

CDIO IN GDANSK: PEOPLE-ORIENTED STRATEGY

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ABSTRACT

The CDIO system implementation in Poland meets problems and Gdansk University of Technology (GUT) is still a single higher education institution in Poland accepted as the member of CDIO Initiative. The paper detects and characterizes the existing problems to be solved. In particular, the different groups of people are considered as supporters or fighters against CDIO idea, their attitudes being considered and applied strategy demonstrated.

The first supporting group includes industrials, especially owners and leaders of small and medium enterprises. The second group is composed of students, who want to be more industry-oriented, thus possessing more chances for a better appointment. They are especially interested in change in curricula, in team projects, in performing the projects based on their own ideas.

The only group which may be against the CDIO implementation is the academic staff. The main objections appear against two important pillars of CDIO system: team projects and new complex curricula. Those determinants are carefully analyzed and described to the specific work conditions in Poland, like conservative attitudes, law limitations, management and financing problems, bureaucratic problems, shortage of time and staff. The people-oriented strategy involves at GUT, among others: invitation of all deans and faculty members for partnership in CDIO implementation; preparation of 15 Mio Euro worth project; preparation and implementation of a special Faculty Development Program in order to change the attitudes of teachers and make them supporters of the CDIO educational system.

KEYWORDS

CDIO implementation, attitudes, determinants, Faculty development

CURRENT EDUCATION SYSTEM IN POLAND AND CDIO IMPLEMENTATION; SUPPORTERS AND FIGHTERS

Current education system in Poland is based on both public universities and private high schools. The overall number of higher education institutions is 470 now, 132 of this number are public [1].

However, it is confusing as also private players on education market are financed more and more by the Ministry of Higher Education and its agencies, like National Centers of Science and Research and Development, and a number of other bodies, like e.g. Foundation of Polish Science. At present, the higher education level is mainly determined by public universities of human sciences, economy and law, technical universities and medical universities.

It is characteristic that in Poland the Gdańsk University of Technology (GUT) is still the only higher education institution in Poland accepted as the member of CDIO Initiative [2]. The reasons are numerous: weak knowledge about the Initiative, other obligatory methods of education quality evaluation, expectations estimated as too high, weak financing of the higher institutions in Poland. Probably also the weakness of external organizations and their marginal influence on the teaching process and contents does not create sufficient pressure on the Universities. It seems that also the increasing popularity of technical studies among the candidates makes the universities feel safe and not seeking additional recruitment. Despite the demographic decline the technical universities have observed the increase of the number of candidates [3].

GUT has been accepted 3 years ago as a member of CDIO Initiative. Since that time we have recognized the existing and specific for Poland problems to be solved. In particular, the different groups of people are considered as supporters or fighters against CDIO idea, their attitudes being considered and applied strategy demonstrated. The supporters include: industrials, enthusiast and market oriented students, enthusiast Faculty members, authorities starting from the university level and ending at the Ministry of Science and Higher Education. The fighters against the CDIO idea may be, surprisingly, found among teachers. The reasons and countermeasures are discussed below.

IMPORTANCE OF INDUSTRIALS

The first strongly supporting group includes industrials, especially owners and leaders of small and medium enterprises; they want to have graduates with necessary skills, especially those able to create the innovative products, to lead or to work inside a team, to make risk analysis. However, there is a need in Poland to prove that the financing the team projects is usually a benefit for an industrial organization.

GUT is one of the mostly assessed technological universities as far as the managing capacities of graduates in Poland are concerned. Despite that, the present educational system and curricula, in particular, are criticized by industrials. The interest of industrials in modifications of curricula was demonstrated by the active participation of Alumni Society in the conference organized at GUT and devising a manifest to the university and local authorities [4]. The industrials claim they need from 6 months (graduates from Faculty of Chemistry) to 2 weeks (graduates from Mechanical Engineering Faculty) to teach the graduates basic engineering everyday skills not to mention team cooperation, project management, risk analysis. The self-presentation is among highly assessed skills. It should also be said that these soft skills, important for CDIO scheme are missing in the curricula of the students of engineering faculties participating in the project. The importance of such skills is ranked much below the importance of detailed technical knowledge and engineering skills.

A bit of recent history of Polish economy is probably needed to explain the ties of GUT with the industry. Before 1989 in Eastern Block Poland with a centralized economy and a large sector of heavy industry, universities had quite tight relations with big factories including not only R&D

activity but also positions for students for their apprenticeships, subjects and support for diploma projects and finally stable employment. In Pomerania Region the strength of the marine industry was demonstrated by four large shipyards and many cooperating smaller factories including strong sector of hydraulic machinery and sector manufacturing ventilation/air conditioning/cooling equipment. Then, in the transition period (1990's) these companies had to change their products and in general downsized considerably. Now, quite a lot of new companies take over, including mainly IT companies, biotechnology, small shipyards, small machine building/automatics and control companies, but still the industry in the northern Poland is weak. Even if the industrials are the strongest supporters, the fact that there are in majority SME's representatives, the financial support from the industry, especially in northern Poland and in economic crisis era, is insufficient for thousand of graduates each year. Such interest and support may be prevalent in IT area and very low in civil engineering, which is huge education field in Gdańsk and a big, but very dispersed branch of local economy. Potentially formal organizations integrating the companies are a good partner for the Universities and local authorities, but still the development of clusters is at an early stage [5]. GUT is a partner of an industrial cluster KlimaPomerania integrating firms from the sector manufacturing ventilation/air conditioning/cooling equipment, but this initiative is at the early stage of development and apart from discussions and expression of interest in the modification of study contents and closer cooperation with the University did not get any further, so far. This is a main reason for which the approach to CDIO idea is modified at GUT: in the IT sector where interest of industrials is great, the team projects are obligatory, and in e.g. materials engineering they constitute some 50%. However, we make the situation reverse: we do not expect the industry to propose projects, we expect the students to find and make the industrials interested in the projects proposed by our students. Taking this reason into account (and some others, and discussed later on), it is proposed in the Materials Engineering course, for example, that at present one engineering project is performed within the Engineering Thesis, starting from 5th Semester and finishing in 7th. Semester. The 5th Semester is devoted, among others, to create an idea of the project and find industrials or at least industrial application; in other words, to solve both engineering and business problem.

INTEREST OF STUDENTS

The second supporting group is composed of self-conscious students (by no means the majority!), who want to be more industry-oriented educated graduates, thus possessing more chances for a better employment. The reasons are numerous. At first, the students themselves are especially interested in change in curricula. They complain that they must learn or be taught too much in narrow engineers fields and not at all in business, project planning and performing team work. Graduates interviewed at the end of their studies about the courses character point the need to enhance practical aspects of engineering knowledge and increase the volume of design exercise. Some of them also point out that they should have the possibility of manufacturing something on the basis of their own designs: "...there is the need that we have the opportunity to participate in manufacturing the objects we have designed, at least to some extent..." [6]. Following such opinions, the curricula will be gradually changed to the CDIO model, at least in some 30%. The changes will include: performing the engineers' project in 5th Semester (creation of idea, finding the financial aids, creation of project team and a leader, planning the project), 6th Semester (design and implement) and 7th Semester (implement and operate). The courses will be joined together; at GUT there are over 6500 courses [7] and in Lodz University of Technology – only 2500 courses for comparable number of students [8]. The most difficult problem will be implementation of no engineering courses, as there is a shortage of specialists in such fields like project planning or risk analysis among the faculty staff.

Many students really admire self-dependent creation of the engineer projects. The project teams which follow this idea have been formed since 3 years in Materials Engineering. Figure 1 shows an example of a result obtained for such a project. A student wanted to create a seat for a small child to play, when his/her mother would like to make another thing just nearby. Even if it has not been a team project and had some faults (insufficient safety, for example), it has also great advantages: the seat could be packed in a woman handbag before and after the use, and one had to spend only 40 Euro. The invention is under patenting and most likely will be manufactured in Poland.

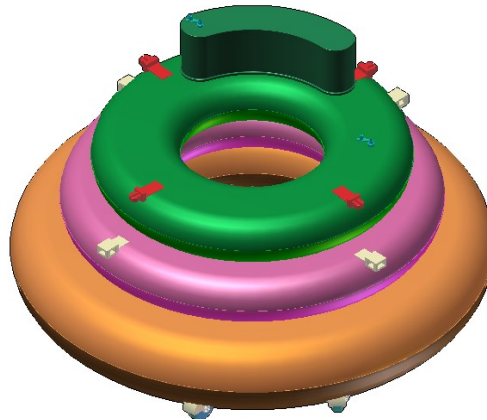


Figure 1. Engineer project: mobile seat for a small child

At the Mechanical Engineering Faculty even without the CDIO scheme there were quite many diploma projects carried out in Conceive-Develop-Implement-Operate stages. Quite recently the students of a new course of Engineering in Medicine also started to build prototypes of various medical equipment as their diploma projects (Figure 2).



Figure 2. Engineering diploma project - bathing armchair for a handicapped person and a device for rehabilitation of scoliosis [9]

Before, most often there were various vehicles being designed and built by car-enthusiasts. The examples are shown in the photographs in Figure 3.



Figure 3. Engineering diploma project - vehicles designed and built by groups of students of the Faculty of Mechanical Engineering

The team projects also become more popular among students outside the official educational programs. Even if on the average team projects are performed by 2 to 5 persons, the greatest such project, the Green Car, includes 170 students and is self-organized. Enthusiast students under a good supervision are successful in international engineering contests, including IT - competitions in programming but also outside virtual reality - a good examples being the students of the Shipbuilding and Ocean Technology Faculty taking part in Solar Boats Regatta in Netherlands and Waterbike Regatta organized in various European countries (Figure 4).



Figure 4. A solar boat and a water bike designed and built by GUT students for students competitions [10], [11].

The students are also very interested in performing the projects with their colleagues from different Faculties and even universities. The mostly developed are such projects organised by students from Mechanical Engineering and Architecture Faculty, and interfaculty (i.e. with students of Architecture, Mechanical Engineering, ICT) projects, finally – in possibility of performing the projects based on their own ideas. Specifically, the students are themselves looking for industrial projects and financial support from industry, even abroad.

SUPPORT FROM AUTHORITIES

The last, but extremely important supporting group is constituted by local and national authorities. This idea is personally and openly supported by the Polish Ministry of Science and Higher Education and the leadership of Pomorskie voivodship. The minister, Professor Barbara Kudrycka, has herself given a paid announcement in the greatest Polish newspaper “Gazeta Wyborcza” showing the GUT as a first higher institution in Poland to implement the CDIO system and encouraging other universities to follow it. The authorities of GUT are also devoted to implementation of CDIO standards into the curricula – in order to facilitate its introduction they decided to apply for an infrastructure grant co-funded within EU structural programs, aimed at building and equipping the facilities necessary to enable students’ activity within CDIO projects.

FINANCIAL SUPPORT FROM GOVERNMENTAL AGENCY

The best evidence of interest of the authorities has been granting the 15 Mln Euro for a project entitled “Infrastructure for education of an Engineer of Future”. The project is supported by the European Union funds aimed at the development of infrastructure in the new member states (Infrastructure and Environment). Within the project it is planned to build and purchase equipment for various laboratories.

Three Faculties and a Mathematics Teaching Centre participate in the project. The Faculty of Mechanical Engineering is the largest participant with the plans comprising adding one floor to the faculty building (ca. 1350 sqm of new space) with laboratories, lecture halls, student workspace. It is also planned to rebuild 2 large laboratories (ca. 1000 sqm) into the CDIO workspace equipped with appropriate machines and also computer laboratory with simulation and CAD software (Figure 5 and 6).



Figure 5. Laboratory devoted to the students workspace - at present and architectural vision after rebuilding [12]

The other elements of the infrastructural project comprise:

Faculty of Architecture - Students workspace - 3D and Rapid Prototyping equipment (Figure 7)

Faculty of Ship Building and Ocean Technology - large Laboratory hall - students space

Mathematics Teaching and Distance Learning Centre - lecture and seminar rooms and computer labs for the courses in mathematical simulation in engineering.

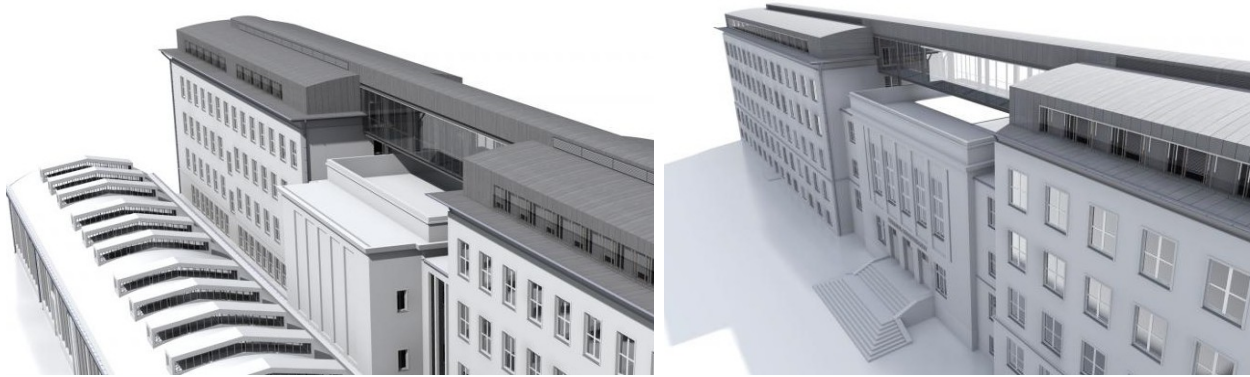


Figure 6. Planned fifth floor added to the building of Mechanical Engineering Faculty [12]



Figure 7. Planned students space at the Faculty of Architecture [12]

ATTITUDES OF TEACHERS

The only group which is not a strong supporter the CDIO implementation is the academic staff. The main objections appear against important pillars of CDIO system: team projects and new complex curricula and also the introduction of non-technical courses aimed at training soft skills instead of narrow specialist technical courses. Since GUT is the only Polish University introducing CDIO scheme, there is no deeper knowledge, based in broader surveys to prove these findings of the discussions carried out at the faculties. These determinants are carefully analyzed and described to the specific work conditions in Poland, like conservative attitudes, law limitations, management and financing problems, bureaucratic problems.

In the recent years GUT has admitted at least 25% more students than before without any increase in the staff, in the same time new regulations concerning changes in the contents of curricula were introduced forcing the staff to prepare modified courses. As a result Faculty staff at most faculties are overworked and in majority not ready for revolutionary changes. On the other hand, however, there is a group of lecturers who have always been student-oriented and who are more willing to introduce changes in the methods of teaching. There have been many active and successful student scientific sections supervised by such enthusiast teachers. Enthusiastic approach and internal motivations of the teachers are crucial because the academic career in Poland is based on scientific progress assessed by the success in obtaining

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subsequent academic degrees or positions, with as many as 5 major steps in the course of this career - usually: PhD, DSc (habilitation), Associate Professor position, Professor title and Full Professor position. Teaching activity and standards are formally required, but treated much less seriously.

PEOPLE-ORIENTED STRATEGY: GENERAL ASSUMPTIONS AND PILLARS

The people-oriented strategy involves at GUT, among others: invitation of all deans and faculty members for partnership in CDIO implementation (five of nine faculties and 2 of three educational centers answered this invitation); preparation of project involving the interested faculties and asking the governmental agency to support the CDIO implementation at GUT thanks to European funds; establishing the Proxy of Rector for CDIO as also the leader of the University CDIO Team; start of the development by CDIO Team members and teachers outside the Team the CDIO self-implementation program including both tasks and expected effects, and timetable; and finally the preparation and implementation of a special Faculty Development Program in order to change the attitudes of teachers and make them supporters of the CDIO educational system.

OVERALL CONTRIBUTION IN CDIO IMPLEMENTATION

The contribution of 9 Faculties and 3 Education Centers is totally voluntary at the GUT. So far, 5 Faculties and 1 Education Center have expressed their interest in CDIO implementation. The less interested seem the Faculty of Technical Physics and Applied Mathematics, and Faculty of Management and Economics, in both cases not typical engineering Faculties, although the staff of the Faculty of Management and Economics may be helpful in providing supplementary education in soft skills. Similarly Faculty of Physics and Centre of Math Education will be involved in teaching oriented towards modeling of physical phenomena and application of appropriate software for math modeling and simulation.

Apart from inter faculty cooperation for which mechanical and IT or automation and robotics seem most natural it is also expected that some team projects in the course of Mechanical Engineering in Medicine will be executed in cooperation with Medical University of Gdańsk.

ESTABLISHING OF THE PROXY OF RECTOR AND CDIO WEBPAGE

The Proxy of Rector has been nominated, at the beginning it was Professor Andrzej Zieliński, initiator of applying to CDIO Initiative by GUT. Now he was substituted by Professor Michał Wasilczuk with a task of representing GUT at CDIO Consortium, to participate at world and regional conferences, to learn about CDIO implementation in other Universities and to apply CDIO Standards to local conditions and constraints and finally to coordinate implementation of the standards at GUT. Professor Edmund Wittbrodt was nominated as the Main Co-ordinator of the project.

ELABORATION OF CDIO IMPLEMENTATION SCHEME AND TIMETABLE - IDENTIFIED PROBLEMS

In general the CDIO implementation will follow the chart (Figure 8). As mentioned above, managing the team project may create problems to the staff since, among the staff of the engineering faculties the detailed technical knowledge is at the high level, while they might not be aware of contemporary methods of training soft skills and we will have to arrange some courses and workshops according to the 10th CDIO standard.

It is also quite obvious that financial side of the realizing the projects will have a crucial influence of the number of the projects we will be able to realize, bearing in mind limited chances for bigger financial involvement of the industry.

Going down to technical details - we are not aware how the danger of accidents during the use of various machinery can be avoided and how to avoid potential risks of claims.

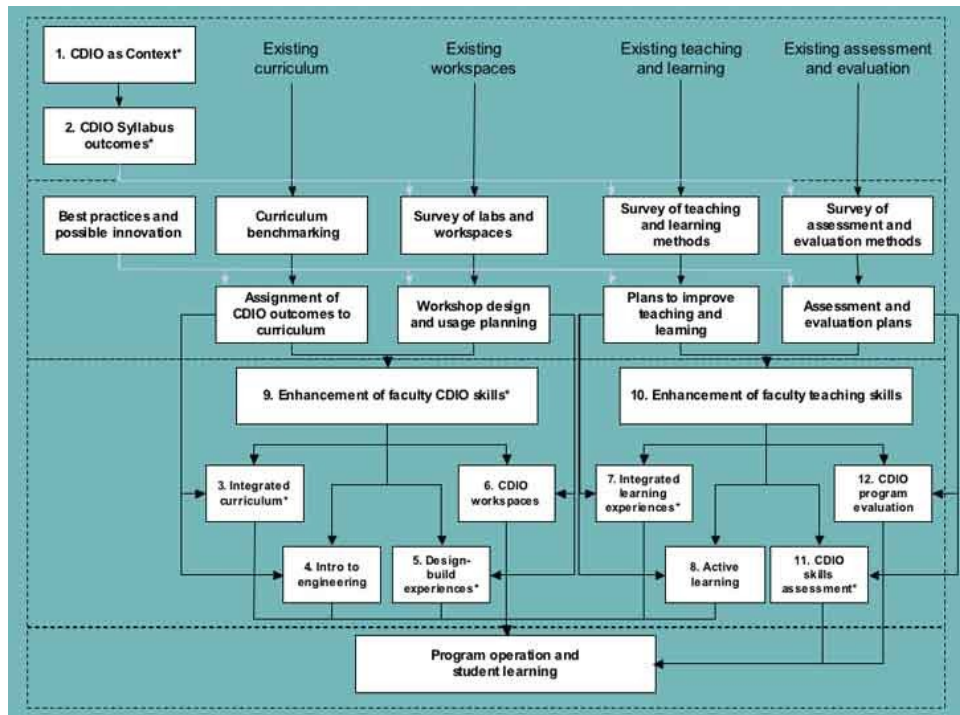


Figure 8. CDIO adoption process chart [2]

CONCLUSIONS

In the course of meetings and discussions some specific problems for CDIO implementation in GUT, or in some cases more generally, in Polish universities were identified. The main are:

- centralized and over-regulated rules of creating curricula imposed by certifying bodies;
- financial problems including lack of modern equipment, not sufficient financing of everyday operation, deficiency of labs and lecture rooms
- weak industry in northern Poland, not ready to cooperate and to take part in co-financing of student diploma projects;
- overworked staff not ready for changes and lacking knowledge in the field of soft skills training;
- lack of staff ready for modern teaching and training of soft skills.

On the other hand, financing of the infrastructural projects will for sure increase the motivation and improve the conditions of implementing CDIO at GUT. It also shows the involvement of University authorities into adoption of the new teaching methods.

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BIOGRAPHICAL INFORMATION

Michał Wasilczuk, Associate Professor at GUT, Head of the Department of Machine Design and Automotive Engineering, former Vice Dean for Development and a newly appointed Proxy of the Rector of GUT in the CDIO Initiative, lecturer of machine design, and a researcher in the field of tribology and bearing systems. The author of 2 books and more than 100 papers and conference contributions and numerous research and development studies for the industry.

Edmund Wittbrodt, Full Professor at GUT, Head of the Department of Mechanics and Mechatronics, former Dean of Machine Design Faculty, former Rector of GUT, former V-Chairman of the Main Council of Higher Education, and also former Minister of National Education of the Republic of Poland. The author of 25 books, more than 250 papers and conference contributions, academic teacher since 1972 in applied mechanics, automatic control, robotics, biomechanics, and computer methods in mechanics. Since 1997 He is also Member of the Senate of the Republic of Poland. Nominated by the Rector of GUT as the Main Co-ordinator of the project.

Andrzej Zieliński, Full Professor at GUT, Head of the Materials Science and Engineering Dept., Director of Advanced Materials Center, former Vice-Rector for International Cooperation and European Projects. Due to his initiative and activity GUT joined CDIO community, he was the first Proxy of Rector in CDIO initiative. The author of more than 300 papers and conference contributions, academic teacher since 1982 in materials engineering and biomaterials.

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