Do we educate engineers that can engineer?

Since 2008, the Bachelor of Engineering education at the Technical University of Denmark has been CDIO-based, including the software technology and IT and economics study lines. Consequently, the study plans of these study lines were revised to include cross-disciplinary CDIO projects in each of the first four semesters. These projects replaced 11 smaller, course-specific projects in the old study plans. The first three semesters contain design-build projects spanning several courses, and the fourth semester centers around a stand-alone CDIO project. These team-based projects aim at training the students' engineering skills (CDIO competence category 4) and at improving the students' skills in CDIO competence categories 2 and 3. In the tenth year of operation, we now decided to investigate, how content students and employers are with our students' engineering skills. To this end we have designed a survey to provide us with insights for improving our study lines and to address the question: "Are we educating engineers who can engineer?" The questionnaire is aligned with the CDIO syllabus and can also serve for surveying other study lines, since it is not study line specific. To obtain meaningful results, we decided to target students who have at least passed the first four terms, and companies that have hosted a significant number of students in the last 3 years in internships or for the final thesis. These companies interact with the students for almost one year at the end of their studies, providing a good foundation for the company supervisors to answer questions about the students' abilities as an engineer. In this paper, we discuss the design and result of the questionnaire, and the obtained results. As mentioned above, the survey will give us and the CDIO community detailed insights as to how our students and their employers experience the result of our education.
The innovation element of the diploma (B.Eng) programs at DTU

In September 2014 the first version of the newly developed CDIO-based diploma (B.Eng) programs were launched at DTU (Nyborg et al., 2015). The programs are the result of a comprehensive merger process of former diploma programs, namely the programs at Engineering College of Copenhagen (now DTU Diploma) and the Technical University of Denmark.

The most significant new activity in the programs is the introduction of a common 10 ECTS compulsory course in innovation in the later part of the programs. The idea behind this course is to give students the opportunity to collaborate on interdisciplinary real-life projects.

This course strengthens not only innovation skills but personal and interpersonal skills as well. In this paper we will discuss the organization of the Innovation Pilot course. In particular we focus on:

- Structure of programmes
- Organization of the Innovation Pilot course
- The didactical considerations
- Scaling up the course from 50 to 500 students

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CDIO-based study programs, Stakeholder involvement, Innovation

Developing merged CDIO based curricula for diploma (B.Eng.) IT study programs at DTU

Starting 2007, the Danish government drew up a new map of universities through a process of mergers of a number of universities and research institutions (UFM 2007), as part of the national innovation strategy. In the beginning of 2013, the Engineering College Copenhagen (IHK, now DTU Ballerup) merged with the Technical University of Denmark (DTU Lyngby). The goal of the merger was to educate ever more innovative diploma engineers to fulfill the needs by Danish industry through combining a practice-oriented development environment and a research-oriented environment.

Merging a university with an engineering college implies merging two different cultures: established teaching staff, different study lines; a difficult undertaking at best. Existing study lines must be merged, overlaps and differences identified and handled, and in general a common understanding and language must be established.

The two institutions represented before the merger well 3500 B.Eng. students. The goal of the merger was to combine the best of the existing educations rooted in a practice-oriented development environment and a research-oriented environment. At the same time, the merger was supposed to contribute to the national innovation strategy.

In this paper we describe the process of developing new, merged B.Eng curricula in the IT field (Diploma IT), as part of the merger between DTU Lyngby and IHK. Particular attention will be given to the following subjects:

• The design process used to develop the new merged study programs;
• Involvement of stakeholders in designing the new curricula;
Introduction of a common interdisciplinary innovation course in the programs; and
Education of teaching staff: Integration into one organization.

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Testing and Deployment of Software Systems (in practice)
The CDIO concept is now well integrated into many curricula at universities around the world and it has meant an increase in the quality of engineering education. However, the main focus has been on design-build projects and less on the ‘C’ and ‘O’ part.

In particular, the ‘O’ part of CDIO has received very little focus, since this is probably the most difficult part to implement in a university environment.

Because of this observation, in 2011 we decided to launch a new elective course, ‘Testing and deployment of software systems (in practice)’, focusing entirely on the ‘O’ part in CDIO.

The aim of this paper is to describe:
• the unified software development process and compare this with CDIO.
• the activities covering the ‘O’ part in software engineering.
• the course structure and schedule.
• the evaluations and comments received from students.

The paper concludes that:
It is possible to give students a realistic experience of the ‘O’ phase of CDIO. The prerequisite for this is that the course’s entry level is a working prototype.
It is very important to identify an actor outside the university, which can act as a client (customer). This gives the students a more realistic environment.
The course also prepares the students for meetings with industry, taking place in the 6th semester, during the students’ internship and later in the exam project in the 7th semester.

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CDIO-based study programs, Testing, Deployment, Operate, Industry contacts, product maturity, pre-internship
Electronic versions:
SmartNursing - a mobile application to improve communication in home care
This paper presents SmartNursing system and discusses how increasing capabilities of smartphones could benefit employees in working environment. A SmartNursing system is developed for home nurses working environment to fulfil their needs. The solution helps to improve communication among nurses, provide customized information and increase work efficiency. Developed system consists of mobile application, web-based server and database. This article discusses the solution SmartNursing from design to implementation.

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Evaluation of the industrial internship for the Diploma IT programme at DTU
In this paper we present the result of analyzing data based on more than 5 years’ systematic collection of questionnaire survey data on the evaluation of the industrial internship for the Diploma IT programme at the Technical University of Denmark (DTU). Since 2005, we have been tutors for all students at Diploma IT. During this period we have systematically collected data from students and companies involved.
In total 785 questionnaires have been analyzed, which offers a good foundation for judging the success of the internship and a great opportunity for learning from the results.
The questionnaires comprise various questions measuring the general level of satisfaction with the internship. The results in general show high satisfaction, both from perspective of the companies involved and from the students’ perspective. In addition to the satisfaction surveys, we have also collected data on remuneration during the internship and data on the number of students who had a job at the time of graduation.
The last year of data collected, 2011, contains results from the new CDIO-based curriculum, which was launched in autumn 2008. This enables us to compare results for students enrolled in the old curriculum with students enrolled in the new CDIO-based curriculum.
In general the data collected forms an important source in understanding how the transfer from the educational system to industry is experienced from both sides.

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CDIO Projects in DTU's B.Eng. in IT Study Program
Since the fall 2008 all B.Eng. study programs at the Technical University of Denmark have been based on the CDIO concept. The adoption of the CDIO standards and principles resulted in new or significantly revised study programs. As part of this effort design-build projects have been introduced on each of the first 4 semesters, and each semester-project spans several courses. The aim of this paper is to describe the four CDIO semester projects in the B.Eng. in IT study, and – along with similar papers describing the other six B.Eng. programs – to provide documentation to accompany an exposition with stands providing additional information and with students demonstrating their projects. The paper is narrowly focused on the IT-study program. At the time of writing this paper the students enrolled in 2008 have completed all four semesters in the new CDIO-based study plan, and the students enrolled in 2009 are currently in the process of finishing the 4th semester. Consequently, the paper is reporting on curriculum development which has been implemented, and for which experiences have gained.

Developing Open Source System Expertise in Europe programme (IP). The aim of this IP is to exchange knowledge of and experience in local methods and techniques in the field of open source software knowledge in ICT by engaging a group of international students and lecturers in a joint, explorative investigation of contemporary methods of open source software systems. In addition the program focuses on the students learning interpersonal skills, such as personal and professional skills, multidisciplinary teamwork, communication, communication in a foreign language and leadership. The target group consists of European engineering students who are interested in knowing which factors play a role in information systems and what the similarities and differences between the various national approaches in open source software systems and techniques are. The event forms a unique opportunity in promoting active learning in an international environment. Students get experience working in teams across country boundaries. In the paper we will describe the structure and our experiences from participating in this IP with relation to the CDIO initiative. Finally we draw conclusions and give our recommendations based on those.
Mapping and industrial IT project to a 2nd semester design-build project

CDIO means bringing the engineer's daily life and working practice into the educational system. In our opinion this is best done by selecting an appropriate project from industry. In this paper we describe how we have mapped an industrial IT project to a 2nd semester design-build project in the Diploma IT program at the Technical University of Denmark. The system in question is a weighing system operating in a LAN environment. The system is used in the medical industry for producing tablets. We present the design of a curriculum to support the development of major components of the weighing system. A simple teaching model for software engineering is presented which combines technical disciplines with disciplines from section 2-4 in the CDIO syllabus. The implementation of a joint project involving several courses supports the CDIO perspective. Already the traditional IT-diploma education for decades has included many of the essential features of the CDIO (for example, focus on teamwork, development of social skills, the open nature of design problems). The specific project has previously been conducted on 5th Semester The project has now been brought forward to the 2nd semester of study. A successful implementation at this level requires careful planning of activities through the semester. Principles of the CDIO have been of great help in this regard. Finally we draw conclusions and give our recommendations based on those.

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Projects:

A survey of the relation between early field failures and production processes

The objective with the project is to establish the relation between early field reliability performance and production yield for different production processes and to investigate the root causes of early field failures by investigating the failed components

Department of Applied Electronics
Period: 01/01/1999 → 31/12/1999
Number of participants: 1
Project Manager, organisational:

Nyborg, Mads (Intern)
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The objective with the project is to establish the relation between early field reliability performance and production yield for different production processes and to investigate the root causes of early field failures by investigating the failed components

Department of Applied Electronics
Period: 01/01/1998 → 31/12/1998
Number of participants: 1
Project Manager, organisational:
Nyborg, Mads (Intern)

Project

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Department of Applied Electronics
Period: 01/01/1997 → 31/12/1997
Number of participants: 1
Project Manager, organisational:
Nyborg, Mads (Intern)

Project