Academia and industry cooperation: an example drawn from courses in electrical engineering

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ABSTRACT: The authors' aim in this paper is to outline the practical benefits of cooperation between academia and industry using as an example the Electrical Engineering course in the Faculty of Electrical Engineering, Automatics, IT and Electronics at the AGH University of Science and Technology (AGH-UST). The possibilities of cooperation between industry and higher education are outlined in this paper. It presents the areas and forms of cooperation with industry and its benefits for graduate students of the AGH-UST, based on ongoing courses which indicate the practical benefits of cooperation with industry. In addition, the criteria for strategy on the development of science are described in this paper, especially electrical engineering, as a response to the needs of the knowledge-based economy and industry. In conclusion, the involvement of firms or companies in the process of teaching, and active cooperation by the University with industry, most definitely improve the quality of engineering education. The value of graduate students to the jobs market also may give rise to an increase of interest in the Faculty.

INTRODUCTION

Electrical engineering, as a field of study, as well as a field of science, is viewed as being highly traditional. Compared with new directions of study, such as information technology, telecommunications, automation and robotics, and biomedical engineering, this may be true. However, in practice, changes in the work of electrical engineers are comparable with other professions. Many advances in new areas of science are being implemented in the field of electrical engineering, from design through implementation, to exploitation. Working methods and tools currently used by electrical engineers are significantly different from those of the previous 10 to 15 years; and this is a reason why companies proposing cooperation increasingly want to participate in the educational process of students.

The aim of this paper is to show the opportunities academia and industry have for cooperation, and the benefits that flow from it. The AGH University of Science and Technology (AGH-UST), customarily has cooperated with industry in both the research area and education. So far, cooperation with industry in the area of education has consisted mainly of student practice, but in the past few years this has not been the only form of cooperation.

FORMS OF COOPERATION

Dynamic development of new technologies and devices has caused significant changes and requirements for new graduate engineers. There are also new jobs as a consequence of the globalisation of industry. As a result, engineers may need such skills as project management, product management, asset management, etc.

The AGH-UST Electrical Engineering course curriculum is being adjusted continuously to reflect the current level of technological development. A highly useful element in this process is cooperation with industry, and this cooperation takes various forms in the field of electrical engineering courses:

- consultations/meetings with industry, initiated either by the university or the company. This consultation requires, inter alia, the possibility of introducing into the study programme new subjects and issues adapted to the company's currently used technology;
- work practice for students, and internships;
- workshops and presentations conducted by representatives of the companies;
- technical tours;
- collaboration on theses;
- modernisation of the university laboratory bench.

The effects of cooperation agreements are outlined in action plans prepared in the present academic year, and the scope of these actions depends on the possibilities presented by the companies.

APPRENTICESHIP AND INTERNSHIP

Apprenticeships are the most traditional forms of cooperation with industry in the area of education. Students of electrical engineering courses have an obligatory apprenticeship which takes place in four-week periods after the third and fourth years of study, with the last four weeks of apprenticeship being served during the last semester. After implementation of the Bologna Process for a three-cycle programme of study, there is an obligatory six weeks of apprenticeship, but only for first-cycle programmes. Thanks to cooperation with industry, it is possible to better customise student apprenticeships and their programme of study. Before deciding on the place where an apprenticeship will take place, students have the opportunity to get to know the specific job conditions, as well as to know details of their apprenticeship offer.

In addition, the opportunities for internships were created for students of second-cycle programmes. These internships are beneficial for both students and companies; for example, companies have a chance to review a potential employee, and students to gain experience. Presentations provide an overview of all the activities of the companies and/or descriptions of specific products.

Apprenticeships are held mainly during the holiday season. However, internships are also carried out during the semester in students' leisure time. Every apprenticeship must be confirmed by a student report and a certificate of their completion.

Often, the results of apprenticeships or internships are the topics of theses implemented by graduate students. Theses deal with issues relating to the activities of companies in which the apprenticeships or internships took place. For the past three years the AGH University of Technology has been organising meetings in March with cooperating companies. The aim of these meetings was to secure the best placements for apprenticeships. During these meetings the companies presented their offers of apprenticeships and internships for students of electrical engineering. Only companies with a long-term commitment to cooperation were invited to the meetings.

ADDITIONAL CLASSES

Representatives of companies also often prepared workshops for students and presentations about the products they offered. The workshops enhanced the practical skills of students and presentations showed the firms' or companies' newest activities and products. The workshops dealt mainly with specialist software or devices offered by the companies. Presentations contained overviews of all the activities of companies or descriptions of their specific products. These additional classes did not have a regular schedule and the duration was adjusted to the students' schedules.

Additionally, for students of electrical engineering courses, technical tours were organised to complement the theoretical lectures and laboratory sessions. These tours were organised annually, in places such as hydroelectric power plants (e.g. ZEW Niedzica S.A., ZEW Solina-Myczkowce S.A.); factories producing electrical devices, such as switchgear, transformers, electric motors, power cables, etc (e.g. ZPUE S.A., ABB S.A., TELE-FONIKA Kable Sp. z o.o. S.K.A.); mines and steel mills. In many of these companies, employees are graduates of electrical engineering courses at AGH-UST. They are excellent guides for younger colleagues through simply having their job and talking about it. It is a type of intergenerational exchange of experiences. For this reason, and among other things, these tours are highly popular with students. The tours are usually organised in groups of up to 40 people, which allow all of them to participate actively.

DIPLOMA THESES

Another result of cooperation between university and industry are diploma theses, which are valuable because of their practical nature. Typically, apart from the academic supervisor, an industrial supervisor is also involved in the process. Topics of many diploma theses often include research in new products or real business projects. An example is the testing of de-rating a new MV switchgear with a new type of power switch (Figure 1).

Work related to diploma theses are implemented in companies, as well as in the University laboratories, on laboratory benches equipped partially by companies. Often, the subject of the diploma thesis can be the design or construction of a laboratory bench using components supplied by the producers. An example of a bench made this way is the simulation and testing system of automatic protection system INS 5L (Figure 2) for electrical power devices.

Final diploma theses take a very different character and form. They can include research involving experimental design; and the realisation of the device or product. Design themes, for example, include real projects, which later are realised in a following thesis or in the company's professional activities. All diploma theses made this way have a high level of

quality and offer students great professional satisfaction. A secondary effect of these theses can be to equip laboratories with a new bench and equipment provided for the implementation of theses.

Figure 1: MV switchgear test with switch Entelliguard 2000A (1600A), GE Power Controls.

Figure 2: The position measuring system protection type INS 5L.

MODERNISATION OF LABORATORIES

To advertise their products and, as an element of cooperation, companies also participate in the modernisation of laboratories. In materials, such as catalogues used in the project classes, companies advertise their products to potential future customers. Additionally, the devices or equipment provided to laboratories have one aim - during their study as students, future engineering staff become used to the company's preferred practices and standards.

The need to maintain a high level of education requires constant upgrading of the laboratory base, especially in technical fields such as electrical engineering. Employers' equipping of the University's laboratory base with modern technology is useful for students, in that they learn of the latest solutions used in industry; for example, the laboratory bench mentioned above (Figures 1, 2): which is one of many electric devices, electrical protection or high voltage technology created in the University's laboratories.

SUMMARY

Graduates of the AGH University of Science and Technology are valued and sought-after workers in the labour market. In many firms they work as managers, which significantly contributes to the development of cooperation between industry and the AGH-UST. Over the past 3 to 4 years, cooperation in the field of education in electrical engineering courses has been strongly developed. Such cooperation brings mutual benefits.

Companies have the opportunity to become acquainted with the curriculum implemented for courses and express their opinions and suggestions regarding the possible direction for modernisation of these courses. Often, they suggest the teaching of highly practical and specific skills without some elements of theory. However, there should also be a high level of graduate education to prepare students for future jobs, but in a wide range, characterised by complementarities and strong fundamentals in all areas of electrical engineering. Through this approach, a graduate undergoing brief training by an employer can become a fully-fledged employee. Changing this model of education could lead to the devaluation of higher education and bring it down to the level of *ordinary* training.

With the help of companies or firms in modernising the laboratory base, the updating of teaching materials allows them to present their products to potential users, along with proposed solutions. In addition, students can broaden their knowledge of data products and solutions offered by companies or firms in workshops and presentations, which are the perfect complement to mandatory classes.

Frequent contact between companies and students can also help students to find good internships or to gain professional experience. Until now, students without knowledge of the labour market were faced with huge problems in finding a place for apprenticeship. Until now, choosing the apprenticeship was often accidental, due to precisely this lack of knowledge. Meeting with companies is an opportunity for them to gain feedback on students' educational level.

Proposals for diploma theses often also have a second aim. They allow an employer to identify a student as a potential new employee, based upon the implementation of the student's thesis.

The biggest beneficiaries of cooperation between university and industry are the students. Through this cooperation students have the opportunity to:

- gather knowledge about good practice in the electrical engineering profession;
- gain experience through apprenticeships and internships;
- produce interesting and practical implementations of theses with extra industry supervision;
- enrich their knowledge with the experience of technical tours to industry workplaces;
- acquire education in upgraded laboratories.

As a result, through cooperation, the University achieves the following:

- an increase in the value of graduates in the labour market;
- production of graduates with knowledge of organisations and tasks in industry, project management techniques and time management skills;
- retainment in the country of the best students for internships and an increase in their chances of getting good jobs in the domestic market;
- an increase in the periods of apprenticeships and the importance of practical forms of education;
- development and preparation of teaching materials, taking into account expectations of future employers;
- acquisition of theses on topics of current business activity.

To sum up, cooperation between industry and academia most definitely should be developed because its effects are beneficial to both parties and it contributes to a better education for students majoring in electrical engineering.