Chapter 4

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2020 COMPETENCE MODEL OF THE SLOVAK INDUSTRIAL ENGINEERS

Abstract: The article is based on the results of the European Structural Funds project ITMS 26110230055 Rationalisation and improvement of the industrial management study programme to support career guidance. The aim of the project was, based on the results of the Slovak industrial enterprises requirements on the industrial manager's competencies, prepare the new profile of the graduates of the study programme Industrial Management. Significant changes of the industry and labour market have influenced also the qualification demand. In Slovak Republic a considerable proportion of the new jobs created in automotive industry sector are predominantly high skilled jobs where almost a third of these jobs are managerial positions. This has created a pressure on the universities to reconsider the content of the technical study programmes based on the newly defined competencies profiles.

Key words: Waste management, Cradle to Cradle, Circular economy, Material

4. 1. Introduction

Before the year 1989 the industry in Slovak Republic was oriented on

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heavy engineering, armaments, iron and steel production, nonferrous metals, and chemicals. In the early ninetieth major foreign investors were Volkswagen, US Steel, and Whirlpool. The second wave of investments in 2003 and 2004 was oriented into the automotive industry with the arrival of two automotive companies: PSA Peugeot Citroen and KIA Motors. Later was built also a wide range of suppliers with the direct connection on existing automotive plants (Figure 4.1.) (SUJANOVA, CAGANOVA, CAMBAL 2013, HAJNIK B., STACHO Z., STACHOVÁ K. 2011, ŠUJANOVÁ J., GABRIŠ P., LIČKO M., PAVLENDA P., STASIAK-BETLEJEWSKA R. 2012).

Fig. 4.1. Distribution of automotive industry suppliers in Slovak and Czech Republic (Uhrik 2011).

The automotive industry in Slovak Republic today represents 40 % of the industry; it covers about 36% of the industry export and generates about 33% of total industrial turnover. As a strongest representative of the industry it also influences the labour market with the demand of specific competencies. Few years ago the secondary vocational schools system was close to collapse. Several initiatives took place especially in the area of education in automotive specialisation on secondary

vocational schools. System of 13 pilot centres is guaranteed by ZAP SR (Automotive Industry Association of the Slovak Republic) and CPA SR (Craft of sellers and auto services of the Slovak Republic) and the professional growth of pedagogues in pilot centres is secured by ŠIOV (State Institute of Professional Education), Methodical centres and Lecturer centres. The growing demand for the qualified working forces in this area led also to the establishment of the postgraduate MBA program in cooperation between the Mobility Cluster Vienna, Vienna Business Agency, the Vienna University of Technology and the Slovak University of Technology in Bratislava. The aim of this MBA program is to train managers for the automotive and components supply industries. (SUJANOVA ET AL. 2012).

The second driver for the change of the graduates' competencies is the necessity to implement national qualification frameworks according to the European Qualifications Framework (EQF) for the Lifelong Learning (EQF 2013). Slovak Republic started at March this year a follow up project oriented on the creation of the national qualification framework. The national qualification frameworks are also closely linked with the European Credit Transfer and Accumulation System (ECTS 2013).

4. 2. Core knowledge, skills and competencies for the study programme Industrial Engineering in Slovak Republic

In the Slovak Republic the system of the fields of study is regulated by the Ministry of Education according to Act No. 131/2002 of Law Code on higher education and on the change and supplement to some acts, as amended.

The Ministry of Education of the Slovak Republic issued the List of Study Fields in Higher Education in the Slovak Republic as the Decision of the Ministry No. 2090/2002 of 16.12.2002 where the study branch 5.2.52. Industrial Engineering is in the group 5: construction, Technologies, production and communication, subcategory 5.2.

construction engineering, technologies, production and communication.

According to this classification Ministry of Education of the Slovak Republic has designed recommended key knowledge, skill and competencies for the three levels of graduates for listed areas (SUJANOVA, CAGANOVA, CAMBAL 2013):

- Theoretical Subjects (i.e. Mathematics, Physics)
- Informatics and Applied Informatics (i.e. Information technologies, Programming)
- Management (i.e. Industrial Management, Human Resources)
- Technologies and Materials (i.e. Casting, Forming, Materials)
- Production, Logistic, Automation
- Engineering Subjects (i.e. Elasticity, Strength and Plasticity, Electrotechnics)
- Humanistic Subjects (i.e. Foreign Language, Psychology)

The emphasis is put on the Engineering subjects – 34%. Management and theoretical subjects represent 17% and 14% Technologies and Materials. Less emphasis is put on the humanitistic subjects especially foreign languages or subjects related to social inteligence or critical thinking (PAULOVÁ I., MIROSLAVA M. 2007).

Base on the above mentioned areas accredited study programmes in all three degrees at the Institute of Industrial Engineering and Management, Faculty of Materials Science and Technology in Trnava defines the following profiles of graduates (SUJANOVA ET AL. 2012):

- The graduate of the bachelor programme Industrial Management has to understand social and technical systems integrating human resources, information, materials, devices and processes within the complex life cycle of products and services. The graduate has to acquire fundamental knowledge of natural sciences, technical, technological and humane disciplines, as well as knowledge of informatics and specific knowledge of industrial engineering oriented on plant management, economy, production management, marketing, accounting etc., with emphasis on practical application of the aforementioned knowledge. The graduate also has to be able to

apply gained knowledge and skills in practice, mainly as a team leader or team-member in the middle management.

- The graduate of the master programme Industrial Management gains complete university education focused on planning, designing, implementing and managing production systems and also creativity development in engineering projects or processes. He has to possess deep knowledge of natural sciences, technical, technological disciplines and humanities with expertise in industrial management, company management, production management, plant economy, theoretical knowledge of operation and system analysis, logistics, personnel, investment, finance, innovation, information management, etc. The graduate has to be ready either to continue his study in a postgraduate degree and develop his research career in industrial management, or to enter the job market immediately. He has to successfully perform as a middle or top manager in organisations within various sectors of industry requiring the synergy of managerial, economical, technical and soft skills and knowledge.
- The graduate of the postgraduate programme Industrial Management has to gains complex university education oriented on the knowledge development in the field of managerial activities, tools and methods applied in various types of companies. He has to master research and development methods of gaining knowledge autonomously. He has to be able to develop creative methods in the field of industrial management and design, provide social, technical and managerial systems in various types of companies, accelerate the development of innovative processes, and to apply various management improvement approaches. The graduate has to perform in the top managerial positions in various types of organisations, consulting companies and universities, in both research and teaching careers.

4.3. The comparison of study programmes Industrial Engineering in Slovak Republic

As a part of the project we have made a comparison of comparable study programmes at the major Slovak technical universities. Results have been presented for example in (SUJANOVA, CAGANOVA, CAMBAL 2013), (SUJANOVA ET AL. 2012), (WOOLLISCROFT ET AL. 2013) and at 10th conference on Human Potential Developmen 2013 or 3rd conference MARVI 2012. Significant differences between analysed universities have been identified at the first level of the higher education whereas at Slovak University of Technology (STU) is the emphasis put on managerial subjects, at Technical University in Žilina (ŽU Žilina) key knowledge areas are Engineering subjects. Minor significances have been identified also in other subject areas. Compering the key knowledge areas with the knowledge areas recommended by the Ministry of education it is the Slovak University of Technology where the structure of subjects is closest to the proposed one. Differences have been identified also in the second level of higher education where they flatten differences generated at the first level of the higher education. In the comparison with the recommended structure by the Ministry of Education subject areas are similarly balanced.

We have also compared study program Industrial Management with comparable study programmes in Czech Republic. Here we can conclude that in Czech Republic the emphasis is put on the theoretical and engineering subjects, as well as the technologies and materials. Czech universities mostly offer the study programme Industrial management only at the second level of the higher education based on the study programme Mechanical Engineering at the first level of the higher education (URBANCOVÁ H. 2012).

4.4. Conclusions on Future Industrial Engineer

Today we can observe discussions in scholarly articles and conferences discussions about the future competencies profile of industrial engineers based on the discussion about the future workforce. Institute of the future (IFTF 2013) has defined 10 key competencies:

- Sense-making: ability to determine the deeper meaning or significance of what is being expressed
- Social Intelligence: ability to connect to others in a deep and direct way, to sense and stimulate reactions and desired interactions
- Novel and Adaptive Thinking: proficiency at thinking and coming up with solutions and responses beyond that which is rote or rule-based
- Cross Cultural Competency: ability to operate in different cultural settings
- Computational Thinking: ability to translate vast amounts of data into abstract concepts and to understand data-based reasoning
- New-Media Literacy: ability to critically assess and develop content that uses new media forms, and to leverage these media for persuasive communication
- Transdisciplinarity: literacy in and ability to understand concepts across multiple disciplines
- Design Mindset: ability to represent and develop tasks and work processes for desired outcomes
- Cognitive Load Management: ability to discriminate and filter information for importance, and to understand how to maximize cognitive functioning using a variety of tools and techniques
- Virtual Collaboration: ability to work productively, drive engagement, and demonstrate presence as a member of a virtual team.

Prof. Kosturiak (IPASLOVAKIA 2013) see the new paradigms influencing further development of industrial engineering (Figure 4.2.)

	Yesterday	Tomorrow
Corporate strategy focus	Productivity	Innovation
Corporate processes	Standardisation	Improvement
Change management focus	Best practices, benchmarking, increase customer value	New Practices – Blue Ocean, create new or different customer value
Employees	Focus on the "empolyee´s muscles" (peformance – physical intelligence) and brains (kaizen – mental intelligence)	Focus on the employee´s heart (self motivation, emotional intelligence) and soul (moral and ethics – soul intelligence)
Competitive factors	Hardware, software	Brainware, co-ware
Corporate culture	No mistake and error culture	Culture of trials and experiments
Intercorporate relationships	Competition, fight	Co-operation, partnership
Management philosophy	Trade Off Thinking - High Quality **OR** Low Cost, Affordable **OR** Customized	Breakthrough Thinking, High Quality **AND** Low Cost, Affordable **AND** Customized
Management focus	Quality, Productivity, Flexibility	Innovation and Knowledge Management
Improvement concepts	Lean Manufacturing, Six Sigma, TOC	Systematic Innovation, Lean Product Development
Innovation focus	Product and Process innovation	Business and Thinking Innovation
Management principles	Management by objectives, process and project management	Management by opportunities, company as a living organism

Fig. 4.2. New paradigms influencing further development of industrial engineering (IPASLOVAKIA 2013)

Compering the current key knowledge areas, skill and competencies of the study programme Industrial Engineering, taking in consideration key managerial competencies for Slovak industrial enterprises (CAMBAL, CAGANOVA, SUJANOVA 2012) and the above defined 2020 competencies we can conclude that future graduate profiles should be more oriented on:

- Innovation and creativity
- Entrepreneurship
- System and critical thinking
- Social competencies
- Multicultural competencies
- Networking and collaboration
- ICT.

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