

# Ten Years of Experience in University – Industry Co-operative Education and Research in Power Engineering

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**Abstract:** One of the main problems of higher education these days is to prepare students for rapid changes in technology and the labour-market. In order for the preparation to be effective and as rapid as possible, it is necessary to closely co-operate with industry and power engineering, and also to ensure the rapidity and effectiveness of the mutual transfer of information– from the University point of view dealing with the latest changes as far as education possibilities are concerned, and from the company point of view – dealing with the latest needs in education as far as changes in technology and in labour-market are concerned. The Faculty of Electrical Engineering and Informatics of the Technical University of Ostrava and the Northern-Moravian Power Company in Ostrava have been closely co-operating together since the foundation of the Faculty in 1991, both in the areas of education and scientific work. Long-term experience testifies to the mutual advantage of this type of co-operation. We may show some aspects of this mutually advantageous and successful co-operation as for instance

- innovation of study programs according to the needs of power engineering – the introduction of new Bachelor programs
- active participation of power engineering experts in the education of Ing. graduates and especially postgraduates (doctoral studies), the result of which is a better implementation of new technological knowledge in power engineering
- improvement of the qualification of power engineering employees in connection with the development of new technology, and with respect to the needs of a firm's restructuring
- solutions to the technical problems of power engineering with the financial support of the company

**Keywords:** education, co-operation, industry, power engineering

## 1. Introduction

After 1989 the Czech Republic, a country in Central Europe, underwent a number of political and especially significant economic changes. The change of political system, now oriented towards western democratic systems, brought about fundamental changes in property rights – previously state owned socialist property was gradually privatized by means of various methods. The privatization of majority of the smaller industrial companies, commerce and services through the commonly called "coupon method" was done relatively quickly. Bigger problems appeared when big industrial companies were privatized, because together with the privatization it was necessary to ensure restructuring of industry. The Czech Republic, as a component of the Eastern Soviet block before the year 1989, was significantly oriented to the development of heavy engineering and metallurgy industries. This orientation was considerably developed in the Northern-Moravian region of the Czech Republic where the development of heavy industry was supported by quality black coal beds in commonly called Silesia. However, the restructuring of industry proved to be a long-term and often painful matter. It is necessary to up-date out-dated technologies, to modernize and to automate operations, and in many cases change the whole structure of the companies. This is related to the necessary change of the employees qualification system, and in the majority of companies, also to the reduction of the number of employees in these companies, which brings about considerable social tension in the region. For example, within the last decade the number of employees in the big metallurgical companies in the Northern-Moravian region was decreased to 43 thousand in the year 2000, which means nearly 50%. This is about 40 thousand employees who either have to undergo training or they are unemployed. It is

expected that this trend will continue and in the next decade the number of employees in these companies will decrease by 18 thousand in the year 2005 and by 20 thousand in the year 2010. On the other hand, a new structure of companies is being gradually developed, specializing especially in new Information Technologies. Thanks to considerable investments of foreign firms in this sphere (Philips, Motorola), Czech companies are being modernized and the construction of new operations is being started, which will bring about new job opportunities for a few thousand employees.

These structural changes has considerably touched upon the operation of the Northern–Moravian Power Company (SME, a.s.). The structure of electrical energy consumption has changed, on one hand the consumption in heavy engineering and metallurgy industries considerably decreases due to production decrease, on the other hand new or modernized companies with the increase in consumption of electrical energy emerge. In these companies the energy demands from the point of view of effect of energy transformation mildly decreases, but the electrical energy consumption increases, e.g. for the production of 1 ton of steel due to new technologies of treatment. New companies in the area of Information Technologies put higher demands on the reliability of supply and the quality of the supplied electrical energy and other services. All of these requirements call for the need of management change of SME, a.s. and also higher demands as far as the qualification of employees is concerned. These changes also reflect the need to prepare for the liberalization of the market with electrical energy, which will come into effect in the Czech Republic from 1<sup>st</sup> January 2002.

The Technical University of Ostrava (TUO) management understood and reacted very quickly to the changing needs of industry and power engineering, and that is why, immediately after the political changes in 1989 the syllabuses of subjects were gradually changed, new subjects were and are being introduced, and new study branches are being implemented. These alterations are reflected in the whole change of the University structure so that in 1991 the independent Faculty of Electrical Engineering and Informatics was established, and then, in 1998, also the new Faculty of Civil Engineering. The Technical University of Ostrava significantly contributes to the necessary changes of qualifying structure in the Northern-Moravian region.

The restructuring of industry in the Northern-Moravian region cannot be carried out without changing the qualifying structure, and without a considerable contribution from the Technical University. In the same way the restructuring and modernization of the University cannot be carried out without close co-operation with industry in this region. Also, the Faculty of Electrical Engineering and Informatics (FEI-TUO) considerably contributes to changes of the qualifying structure in the region. From the development point of view of the FEI-TUO, the Northern-Moravian Power Company has been the main partner, co-operating in various forms, for a long time, since 1970 when the Electrical Power Engineering branch of study was introduced at TUO. The mutual co-operation advantageous to both sides has been considerably expanding within the last decade, not only quantitatively, but also gradually into other areas.

## **2. The Faculty of Electrical Engineering and Informatics-Technical University of Ostrava after ten years**

The history of the **Technical University of Ostrava** goes back to the year 1717, when the first mining school was established in Jachymov by the Emperor's decree. In 1849 it moved to Příbram, and in 1865 it was given the right to use the name Mining Academy. In 1894 it was declared to have all the rights of a university. In 1904 it changed its name to the Mining University. After the end of the Second World War, in 1945, it moved to Ostrava.

The teaching of electrical engineering at the University has been given significant meaning since the very beginning of its bold passage into the production processes in mining, metallurgy and engineering. The students have met with electricity and magnetism since the year 1860 within the framework of lectures in physics. In 1904 two independent electrotechnical courses were introduced. In 1945 the independent Department of Electrotechnics was established, and in 1970 the branch of Electrical Power Engineering was instituted at the Faculty of Mechanical Engineering. In the year 1977 the Faculty changed over to the Faculty of Mechanical and Electrical Engineering.

**The Faculty of Electrical Engineering and Informatics** officially commenced on January 1, 1991, after the division of the original Faculty of Mechanical and Electrical Engineering into two independent faculties. The newly established faculty recognizes the century-old history of the University.

The FEI-TUO has been developing boldly as seen in Fig. 1. For example, the number of students accepted into the first year has increased from 102 in 1989 to more than 500 since 1996. In the year 2000 the Faculty has 1700 students and 105 teachers. Gradually, the offer of study branches has increased, and at present the Faculty ensures a Master study in five branches (Electric Power Engineering, Electrical Machines and Drives, Measuring and Controlling Engineering, Electronics and Telecommunications, Computer Science).

Also, the Bachelor study is being developed, this year the Faculty offers the Bc. study in Electric Power Engineering and Computer Science. The Faculty thus ensures a study within the whole scope of Electrotechnics and Informatics. At the same time the Faculty ensures a postgraduate doctoral study (PhD.) in the branches of Electric Power

Engineering, , Electrical Machines and Drives, Informatics and Applied Mathematics, Cybernetics, Electronics. In the area of scientific research the Faculty staff is involved in the grant projects of the Czech Republic. It is also involved in international projects, and last but not least, it is in close collaboration with other workplaces in Europe and the USA.

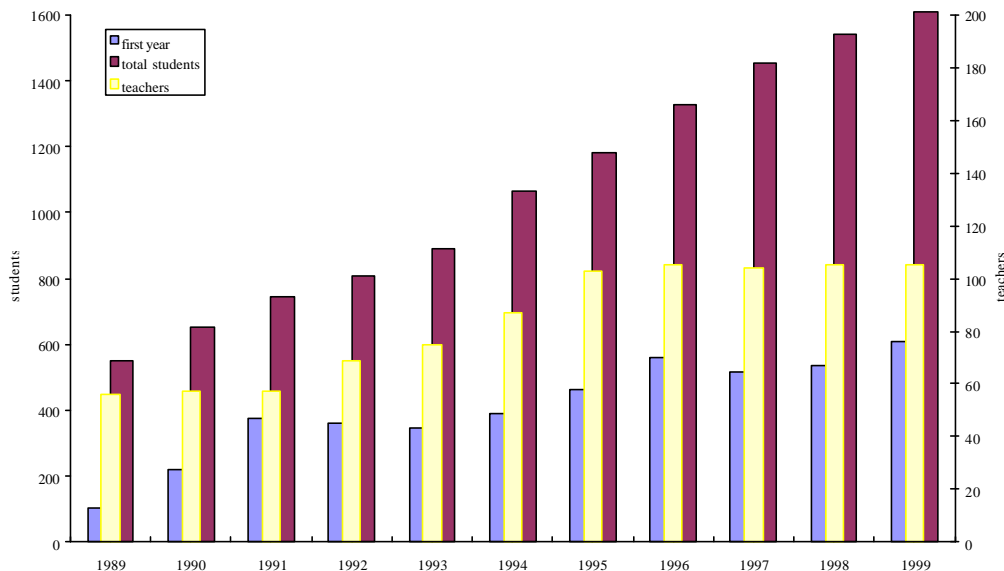


Fig. 1 Developing of the Faculty

### 3. The Northern-Moravian Power Company, Ostrava

The Northern-Moravian Power Company is among the companies with the longest history in Northern Moravia. Its foundation date is considered to be the year 1919. The Northern-Moravian Power Company was established on January 1, 1994, after the transformation of the state company. It is owned (gradual privatization) by the state (51%), villages and towns (34%), TXU-Europe, the biggest British distributor (15%). At present, the Government is preparing the final part of the privatization of power engineering. Its implementation will, among others, depend on the political climate of the country.

The company operates in Northern Moravia and Silesia, in the area of 11 066 km<sup>2</sup> and almost two million inhabitants. The organizational company structure has adjusted to this. The Northern-Moravian Power Plant is the biggest energy distributor in the Czech Republic. It supplies energy to 985 thousand consumers, among those are 64% large scale users (mines, metallurgical plants, railways), 12 % businessmen, 24% inhabitants.

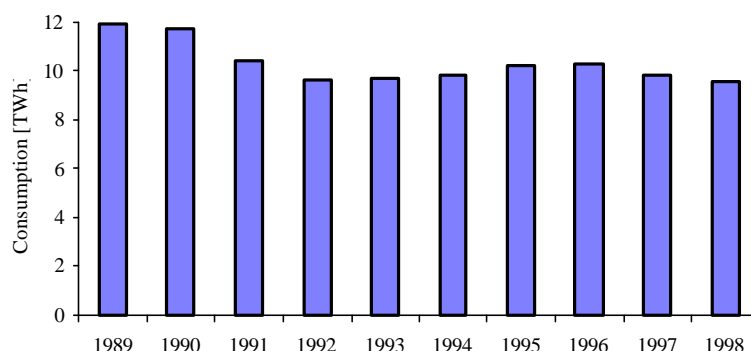


Fig. 2 Development of the consumption

These energy supplies are provided at different voltage levels (110, 22, and 6 kV distribution network, and low voltage distribution network). The geographical location of the distribution area at the border of three states (Czech

Republic, Slovakia, Poland) brings about the opportunity for advantageous purchase of electrical energy abroad, and the competition in its supply. In 1997 the Company supplied its users with 9.1 GWh of electricity, with the turnover of 0.414 bill. USD. The development of the whole consumption is showed on Fig. 2.

The competitive environment also requires costs reduction, better quality organization and improvement in services. For further enterprise, within the liberalization of electrical energy market environment, it is necessary to have a detailed strategy of the company, which was finished in April this year in SME,a.s. The Company management decided to conduct an in-depth re-engineering study of the company, the result of which is the overall change of management structure of the company (a shift to a process company management) since April 1, 2000. Part of these changes is also the implementation of modern Information Technologies. The construction and operation of the information network is very demanding for the experts in the area of Information Technology. These specialists come and will come from the Faculty of Electrical Engineering and Informatics, Technical University of Ostrava.

#### **4. The co-operation of FEI-TUO with industry**

The Faculty of Electrical Engineering and Informatics has been developing in harmony with the needs for restructuring of industry in the Northern-Moravian region of the Czech Republic. The active mutual co-operation with big industrial companies, power engineering companies and private firms is essential for the Faculty not only in the area of education, but also in the area of scientific research.

A significant activity of the Faculty, in order to expand the links, are regular Faculty management meetings with the firms' representatives which take place annually. Each year the representatives of 40-50 companies mainly from the region but also from the whole Czech Republic meet. On the agenda:

- the Faculty informs the representatives of the cooperating companies about the new study possibilities at the Faculty (new study branches, offer of new specialist courses)
- the firms' representatives inform the Faculty management about the need for education extension in particular areas (e.g. legal and economic education for the technically oriented students). The Faculty responds to this by means of the credit system preparation of its students in the necessary specialization.

For instance, in the last couple of years a useful discussion was going on at these meetings about the sense of the Bachelor education and about the job opportunities of Bc. graduates.

In the second part of the meeting the firms' representatives have the chance to contact the Faculty students, and to offer them suitable job opportunities. Consequently, this offer has been playing a significant role in cooperation between the Faculty and the firms lately. The recent economic difficulties and the necessity for the completion of industrial restructuring have created the increase of the level of unemployment in the Northern-Moravian region. The lack of working opportunities has also gradually affected graduates.

The experience of many years shows that the direct contacts between the students and the representatives are very important because they enable the firms to find suitable perspective employees who can then be prepared for their future jobs in the firms in advance (e.g. diploma work) and the students are motivated to improve their study results, because during their studies they realize that the better prepared students are given a much better chance to find professionally and economically advantageous jobs.

Along with the Faculty development, the cooperation with various firms has been expanding. Of course, the most fruitful is the co-operation with firms in the nearby surroundings of the University, that is in the North-Moravian region. From the development point of view of the FEI-TUO, the SME,a.s. is the main partner. Their various forms of co-operation have been for a number of years, since the beginning of the Electric Power Engineering studies at the University, that is in 1970.

Among those co-operating firms are also branches of leading international concerns such as Siemens, ABB, as for international co-operation then e.g. American firms Texas Instruments and National Instruments. The Faculty management supports links with the firms, in most cases between individual departments and firms.

#### **5. Ten years of co-operation between FEI-TUO and SME,a.s. Ostrava**

If we talk about mutual co-operation since the foundation of the Faculty, then it is necessary to make more accurate that the co-operation between the Faculty of Electrical Engineering and Informatics of the Technical University of Ostrava and the Northern-Moravian Power Company started at the beginning of the electrotechnical studies at the University, that is in 1970.

Every year a number of electroengineers who have been educated at the Faculty for over 25 years start working in SME,a.s. This significantly influences the forms of collaboration and their effectiveness.

In the **pedagogical area** the forms of co-operation are developing especially in the following way:

- from the very beginning of electrotechnical studies at the Technical University of Ostrava the topics of majority

of diploma work have been assigned by experts from practice. The technical specialists from SME,a.s. collaborate every year when evaluating diploma work (their number depends on the number of students of the Power Engineering branch in the given year). In a number of cases, the results of diploma work solution are being used in SME,a.s., and the successful graduates are employed by this company.

- specialists from SME,a.s. not only supervise and evaluate diploma work, but they also assess doctoral dissertations
- for a number of years, the specialists from SME,a.s. come to give lectures (usually single lectures) in engineering and postgraduate studies. By means of this the students are then acquainted with the topical problems of practice. The students are in favor of these lectures.
- thanks to understanding of this situation and financial support from SME,a.s. new modern laboratories were established in the last couple of years. As an example we can mention the laboratory of electrical network protection at the Department of Electric Power Engineering or at the Department of Electronics and Telecommunications, where the laboratory of telecommunication network is equipped with special apparatus
- the changes in SME,a.s. management require deeper and more profound knowledge of the employees. That is why, in the last couple of years the Faculty prepared several specialized courses in the area of power engineering and telecommunication
- especially on the basis of the requirement of SME,a.s. the Faculty prepared the Bachelor study in the field of Power Engineering, which commenced last year

In the **scientific research** area the forms of co-operation can be summarized into these areas:

- from the very beginning the main form of co-operation was the solution of technical problems of SME, a.s. by means of the scientific potential of the Faculty. As for the financial contribution to the Faculty, it is dominant and has a rising trend. Thus in 1998 the contracts for 3 mil. CZK (45% of the total number of contracts) were solved, and in 1999 for 6 mil. CZK (80% of the total number of contracts).
- the trend of gradual involvement of an increasing number of departments into the co-operation is seen as very positive. This results in an increasing number of contracts and finances.
- especially the problems of reliability of power engineering networks operation and the quality of electrical energy (EMC) are being solved for a long time. Recently, the Faculty specialists try to use knowledge of the latest development (e.g. the application of neuron networks), measuring methods and special measuring equipment (e.g. for monitoring the quality of electrical energy or for localization of the faults in electrical networks) which is available at the Faculty.
- in the last couple of years, the interest of SME,a.s. in the solution of topical problems in the area of telecommunication considerably increased
- the Faculty specialists evaluate some of the SME, a.s. technical projects, e.g. the optimization of control system
- on the other hand, the SME,a.s. specialists evaluate some of the grant projects of the Faculty

## 6. Co-operation evaluation

The Faculty of Electrical Engineering and Informatics educates experts in all study branches of Electrotechnics and Informatics for the regional industrial companies and SME,a.s. It also educates specialists with a view to a more complex orientation according to the needs and requirements of the firms in the region. For example, in Electric Power Engineering and according to the new requirements of power engineering specialists educated in Informatics, Telecommunication and Economics in power engineering.

We may state that at its present level, the co-operation between the Faculty and SME,a.s. is advantageous to both sides:

- ⇒ graduates are prepared for the needs of SME,a.s. at the greatest level, the study program in the branch of Electric Power Engineering is constantly complemented and innovated in harmony with the needs of SME,a.s.
- ⇒ the flow of technical information is ensured to both sides
- ⇒ the results of the solution of SME,a.s. technical problems by the Faculty specialists are used in practice, and in a number of cases the solution is less expensive than in other firms

Various forms of financial support, especially when renewing and building new laboratories, are also a significant contribution to the Faculty.

The official contract about co-operation, signed by the General Director of SME,a.s. and the Rector of TUO specifies the points of mutually advantageous cooperation. The very good personal contacts between the management of the Technical University of Ostrava and the Northern-Moravian Power Company also ensure the successful co-operation.