

QUALITY ASSURANCE WITH CDIO SELF-EVALUATION - FIRST RESULTS OF A NORDIC PROJECT

Juha Kontio, Janne Roslöf

Turku University of Applied Sciences

Kristina Edström, Sara Thyberg Naumann

KTH – Royal Institute of Technology

Peter Munkebo Hussmann

DTU - Technical University of Denmark

Katriina Schrey-Niemenmaa, Markku Karhu

Helsinki Metropolia University of Applied Sciences

ABSTRACT

This paper describes the Nordic project 'Quality Assurance in Higher Education'. The main goal of the project is to develop and implement a self-evaluation model in the participating Higher Education Institutions (HEIs) to support their quality assurance work and continuous curriculum development in the field of engineering. Furthermore, the project aims at developing cross-evaluation methods for international use as well as strengthening the cooperation of HEIs in quality assurance and disseminating good practices of QA. The framework of development in this project is based on the CDIO initiative and the CDIO self-evaluation model. The project started in October 2009 and will continue until the end of October 2011. The project is divided into two phases. The first phase focused on self-evaluation and the second will focus on cross-evaluation. This paper describes the first project phase. The main results are a detailed definition of the self-evaluation process, well-documented self-evaluations of the participating degree programmes, as well as identification of main development areas and actions in each participating degree programme. The development actions included, for example, a) implementing a capstone project into the curriculum, b) practical training – improving the connection between the industry and a HEI, c) integration of teaching activities – CDIO awareness, and d) programme organization – programme management team including student representatives. Furthermore, the project has increased the partners' understanding of other partners and their challenges. Finally, the quality assurance has been enhanced in each participating programme. Hopefully, this project will provide new ideas and support for quality assurance work on other higher education institutes.

KEYWORDS

Quality Assurance, Self-evaluation, Nordic project, Continuous development, Programme development

INTRODUCTION

The overall idea of CDIO initiative is to support engineering education development and educate students who are able to [1]:

- master a deeper working knowledge of technical fundamentals
- lead in the creation and operation of new products, processes and systems
- understand the importance and strategic impact of research and technical development on society.

Important tools in this task are the 12 CDIO standards [2] and CDIO syllabus. The standards act as guiding principles for designing and development of a degree programme. Focusing the development in the areas defined by the standards will lead to better student experience and improved learning results. The standards address issues relating to what to teach and how to teach, but also issues relating to teaching staff skills. Finally, the 12th standard focuses on evaluating the current situation of the programme. This is the fundamental starting point of the Quality Assurance in Higher Education Institutes (QA in HEI) project described in this paper.

QA IN HEI PROJECT

The QA in HEI project is funded by Nordplus [3]. The project started in October 2009 and will continue until the end of October 2011. The project has four partners: Turku University of Applied Sciences (TUAS) is the coordinator, and Royal Institute of Technology, Technical University of Denmark and Helsinki Metropolia University of Applied Sciences are other partners.

The main goal of the project is to develop and implement a self-evaluation model in the participating higher education institutions in order to support their quality assurance and continuous curriculum development in the field of engineering. The project aims at defining the self-evaluation process in HEIs and developing new tools for supporting the process of quality assurance. Based on these newly developed methods, the quality of education is monitored and actively improved in HEIs. Furthermore, the project aims at developing cross-evaluation methods for international use.

The project has as an objective the construction of a framework for quality assurance that promotes the international comparability of educational quality. The quality assurance models are established, implemented and further developed in the participating degree programmes. The main purpose of this international cross-evaluation model is to provide the HEIs with new methods and tools of international quality assurance work in close co-operation with other HEIs. The cross-evaluation between HEIs promotes both the quality assurance work and the quality of education. Thus, the project aims at creating a circle of continuous quality assurance that fosters active development culture. In this cyclic model, the quality of education is reviewed by using self-evaluation and cross-evaluation methods. Based on the evaluation results, the development actions are defined, planned, and implemented in order to promote educational quality.

In the Nordic level, the project also aims at strengthening the co-operation of HEIs and disseminating the best practices of quality assurance methods and educational solutions. The international cross-evaluation model, by definition, promotes cooperation and comparability of educational quality in the Nordic and international level.

The project is divided in two phases that have different focuses. The first phase focused on the self-evaluation and it contained the following steps:

- 1) Definition of the self-evaluation process
- 2) Conducting the self-evaluation in the selected degree programmes
- 3) Analysing the results of the self-evaluation and defining development activities
- 4) Assessment of self-evaluation criteria and process based on the gained experiences.

The second phase, currently ongoing, focuses on cross-evaluation. Therefore this paper focuses on describing the first phase of the project.

Each project partner has a core group of persons working in the project. Typically these persons included the local CDIO leader, a quality assurance expert and degree programme manager/leader. In addition, each HEI defined a degree programme that would pilot the developed self-evaluation model and participate in the cross-evaluations in the second project period. A working group of local players followed the self-evaluation model and produced defined documentations. Finally, the project has a steering group formed by the local CDIO leaders.

DEVELOPED MODEL AND GUIDELINES

At the beginning of the project, the three main steps of the self-evaluation process were defined:

1. Create a programme description
2. Perform the self-evaluation
3. Define possible development actions.

The programme description should contain the following topics:

- Introduction
- Description of the programme goals and structure
- Description of the curriculum and courses
- Description of selected themes
 - Introduction to higher education study and to engineering
 - Training of engineering competences
 - Thesis work
 - Engineering workspaces
 - Student – work life connection
- Description of continuous development process

The description should be specific enough to allow the evaluation of the programme. We agreed to base the evaluation mainly on existing, functioning documentation in order to minimize the production of descriptions that serve only the purpose of this evaluation. If the evaluation inspires improvements in the “real” documents, it may also contribute more directly to developing the programme. The evaluation guidelines included several supporting questions to help producing the programme description.

The self-evaluation is based on the programme description. It contains the actual ratings of the programme in relation to the CDIO standards and recommendations for identified improvements. We grouped the CDIO standards to clarify the structure of the self-evaluations:

- Criterion A. Programme goals and design
 - Standard 1 – The Context
 - Standard 2 – Learning Outcomes
 - Standard 3 -- Integrated Curriculum
- Criterion B. Course goals and design
 - Standard 4 -- Introduction to Engineering

- Standard 7 -- Integrated Learning Experiences
- Standard 8 -- Active Learning
- Standard 11 -- Learning Assessment
- Criterion C. Selected themes
 - Standard 5 -- Design-Implement Experiences
 - Standard 6 -- Engineering Workspaces
- Criterion D. Continuous development
 - Standard 9 -- Enhancement of Faculty Skills Competence
 - Standard 10 -- Enhancement of Faculty Teaching Competence
 - Standard 11 -- Learning Assessment
 - Standard 12 -- Programme Evaluation

The outcome of the self-evaluation should contain the self-evaluation report, a description of three best practices identified by the programme, and a description of the local implementation of the self-evaluation process. Possible development actions are defined, documented and scheduled based on the self-evaluation. They are summarized in an action plan showing the defined and scheduled development actions.

SELF-EVALUATION PROCESSES AND RESULTS

All project partners have been dedicated to the project goals: self-evaluation has been conducted in the selected degree programmes. Based on the results of self-evaluation, development activities have been suggested and discussed together.

Case Turku

The Degree Programme in Information Technology has during the past few years participated in several different evaluation processes. The programme participated in an internal cross-evaluation process at TUAS in 2007, and the different phases of the planning, implementation, evaluation and improvement processes of the programme were studied. In addition, the programme was a candidate for a national centre of excellence in education for 2010-2012, and the application process included an extensive self-evaluation process. Moreover, The Finnish Higher Education Evaluation Council audited the quality assurance system of TUAS in autumn 2009, and the programme participated actively in the collection of audit data, too.

All these recent evaluation processes involved the faculty and programme management, teachers and students. Thus, this CDIO self-evaluation process was based mainly on the existing materials and experiences gathered during the previous exercises, complemented with CDIO specific parts, and a student survey conducted by a student representative in the QA in HEI project.

The self-evaluation process provided again an opportunity to reflect the processes and operations of the programme from different perspectives, especially focusing on the topics emphasized by the CDIO initiative. Topics currently present in the continuous development process of the programme were discussed also during this self-evaluation. For example, defining and improving the programme and course level learning objectives has been one of the main areas of improvement during the past two years. Currently, this process focuses on defining and improving assessment criteria – there definitely still is much to do on that field. In addition to these ongoing development actions, four specific improvement items were identified during this self-evaluation:

- **CDIO Capstone Project:** The current curriculum is flexible and encourages students to participate in different types of projects especially during the second half of their studies. However, these projects are not a mandatory part of the curriculum, and

furthermore the projects are often started on an ad-hoc basis. That is, the curriculum will be studied and a CDIO Capstone project included into it as a more integral part than before.

- **International elements:** In addition to this programme, our faculty also has a fully international Degree Programme in Information Technology. These two programmes have a long tradition of co-operation (shared facilities, joint courses and teachers etc.). However, the co-operation (especially from the students' perspective) is focused on the latter part of the studies. That is, more could be done together already in the beginning of the studies. This could improve the internationalization and networking skills of the Finnish students and, moreover, make it easier for the foreign degree students to integrate in the Finnish student community.
- **Practical training:** The curriculum contains a mandatory practical training worth 30 ECTS credits. During the evaluation process it was identified that the learning objectives and, especially, the assessment of the practical training course need to be updated and improved.
- **CDIO awareness:** Already for some years now, the programme has been developed according to the goals set by CDIO standards. However, the awareness concerning CDIO and its elements is not on a very high level, especially among students. Thus, actions to improve this will be planned and implemented.

Case KTH

In KTH the Chemical Engineering programme from the School of Chemical Science and Engineering participated to the QA in HEI project. The programme is not a fully fledged CDIO programme yet, but it is inspired by the CDIO initiative and has informally adopted many CDIO ideas over the years. So far, the main focus of the programme has been on the integration of communication skills. Last year, KTH has decided to proceed and implement CDIO in all programmes, and now more coherent plans are being formed for each programme, including this one.

The self-evaluation process of the three-year Bachelor programme in Chemical Engineering focused on creating a programme description. The actual CDIO evaluation and rating have not been done yet. The programme description will be used, firstly, in teacher meetings and, secondly, for the actual evaluation and rating. The self-evaluation process itself was very time-consuming work. This should be discussed and possible changes to the guidelines should be considered.

The programme description is well done and there should be possibilities for taking advantage of it. For example, based on the self-evaluation, the Chemical Engineering programme identified several strengths and weaknesses concerning the programme. The major findings regarding potential development actions are the following:

- **Programme organization – programme management team including student representatives:** The student representatives for Chemical Engineering programme should be included in the programme management. So far the role of the representatives has been slightly unclear.
- **New funding systems – reflections to quality?**
- **International aspects:** the programme is intended to prepare students for advanced studies and as part of that, the students should be required to learn adequate technical English.

Case DTU

The self-evaluation process of the Bachelor of Engineering programme in Chemical and Biochemical Engineering at DTU was conducted somewhat differently from the other

programmes involved in this project. After having been introduced to the project and its aims by the local Nordplus project coordinator, the director of studies formed an evaluation group consisting of two teachers, two students and himself. This group collected the data for the self-evaluation report by looking through the official documents (the syllabus etc.) and by talking to fellow teachers and students in order to include their opinions and experiences. They then wrote the self-evaluation report in close collaboration and subsequently discussed the report in the department board of studies.

In order to take the self-evaluation a step further, the report and the findings were discussed at an evaluation meeting at DTU with the participation of all directors of studies and the dean of studies. The purpose of this meeting was to share the findings with director of study colleagues and to identify and discuss actions for improvements of the programme in question as well as study programmes at DTU in general. Since many programmes face the same challenges, this meeting seemed valuable to all the participants and some more general conclusions were drawn. The most important of these was the creation of so called helicopter documents showing the ideas behind the study programme and describing the structure and progression of the programme. In other words, it is a detailed description of all the details which are not covered in the official programme documents. The content of this document should be well known to all teachers in the programme and it should be revised regularly in order to reflect the actual situation at any given time.

In the light of the various discussions of the self-evaluation report, the director of studies and the local project coordinator drafted a document containing several development areas. So far only a few of these areas have been addressed but more will be addressed in relation to and in the wake of the peer evaluation process with KTH, which has not yet been carried out.

The self-evaluation of the BEng in Chemical and Biochemical Engineering identified several strengths and weaknesses concerning the programme. The major findings regarding potential development actions are the following:

- **Learning assessment:** It is a challenge to assess CDIO skills in the evaluation. This is a challenge for all programmes at DTU and probably all CDIO programmes by and large. Ways of improving assessment of CDIO skills will be considered in the future.
- **Validation of learning outcomes by stakeholders (in particular, students and industry):** This kind of validation is done only to a certain extent at the moment. Ways of improving this in the future will be considered, ie. with more systematic discussions with the advisory boards and using scheduled graduand surveys.
- **Alignment of learning objectives at course level and competence profile for the programme:** The programme has been developed according to the goals set by the CDIO standards for some years already. However, the competence profile must be more properly aligned with the learning objectives at the course level. There are a few of the qualifications in CDIO syllabus category 4 that are not yet addressed properly in the study programme (in particular, 4.3, 4.6 and 4.7). The possibilities for incorporating these qualifications in the study programme in the future should be discussed.
- **CDIO awareness:** A “helicopter document” that shows the ideas behind the study programme and describes the structure and progression of the programme should be produced. The content of this document must be well known by all teachers in the study programme and should be revised every year in order to be constantly updated. There still is a high degree of privacy about teaching and evaluation methods. It seems that there is a great potential for improvement of the communication among teachers. More systematic meetings in teacher teams are a possibility. In the BEng programme in Chemical and Biochemical Engineering at DTU the students work in the phases C-D-I. The only possible contact with the O-phase is in the engineering training in the industry. It is difficult to work with the “Operate”-phase in chemistry. How this phase can be treated should be taken in examination.

Case Metropolia

At Helsinki Metropolia University of Applied Sciences, the implementation of strategy, the operations and achieving the objectives are evaluated systematically. The operations are enhanced and improved based on the results from the evaluation and feedback systems so that Metropolia provides services to meet the needs of our customers, i.e. students and other stakeholder like industry, organisations and society.

The operations of the institution are developed in a co-operative way together with staff, students and stakeholders. The implementation of the major objectives of Metropolia, and developing its operations, quality and competitiveness are based on continuous improvements according to principles of PDCA (Plan – Do - Check - Act).

The Quality Assurance system is based on strategic leadership and management, supportive core processes, information and feedback systems, described processes and their guidelines and organization and responsibilities.

The implementation level of CDIO approach has been carried out in 2009, just one year after Metropolia became a collaborator in CDIO. The results were not so reliable due to the diverse viewpoints towards CDIO, but the evaluation was a good start-up to increase the awareness of CDIO as a concept.

In 2010, a self-evaluation process was carried out and it was based on the new strategic objectives which were set for the entire Metropolia:

1. Highest throughput in Finland
2. Customized and efficient processes
3. Best teaching in Finland according to the feedback of students
4. Best working place in Finland based on the great work places contest
5. Eligible strategic partner (in partnerships and in international networks)
6. Expertize and qualified employees to the region
7. Economic freedom to maintain the HEI autonomy

Key findings of the self-evaluation in SWOT-format are shown in the figure below.



Figure 1. SWOT of Metropolia.

We identified the development areas and we are facing four major challenges:

1. How to supervise and manage a great number of innovation projects running simultaneously
2. How to increase the knowledge of students of developing an international career in engineering. Some actions have been taken, including the following: International ICT week for international and domestic students
3. To manage better the work placement arrangements - improve the connection between industry and Metropolia
4. Integrating teaching activities, increasing CDIO awareness and carrying out the implementation

DISCUSSION

The project met well all the planned objectives:

- 1) Guidelines and evaluation criteria for self-evaluation process have been created.
- 2) Each HEI has documented their participating degree programme in detail.
- 3) Each participating programme has done the self-evaluation.
- 4) Each programme has identified the main development actions based on the self-evaluation.
- 5) Understanding of other partners and their challenges has increased.
- 6) The quality assurance has been developed in each participating programme.

The guidelines and evaluation criteria for self-evaluation process were successfully used. The developed self-evaluation model functioned, but at the same time it was a very time consuming process. However, the process was also rewarding in the sense that those who have been working with the report have gained a very good overview of the programme. Furthermore it is valuable to be “forced” to look closer at one’s own programme.

The self-evaluation documentations were very thorough and they described the programmes well. In this sense, it seems that the guidelines and criteria provide useful help for the self-evaluation. Finally, the self-evaluation helped the programmes to identify possible development areas. Now the programmes have material and evidence for programme development. Interestingly, the development areas were partly overlapping and showed common needs for development, which could promote future co-operation.

The self-evaluation contained rating the performance with the CDIO standards. In this project we still used the older set of standards where there were no individual rubrics for each standard. This scoring is a rewarding and easy way to show progress in development, but it does not guarantee comparability with other programmes. The scoring is still a very subjective process. Therefore it is important that reasonable rationales for the scores are attached, because otherwise it is difficult to show and analyze the progress. The new CDIO standard version with the rubrics is a step forward.

The co-operation between project partners has been successful and deepened since the beginning of the project. Every partner HEI has been committed to the project objectives and timetable. Regular meetings between project partners have been very fruitful and given plenty of new development ideas. The project has started a close cooperation between the Nordic partners and we intend to continue working together in the area of quality assurance in education in the future. All experience gained from self-evaluation work will be utilized also in the future while evaluating degree programmes in individual HEIs.

CONCLUSIONS

The self-evaluation model created in this project is a good tool for improving quality assurance in higher education. The model provides easy-to-follow guidelines and criteria for self-evaluation. However, the model also needs some modifications, such as the exact content of the self-evaluation report, that are going to be discussed at the end of the whole project.

The project focused on engineering education, and thus the participating HEIs and degree programmes represented the engineering field. Although the educational challenges nowadays concern higher education in a general level, especially engineering education is challenged to develop new methods of quality assurance work in order to produce experts that meet the growing demands of working life. However, the project results can be further developed and adapted also to other educational fields by refining the methods and tools produced during this project.

The project encouraged the programmes to do self-evaluation and to define the development areas. Hopefully the project also created a quality assurance spirit into the programmes and self-evaluation will become a regular method in quality assurance of the programmes.

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Biographical Information

Dr. Juha Kontio is a Director of Education at the Faculty of Telecommunication and e-Business in the Turku University of Applied Sciences. He is the CDIO contact person at the Turku University of Applied Sciences.

Dr. Janne Roslöf is a principal lecturer in Software Engineering at Turku University of Applied Sciences (TUAS). He is also the head of the B.Eng. Degree Programme in Information Technology at TUAS.

Kristina Edström is an Engineering Education Research & Development expert at the KTH. She is the CDIO contact person at the KTH.

Peter Munkebo Hussmann is an Evaluation Consultant at the Learning Lab in DTU.

Lic. Tech. Katriina Schrey-Niemenmaa is a senior lecturer and project manager for engineering education for the Schools of Engineering in Metropolia. She is active in many professional national and international engineering associations.

Markku Karhu is the head of the degree programme in Information Technology at Helsinki Metropolia University of Applied Sciences. He is the CDIO contact person at the Helsinki Metropolia University of Applied Sciences.

Corresponding author

Dr. Juha Kontio
Director of Education
Faculty of Telecommunication and e-Business
Turku University of Applied Sciences
Joukahaisenkatu 3 C
20520 Turku
Finland
+358 50 3854122
juha.kontio@turkuamk.fi