

# Chapter 8

## CDIO Standards Implementation and Further Development in Russia

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### ABSTRACT

*Russian experience in the implementation of CDIO (conceive, design, implement, operate) standards for modernization of BEng programs focused on graduate training for complex engineering activity are considered. The CPD program “Applying CDIO Standards in Engineering Education” for managers and faculty staff at Russian HEIs is described. Further development of the CDIO concept for MSc and PhD engineering programs design are discussed taking into account the priorities of innovative and research engineering activities. The FCDI (forecast, conceive, design, implement) standards focused on MSc program graduate training for innovative engineering activity and FFCD (foresight, forecast, conceive, design) standards focused on PhD program graduate training for research engineering activity are presented.*

### INTRODUCTION

More than a hundred universities around the Globe implement *CDIO Standards* to engineering education. The standards are based on the CDIO (Conceive, Design, Implement, Operate) approach to training basic engineering education program graduates to prepare them for *complex* engineering activities at all stages of the life cycle of technical products, processes and systems (Crawley et al, 2014).

The CDIO approach is widely used, as it is consistent with the requirements of International Engineering Alliance (IEA) Standards (*IAE Graduate Attributes and Professional Competences*) to the engineering HEI's graduate learning outcomes (LOs) and competences of *Professional Engineers*. The CDIO Standards allows the design and implementation of BEng programs in accordance with the criteria for accreditation of engineering programs in the countries - signatories of the *Washington Accord*, including the accreditation criteria of the Association for Engineering Education of Russia (Chuchalin, 2012; Brodeur, 2012).

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## **CDIO STANDARDS IMPLEMENTATION**

The CDIO Standards have become popular in many Russian engineering HEIs.

In 2010 the Tomsk Polytechnic University (TPU) began to implement CDIO Standards to modernization of BEng engineering programs. In 2011 TPU formally joined the CDIO Initiative as the first Russian university member. In 2014 the first cohort of Bachelors, trained at TPU under the CDIO programs, graduated. The CDIO programs at TPU were accredited by the Association of Engineering Education of Russia (EUR-ACE Labeled) and by Accreditation Board for Engineering and Technology (USA), the most prestigious engineering organization in the world. Thus, the high quality of the TPU CDIO programs was officially confirmed. Following the example of TPU a dozen Russian HEIs have implemented the CDIO Standards and formally joined the CDIO Initiative.

In 2013 TPU and Skolkovo Institute of Science and Technology (Skoltech) designed and piloted a joint CPD program “Applying CDIO Standards in Engineering Education” in order to ensure proper preparation of managers and faculty staff at Russian HEIs to use the CDIO approach. The CPD program was based on the experience and best practice of engineering programs’ modernization at universities participating in the CDIO Initiative. In total, 27 experts from 6 Russian HEIs: TPU, Skoltech, Ural Federal University, Astrakhan State University, Moscow Institute of Physics and Technology, Tomsk State University of Control Systems and Radio-electronics and 5 foreign HEIs: KTH Royal Institute of Technology, Chalmers University of Technology (Sweden), Delft University of Technology (The Netherlands), Technical University of Denmark, Massachusetts Institute of Technology (USA) were involved in the design of teaching and learning (T&L) materials, as well as in the program implementation (Chuchalin, Tayurskaya, & Malmqvist, 2015).

The CPD program consist of 5 modules designed in compliance with the CDIO model: Conceive, Design, Implement, Operate. At the initial stage, the trainees define the particular engineering program (course) to be improved by applying the acquired knowledge and skills. While studying the sections of the 1<sup>st</sup> module, the trainees pass through the ‘Conceive’ stage of the particular engineering program (course). They develop program (course) objectives and learning outcomes necessary for future professional activity and make them aligned with the key stakeholders (employers). Individual projects of the 2<sup>nd</sup> and 3<sup>rd</sup> modules are focused on the ‘Design’ and ‘Operate’ stages of the particular engineering program and its elements. During the 4<sup>th</sup> module at the ‘Implement’ stage, the trainees develop assessment methods and criteria of students learning outcomes achievement, as well as evaluate the particular engineering program for its compliance with CDIO Standards. The 5<sup>th</sup> module is devoted to faculty staff development for CDIO implementation and enhancing their competency for teaching.

The first version of the CPD program “Applying CDIO Standards in Engineering Education” was scheduled for delivering during a 16-week academic semester and involved 3 face-to-face interactive lectures and practical classes, 2 Internet on-line webinars and 4 individual assignments given as homework. The pilot test of the CPD program started in Spring semester of 2013–2014 academic year. The face-to-face sessions were organized in Russian and foreign universities with experience of the CDIO Standards implementation. Broadcasting of on-line Internet webinars were arranged by TPU instructors. All organizational, T&L materials based on learning management system (LMS) *Moodle* were available on the TPU website.

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