or co-op staff to assist students to gain direct experiences, realize their capacity, and develop themselves before graduation.

On-the-job Training (OJT)

Practice in a government organization, a state enterprise or a company in the relevant field of engineering for at least 270 hours to realize working experiences before graduation.

Table 1 shows numbers of companies and students participated in the internship from 2012-2017. There are 6 companies that continuously offer an internship to RMUTT students. The number of students and the name list of those 6 companies is shown in Table 2. For the academic year 2018-2019, the process has not completed yet.

Table 1. Number of companies and students for internship program from 2012-2017

Year	Number of Companies	Number of Students taking Internship
2012	9	16
2013	12	30
2014	12	21
2015	11	20
2016	4	5
2017	16	31

Table 2. Name list of company for co-operative education of academic year 2012-2017

Company	Number of students	Number of students who were recruited after graduated	Number of Alumni who are still work at the company
Kongsanguan Engineering 1993 Co., Ltd.	6	4	8
Power Engineering Trading Co., Ltd.	8	3	5
InterTech Consultants Co., Ltd.	11	2	5
Paragon Engineering Consultants Co., Ltd.	10	4	7
Southeast Asia Technology Co., Ltd.	8	2	3
Cholnawat Co., Ltd.	9	2	4
Total	52	17	32

Industry Visit

The third step is an industry visit by the faculty member while the students are having their internships at partner companies. This visit allows the faculty members to share their expertise in real-life problems with the industry. At the same time, the students have realized the linkage between the knowledge they acquired at the university and how to implement it in the working environment. Figure 3 shows faculty members of the IRE program visiting the company.



Figure 3. IRE program committees visit partner companies

Industry-based Co-research

The fourth step is an industry-based co-research where the faculty members work closely with the industry to solve specific problems, form a research group, enhance professional skills, and transfer real-world information to students. There are several ways of linking research to teaching and transferring knowledge to students, i.e. research-oriented and research-based teaching. This step provides good opportunities for the student to explore real problems and develop a competency to conduct research. Table 3 shows the co-research titles and courses that integrate the knowledge into classrooms. Figure 4 also represents the program committee works closely with the industries.

Table 3. Co-research projects and related courses

Company / Year	Project Name	Lecturer	Expertise	Related Course
InterTech Consultants Co., Ltd./ (2015)	Environmental Impact Assessment (EIA), Mae Nung Reservoir, Lampang Province	Sanidda	Hydrology Specialist	<ul style="list-style-type: none"> • Engineering Hydrology • Water Resource Engineering • Geographic Information System Application for Engineers
		Supachai	Water Resource Specialist	
		Apirat	GIS Specialist	
United Analyst and Engineering Consultant Co., LTD. (2017-2018)	Environmental Impact Analysis of the Bangkok Airport Development: Don Mueang Airport Development Project	Sanidda	Hydrology Specialist	<ul style="list-style-type: none"> • Engineering Hydrology • Irrigation Engineering and Water Management Pre-Project
Cholnawat Co., Ltd. (2017)	Project Development of Water Information System at the Sub-district Level	Sanidda	Hydrology Specialist	<ul style="list-style-type: none"> • Engineering Hydrology • Water Resource Engineering • Geographic Information System Application for Engineers
		Supachai	Water Resource Specialist	
		Apirat	GIS Specialist	
Cholnawat Co., Ltd. (2018)	The Feasibility Study and Environmental Impact Assessment of Flood Relief in Chumphon Province	Sanidda	Hydrology-Water Balance Specialist	<ul style="list-style-type: none"> • Engineering Hydrology • Water Resource Engineering • Irrigation Engineering and Water Management Pre-Project
		Supachai	Water Resource Specialist	
Cholnawat Co., Ltd.	Preliminary Environmental	Sanidda	Hydrology Specialist	<ul style="list-style-type: none"> • Engineering Hydrology

(2018)	Impact Assessment of the Royal-initiated Huai Mae Khian Reservoir Project, Ngao District, Lampang Province	Supachai	Water Resource Specialist	<ul style="list-style-type: none"> • Water Resource Engineering • Irrigation Engineering and Water Management Pre-Project
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Co-develop Curriculum

The fifth step is to co-develop SWE and IRE curriculum to better educate future engineers entering the industry. The staffs from the company were invited to criticize, validate and give comments on the development of a new curriculum. There are some suggestions on adding knowledge on basic computer, creative thinking and English communication skills. Therefore, the program outcome can meet the industry's expectation on graduate's knowledge, skills, and competencies.



Figure 4. The program committee work closely with the industries

RESULT OF COLLABORATION

Not only the university and industry can strengthen the collaboration, but also enhance the student job opportunity and employability after graduation. Many of the students got job offers from internship companies immediately. As shown in Table 2, 52 students had co-operative education in 6 companies, and 17 of them (32.70%) were recruited.

Other benefits from this academia-industry collaboration can be listed below:

- 1) Promoting the SWE and IRE curriculum
- 2) Expanding the collaboration with the industry
- 3) Validating the curriculum and receiving feedback for curriculum development
- 4) Student Internship
- 5) Co-research between industry and the program members
- 6) Sharing of knowledge, expertise and experiences
- 7) Providing professional development training to partner companies' employees to update and up-skill the knowledge and competencies
- 8) Job opportunity for the student

These benefits are conforming to Mead et al. (1999); Lee (2000) and Liévana (2010), mentioning that benefits from academia-industry collaboration are importance to develop education and fulfill requirements of curriculum outcome. Mead et al. (1999) summarized these partnerships also resulted in increasing potential revenues among the partners and expansion of contacts and resources from both sides of the partnerships. Moreover, students also earn benefits from this collaboration as the following:

- 1) Learning the industry working styles
- 2) Learning how to solve an urgent problem
- 3) Applying the knowledge from university to the real work
- 4) Experiencing job supervision
- 5) Practicing presentation and communication
- 6) Coordinating with another agency

For further improvement the academia-industry collaboration, the following steps should be considered 1) Memorandum of Agreement signing between the AE department and the companies, 2) funding support from the industry and 3) continuously part-time job at the company after students go back the university. However, the sustainability of the collaboration is the challenge faced in implementing the academia-industry collaboration.

CONCLUSION

In this study, the application CDIO is able to enhance the competency of graduates and program committee to meet stakeholder requirement. Moreover, academia-university collaboration has enhanced the faculty professional development regarding the knowledge and skills required to work successfully in the industry. In addition, the collaboration also reveals the knowledge and skills that graduates should have that resulting in revising curriculum supporting the industry's needs. The above results indicate that there is a need to use the CDIO framework in a curriculum. Moreover, the results of the study provided valuable information that could help or give direction in a system of academia-industry collaboration that would eventually benefit the graduates and program committee in the Agricultural Department. For further study, it should survey the perception of student and satisfaction of industry. Moreover, the linking of teaching, research and community service will be considered.

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BIOGRAPHICAL INFORMATION

Sanidda Tiewtoy is an assistant professor in the Department of Agricultural Engineering, Faculty of Engineering, RMUTT. She has actively participated in CDIO activities since 2014. She promoted CDIO implementation to undergraduate programs for enhancing the graduates in the field of Irrigation Engineering and Water management.

Weeraphong Krusong is a senior lecturer at the Department of Agricultural Engineering, Faculty of Engineering, RMUTT. He set up Soil and Water Engineering (SWE) Program in 2003. He has actively participated in CDIO activities since 2014. He promoted CDIO implementation to undergraduate programs for enhancing the graduates in the field of Irrigation Engineering and Water management.

Natha Kuptasthien is currently an assistant to president for International Relations and an associate professor at the industrial engineering department, faculty of engineering, RMUTT. She led a full CDIO implementation at RMUTT since 2013. She has conducted a number of CDIO introductory workshops for engineering and non-engineering programs, which expanded the CDIO network to 8 RMUTs and universities in Asia. Natha graduated with a Bachelor of Engineering in Industrial Engineering from Chulalongkorn University, Master of Science and PhD in Engineering Management from University of Missouri-Rolla, USA.

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