ŠTUDIJNÝ ODBOR PRIEMYSELNÉ INŽINIERSTVO NA VYSOKÝCH ŠKOLÁCH

FIELD OF STUDY INDUSTRIAL ENGINEERING AT SCHOOLS OF HIGHER EDUCATION

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Abstract
This paper deals with the field of study Industrial Engineering, analysis of subjects in the curriculum of industrial engineering field of study at all Slovak schools of higher education that are listed in the accredited educational programs.

Key words
Education, Industrial Engineering, School of Higher Education.

Introduction

At the present globalizing economy and the tightening competitiveness, all manufacturing and service providing companies must cope with increasingly more demanding tasks in the area of product quality and innovation. Quality materials and new technologies open up new horizons for the development of truly competitive products. On the other hand, there is a need for highly skilled professionals in engineering fields, able to take the challenge of today, both from a practical as well as theoretical field of engineering. In addition to traditional engineering specializations, to the fore is getting interdisciplinary approach to engineering oriented to the needs of industry practice. This dynamically developing scientific discipline, reflecting in a field of study with the same name, is in the world generally known as Industrial Engineering.

Industrial Engineering (IE) as a field of study represents number of variation, both in the content, and as well as formal aspects of its delivery. American Institute of Industrial Engineers (IIE) in 2000 presented his ideas about IE position among other study fields with engineering focus:

„Industrial Engineering will be considered as the most important profession and its workers will plan, design, implement and manage systems of production and distribution, services and ensure their operation, reliability and sustainability. These systems are socio-technical in its basis and will integrate people, information, materials, equipment, processes and energy throughout the life cycle of products, services, or programs. To achieve these objectives will be used humanities and social sciences (including economics), computer sciences, basic sciences, management sciences, highly developed communication skills. A key element, by which IE differs from other engineering disciplines, is the emphasis on the human factor. The best systems are implemented through a process of continuous improvement in an environment where labor is considered the largest property and where the quality is of highest priority."

1 Field of study 5.2.52 Industrial Engineering in Slovakia

Currently in Slovakia there are four accredited schools of higher education in the field of study IE. The following table (Table 1) gives us an overview of schools concerned and on what level of studies they received accreditation.

Tab. 1 Overview of schools with IE field of study

School of higher education	Degree level
Technical University of Košice, Faculty of Mechanical Engineering	1., 2., 3. degree
Slovak University of Technology in Bratislava, Faculty of Materials science and Technology in Trnava	1., 2., 3. degree
University of Zilina in Zilina, Faculty of Mechanical Engineering	1., 2., 3. degree
Technical University in Zvolen, Faculty of Environmental and Manufacturing technology	1., 2. degree

Source: own processing

Industrial engineering is a field of study from the system of disciplines processed by the Ministry of Education in Slovakia as a field of knowledge (§ 50 section 1 of the Law no. 131/2002), in which the graduate of study program (§ 51 section 1 of the Law no. 131/2002) gain professional aptitude, competence to perform his original profession or is prepared to continue in subsequent higher education. Field of Study IE can be, under the system of study fields (the SSF) based on the decisions issued by the Ministry of Education no. 2020/2002-sekr. of 16th December 2002, offered to study at the three levels of education (Ministry of Education Accreditation file):

- Higher education degree - Bachelor in the field of IE (BC.) - Standard length of study is 3 years.
- Higher education degree - Industrial Engineer (Ing.) in the field of IE - standard length of study is 2 years. Prerequisite: completed 1st degree in the field of study Industrial Engineering. If an applicant for 2nd degree study ended 1st degree study in another field of study may be proposed study program for 3 years.
- Higher education degree - Philosophiae Doctor (PhD.) in the field of IE - standard length of study is 3 years (full time), standard length of study - 5 years (part-time).

These graduates, according to the achieved level of higher education should be able to perform at different levels of management in economic practice, flexibly adapt to market requirements and will be able to creatively apply knowledge acquired by study. By the fact that graduates will have the knowledge of the technical area, but also from the economic, managerial, social and legal, ethical and scientific disciplines, they can also apply their study in units of technological development, design, economic departments, logistics departments, etc. Industrial engineers can design, implement, plan and manage complex integrated manufacturing systems and processes, systems for the provided services to ensure their high performance, reliability, meeting deadlines and cost control.

2 Knowledge of the IE field of study

From the above table (Table 1) results that all four schools of higher education teach in the 1st and 2nd level of study of field concerned. Therefore, we will deal with subjects that are taught at these levels of study. Each school has its own specific way, according to which it adapts the courses. Accreditation File of IE field of study recognizes two types of subjects; and that is core knowledge and additional optional subjects. The following table (Table 2) gives us an overview of these subjects for the first degree of IE study field.

Tab. 2 Subjects of 1st level of study

	Core knowledge	Optional subjects
1. level	Mathematics Physics Informatics Electrical engineering and electronics Basics of constructing Basics of Management Technical materials Technology General economic theory Basics of Environmental science Engineering Mechanics Manufacturing Technology Technology Flexibility and strength Business management Personnel management Shipping and handling equipment Statistical methods Information Technology Automation and Control Systems Business Management I Quality of Products and Services Unconventional Technology Marketing Calculation and Prices Accounting Production Logistics Production Management I Business Basics Semester Project Final thesis	History of Science and Technology Collection and processing of raw materials Fundamentals of communication Work safety Operation and maintenance of machinery Applied electrical and electronic equipment Industrial Psychology and Sociology Basics of rationalization of work Theory of systems and decision-making Tabular and graphic processors Applied Informatics Fundamentals of law for engineers and managers Automated systems of measurement and data collection Trends in systems maintenance Teamwork Foreign language

Source: Ministry of Education

The following table (table 3) summarizes subjects of 2nd degree of studies in IE field of study.

Tab. 3 Subjects of 2nd level of study

	Core knowledge	Optional subjects
2. level	Business Management II. Operational analysis Financial management of company Ergonomics Strategic Management Innovation Management Designing of manufacturing processes and systems Technical preparation of production Analysis and measurement of work Information Management Management of investment development of company Financial and Economic Analysis Production Management II. Modeling, simulation and optimization of processes and systems Procurement and distribution logistics Project management Quality Management Semester Project Diploma thesis	Certification and standardization Operations Management Simulation Maintenance of production Productivity Taxation Business strategies of small and medium-sized enterprises Business and labor law Psychology at work of manager

Source: Ministry of Education

The main components of the study represent subjects focused on machinery production, its design, operation and management. Expanding, but equally important component of the study is the block of management and economic subjects that help graduate gain competencies to perceive business not only in terms of production, but also from the point of view of manager and economist.

Conclusion

While interpreting the results of the analyzes it is necessary to have in mind that this is purely a quantitative analysis, which does not include qualitative aspects of the educational process. The focus of higher education should probably not be based only on the number of physically taught classes, but rather on the self-study, motivation of student and suitable climate to absorb the required amount of knowledge of the selected field, by the student. The analysis also ignores the form of taught classes, namely whether it is lecture, seminar, workshop, etc. We also have not closely dealt with the description of the specifications of the uniqueness of the faculty, respectively universities where teaching is carried out. Important is also staffing of teachers, availability of academic literature, laboratories, information and communication technologies, as well as a direct relationship with practice, whether in the form of student practice, or while writing Bachelor and Diploma theses. Beside these facts, it is possible to state the following facts. The range of subjects in economics from the perspective of individual universities varies widely. Existing condition creates legitimate doubts about the fulfillment of the declared profile of graduates thus of 1st and 2nd level of study. This situation is particularly alarming at universities that not have accredited 3rd level studies in IE field of study. Mentioned profile of graduates is based on the experience of leading universities (Industrial Engineering – Faculty of Mechanical Engineering, University of West Bohemia Pilsen - Czech Republic, Industrial Engineering, Bilkent University, Ankara - Turkey, Intelligent System Lab, Michigan State University - USA, Faculty of Management and Economics in Zlin, VUT Brno - Czech Republic, Department of Inżynierii Produkcji Politechnika Lódzka Filia Bielsko - Biala, Japan Institute of Industrial Engineers - Japan, etc.)

Therefore, an effort for its fulfillment should be obligatory. Over-emphasis on engineering subjects to the extent of 60-70% of the total hours, without specific engineering specialization creates the illusion of an encyclopedic approach to education, which is characterized by a wide range of the spectrum of knowledge at the expense of deeper knowledge of any particular part.

In the future, teaching of PI should focus more on balanced representation of all subjects form knowledge base tied to clearly declared graduate profile. Only such a balance creates the conditions to manage basic skills of such an interdisciplinary scientific discipline as undeniably modern IE is.

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Súhrn

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Kľúčové slová

Vzdelávanie, Priemyselné inžinierstvo, vysoká škola.

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