Using Deming cycle for strengthening cooperation between industry and university in IT engineering education program

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Abstract — **European Qualification Framework (EQF) forces universities to strengthen the cooperation with industry. Although EQF guidelines were introduced as obligatory into Polish educational system this year, Lublin University of Technology (LUT) had opportunity to implement EQF outlines into educational program earlier, especially in area of cooperation with industry, thanks to educational project for reengineering of second level degree program in Computer Science. To improve the quality of the established cooperation and thus to strengthen it the Deming cycle was used. The paper presents the evaluation of LUT cooperation with industry made after the project. It also discusses gained experience. The main study method was the survey conducted among industry representatives. The survey was focused on three groups of ICT company employers: internships supervisors, MSc thesis industry consultants and high technical managers. The conclusions in research and the plan of those implementation to improve the cooperation between ICT industry and LUT in the Computer Science education field are presented as well.**

Keywords – engineering education, cooperation with industry, lesson learned, Deming cycle, PDCA cycle, improving quality

INTRODUCTION

The European Qualification Framework (EQF) helps to define gained qualifications and to standardize them over European countries. One of its main aims is to promote and support cooperation between university and industry. The mentioned cooperation has two goals. Firstly, it should enable industry participation in curricula development. Secondly, it should provide industry involvement into educational process through activities such as: internship, MSc thesis supervisory, training or seminars conducted by industry professionals at university [1].

On the other hand, the character of IT industry is highly dynamic. IT technologies, methods, trends and standards are constantly extended or changed. It is highlighted by recent interest in virtualization and cloud computing technologies. To follow those changes universities need to provide the dynamic and iterative collaboration process [2].

Lublin University of Technology (LUT) has the opportunity to implement EQF guidelines into educational

process through activities undertaken in the project "A graduate of our time". Despite the project is finished, LUT will continue the cooperation with industry. Thus, to strengthen and adjust the cooperation, as well as to improve the quality of its outcomes, the evaluation method using the Deming cycle was proposed.

I. THE PROJECT "A GRADUATE OF OUR TIME"

The project is granted by Polish Ministry of Science and High Education to Lublin University of Technology (LUT), Lublin, Poland, and co-financed by the European Union under the European Social Fund. The aim of this project is reengineering of second (Master of Science) cycle of education on Computer Science in LUT by developing 5 new Master programs in Computer Science. Master programs are designed for graduates of the first cycle – Bachelor Degree (after 7 semester program) in Computer Science. Those graduates last three semesters and end with carrying out the Master thesis.

All project activities were carried out in close collaboration with software industry and other stakeholders of the project, including the students of Bachelor Degree on Computer Science.

During the project realization the seminars with representatives of the IT industry were conducted. These seminars helped to develop Master programs meeting the needs of employers [3].

The project gives students opportunity to held short practices and internships in companies. They are encouraged to prepare a Master thesis in consultation and collaboration with potential employer from industry. Students are also encouraged to take part in international seminars developed in cooperation with foreign universities experts [4],[5].

What is more, Knowledge Exchange Portal was developed and launched to organize knowledge exchange and contacts in the triangle: university-graduate-industry. The Knowledge Exchange Portal was designed as an element of long-term cooperation both with industry and with students [6]. The tool did not play its role as it was expected, because the exchange of knowledge and innovation requires the change in approach to the problem of knowledge sharing by companies and between

them. This requires long-term work on changing the mentality and business models of ICT companies to make them able to recognize the benefits of open innovation imperative.

II. THE DEMING CYCLE ADAPTATION FOR STRENGTHENING AND QUALITY IMPROVEMENT

The Deming cycle is the well-known method of quality management [7]. It is also known as Deming wheel, Plan-Do-Check-Act (PDCA) model or Shewhart cycle. The method consists of four phases:

- plan – to define the activities for the goal realization;

- do – to conduct those planned activities;

- check – to evaluate gained results and validate goal realization;

- act – to improve the processes and elaborate the new ideas or solutions which can be implemented in next cycle.

The phases of Deming cycle are repeated iteratively.

The essential activities of the project "A graduate of our time" were completed in last two years. The continued cooperation between LUT and IT industry is planned by LUT, so the check phase of Deming cycle was also performed to evaluate the gained experience of mutual cooperation.

The check phase consisted two main activities:

- the panel discussion,

- and anonymous evaluation survey.

The panel discussion was conducted during the final project conference with participation of representatives of IT industry, university authorities, students and academic staff. The conclusions derived from the panel discussion, as well as from the survey, are presented in the conclusion section.

The result from both activities of the check phase will be used to improve the processes and to strengthen the collaboration for next Master study realization at LUT which will start in next academic year.

III. SURVEY RESULTS

The survey was conducted anonymously during the project final conference and using the online questionnaire.

The survey was conducted on the group of 21 respondents. The survey respondents derived from three groups of ICT companies' employers taking part in the project: internships supervisors (84% of respondents), MSc thesis industry consultants (67% of respondents) and high technical managers (57% of respondents).

The goal of the survey was examine the quality of cooperation between industry and the university from the point of view of the following question: "Which areas of cooperation should be improved to enhance the quality of mutual cooperation?". According to this question it was also important to determine the motivation of industry to participate in each project activity and to indicate if their aim was achieved.

The research question has been decomposed into more detailed questions focused on three area of industry-university collaboration:

- curricula development,

- short practices and internships,

- and MSc thesis development process;

as well as on further cooperation.

The results of research in mentioned areas are presented below.

A. Curricula development

The responders were asked to assess the compliance of developed curricula with actual demands and needs of company. Additionally, the responders were requested to point out all difficulties appeared during curricula development process.

Only half of responders indicated that curricula is at least partly corresponding to their needs. Other half of responders were unable to assess the compatibility.

It is important to emphasize that 80% of responders pointed out infrequent meetings of representatives of both, university and industry as the main difficult in curricula development. Other problems are presented in Figure 1.

These results may lead to the conclusion that the companies were not adequately familiarize with the established curriculum. This could be the result of insufficiently frequent meetings with the university representatives as it is indicated in Figure 1. On the other hand, the attendance of company representatives during the project was not high enough due to their unavailability.

B. Short practices and internships

The responders were requested to evaluate the length of short practices and internships, to indicate students' main activities and fields in which their made the main progress. The responders had also possibility to specify difficulties in this area.

Results presented in Figure 2 show that students were assigned to develop the prototype of new products (69% of responders) and to implement outstanding tasks for which companies has no time or resources (63%). During internships, students also often worked on commercial projects together with fulltime employees (56%) and conducted research on new solutions or technologies (56%). Although 33% of responders indicated that length of practices and internships allowed students to complete tasks assigned to them, up to 64% responders pointed out that the length of internship was too short. This fact was regarded as a problem in the collaboration. Other difficulties observed during practices and internships are shown in Figure 3.

C. MSc thesis development process

The survey also checked the correspondence of MSc thesis developed in collaboration with industry. Results show that all of MSc thesis were connected with activities performed by students during internships. What is more, 61% of responders indicated that MSc thesis developed with industry collaboration increased students' motivation and engagement in internship activities.

The major problems for industry in this field were: legal problems related to copyrights, the form of an agreement with the university and the confidentiality of MSc thesis (64%).

D. Further cooperation

For better understanding of the industry interest in further collaboration, its previous motivation factors of collaboration should be known.
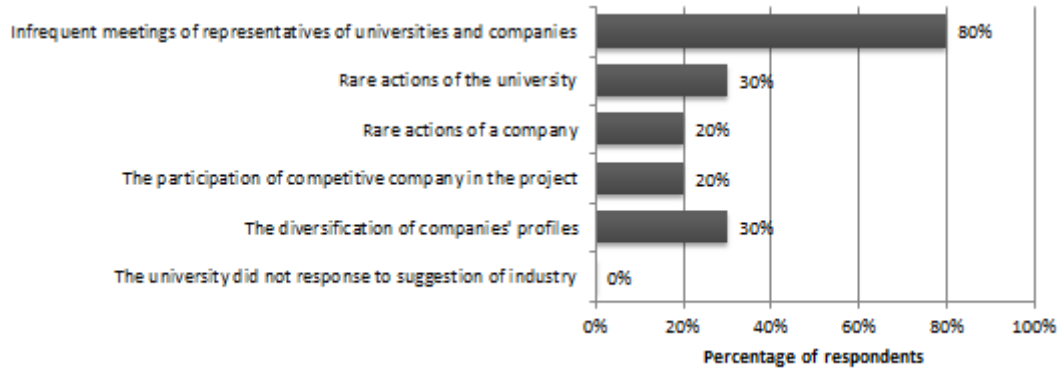
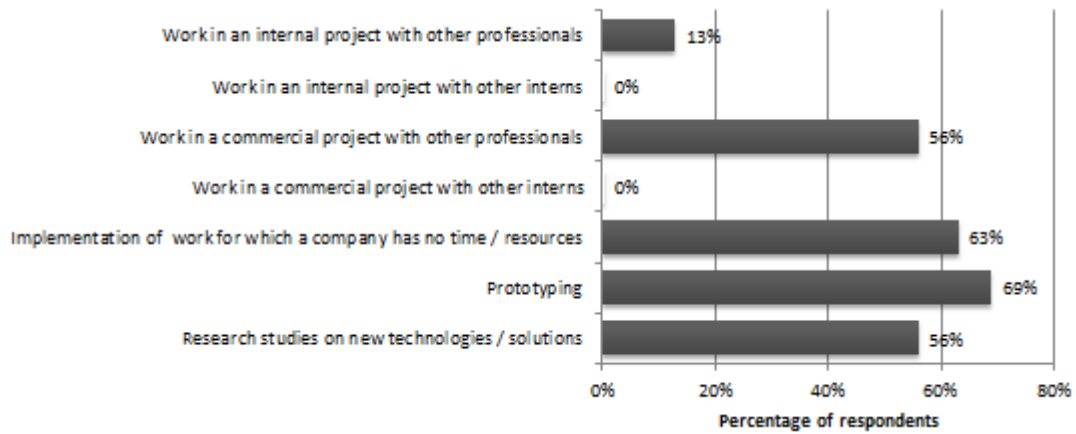Figure 1. The difficulties in curricula development

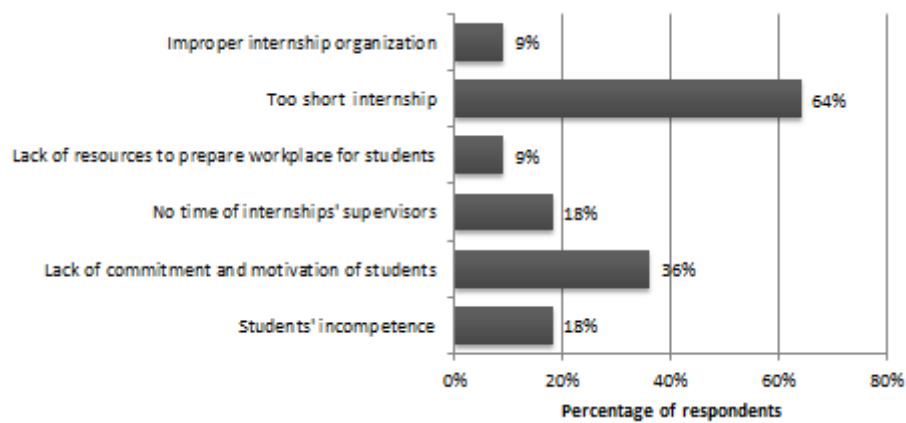Figure 2. Students' main activities during internships

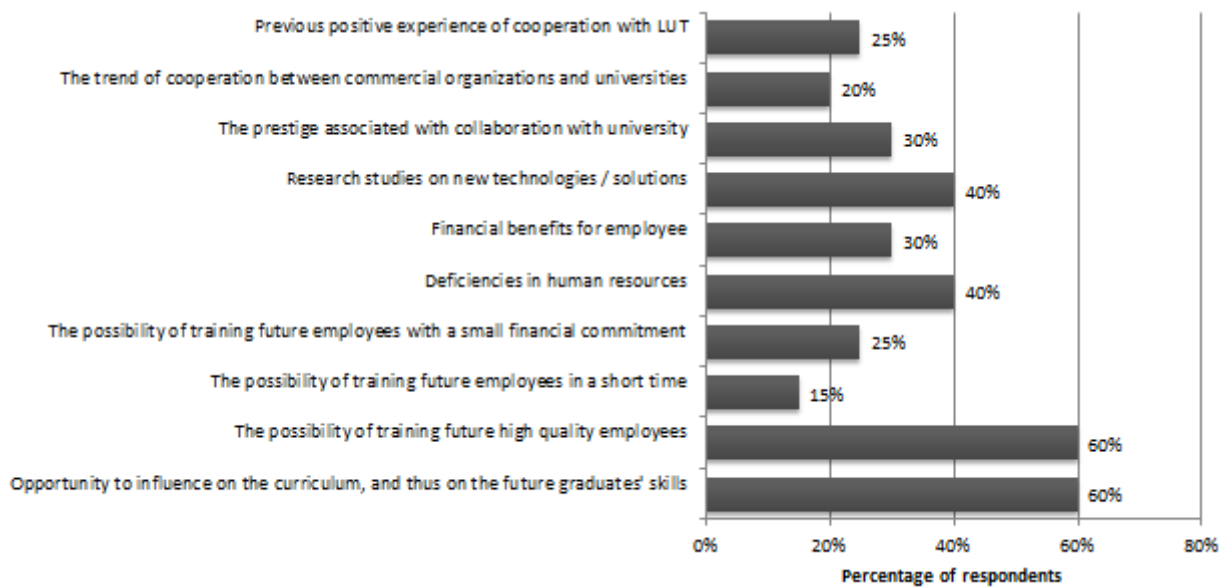Figure 3. The difficulties in short practices and internships

Figure 4. The motivation factors of industry participation in cooperation

As results show, there are two main factors which have influence on MSc curricula. They are: the set of skill of potential employee, and possibility of training future employee during internship with high quality of skills. Up to 50% of respondents admitted that they plan to hire intern. Detailed results of motivation factors are displayed in Figure 4.

Companies were asked about their continuation plans of cooperation with LUT. Only 29% of respondents is interested in cooperation in the field of curricula development, 41% of them wants to continue collaboration in the MSc thesis development process, and 71% is interested in collaboration in the R&D area. All responders (100%) indicated the interest in conducting internships and 82% of them – in conducting short practices. However, none of them (0%) cooperate with other universities in the field of curriculum development. 27% of responders collaborates with other universities in MSc thesis development, 36% in the R&D area, 73% in practices and 82% in internships.

IV. CONCLUSIONS

The industry is the most interested in continued cooperation in practices, internships as well as in the research and development area. That is why those areas of collaboration should be improved firstly with great attention.

Firstly, the pre-selection of students for internships is evaluated very well by the companies. The university should adhere to the same principles of selection during next recruiting students to participate in internships and practices.

Secondly, it is necessary to find the consensus between the length of an internship required by the industry and time that student can allocate on it with no loss to his education at the university. Actually the practices at LUT last 3 weeks with total amount of 45 work hours, while internships last 4 months (80 work hours per month).

Furthermore, the number of formalities should be reduced to minimum. Many companies complain about the bureaucracy in collaboration and communication with the university. Simple and transparent communication policy has to be elaborated.

The survey helped to indicate industry representatives drivers of collaboration in each mentioned area and to validate how they assess the quality of outcomes of each area of collaboration with LUT. It also helped to identify the barriers of cooperation in various aspects. The conclusion will be used to enhance and strengthen cooperation with these companies which LUT successfully work with. The delivered improvements should make mutual cooperation more beneficial for all sides: industry, university and students.

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