



FACULTY OF MECHANICAL AND CIVIL ENGINEERING  
IN KRALJEVO  
UNIVERSITY OF KRAGUJEVAC



IX Triennial  
International Conference

# HEAVY MACHINERY HM 2017

Proceedings

ZLATIBOR, SERBIA  
June 28 - July 1 2017

CIP - Katalogizacija u publikaciji –  
Narodna biblioteka Srbije, Beograd

INTERNATIONAL Triennial Conference Heavy  
Machinery (9 ; 2017 ; Zlatibor)  
Proceedings [Elektronski izvor] / The Ninth International  
Triennial Conference Heavy Machinery HM 2017,  
Zlatibor, June 28 - July 1 2017 ; [editors Milomir Gašić].  
- Kraljevo : Faculty of Mechanical and Civil Engineering,  
2017 (Vrnjačka Banja : SaTCIP). - 1 elektronski optički  
disk (CD-ROM) ; 12 cm

Sistemske zahteve nisu navedeni. - Naslov sa naslovne  
strane dokumenta. - Tiraž 100. - Bibliografija uz svaki  
rad

ISBN 978-86-82631-89-7

621(082)(0.034.2)

621.86/.87(082)(0.034.2)

629.3/.4(082)(0.034.2)

622.6(082)(0.034.2)

681.5(082)(0.034.2)

COBISS.SR-ID 239679756



## Partnership for Entrepreneurial Engineering Education

Milica Gerasimovic, PhD, Advisor/Coordinator<sup>1</sup>, Ugljesa Bugarcic, PhD, Professor<sup>2</sup>

<sup>1</sup> Institute for Improvement of Education Belgrade Serbia

<sup>2</sup> University of Belgrade Faculty of Mechanical Engineering Serbia

Entrepreneurship is identified as important development goal for the future of the modern industry. New technologies require greater entrepreneurial activity in order to further strengthen its economic position. Reformed technical and engineering education system in Serbia is directed to strengthening vocational knowledge and acquiring of key skills necessary to join the world of work and the whole society. The new concept of curriculum has been introduced which, among the others, contains teaching subject entrepreneurship as a novelty. Within this subject students acquire: skills of planning, organizing, analyzing, communicating, realizing and evaluating; abilities for team work; abilities for proactive behaviour and positive reacting to changes; abilities for risk overtaking; positive attitude toward changes and innovation. This paper presents needs for model based on two-way communication and dialogue between learning and business environment. Main objectives of this partnership are: organization and joint efforts with the purpose of gaining wider public, making benefit of the enterprises of entrepreneurial education and development and improvement of the program of entrepreneurial education.

**Keywords:** Entrepreneurial education, Enterprises, Partnership

### 1. INTRODUCTION

The great scientific, economic and technical progress is typical for modern times, and refers specifically to the globalization and the revolution in information and communication technologies. Life-long entrepreneurial education should be a vital aspect of the educational process. The main objective of modern education system is development of competent students and future citizens, professionals and entrepreneurs. Vision of the knowledge society is a vision of society competent people whose ideas, innovation and knowledge are the main driver of development. The documents of European institutions define entrepreneurship as one of the eight key competencies in modern education: „Key competences represent transferable, multifunctional package of knowledge and abilities necessary for the individual to achieve personal fulfillment, development, professional mobility and employment. An individual acquires key competences at the end of vocational education and training and they represent the basis for individual's lifelong learning.”<sup>1</sup> This conceptualization of entrepreneurship as a key competence has since been further developed by the European Commission Thematic Working Group on Entrepreneurship Education: „Entrepreneurship education is about learners developing the skills and mind-set to be able to turn creative ideas into entrepreneurial action. This is a key competence for all learners, supporting personal development, active citizenship, social inclusion and employability. It is relevant across the lifelong learning process, in all disciplines of learning and to all forms of education and training (formal, non-formal and informal) which contribute to an

entrepreneurial spirit or behaviour, with or without a commercial objective.”<sup>2</sup>

The entrepreneurial and innovative spirit are defined by European key competencies framework as well as willingness to accept change, support and adaptation according to external conditions, to take responsibility for their own actions, developing strategic vision, setting and achieving objectives.

Has entrepreneurship been identified as important development goal for the future of the modern industry? The new industry comparative advantage lies in knowledge-based activities. Therefore, actions are needed that will boost growth through the creation of knowledge, innovation and business dynamism. As part of this process, new technologies require greater entrepreneurial activity in order to further strengthen its economic position.

The most economists agree that entrepreneurs are central to the functioning of the economy. According to Shook, Priem and McGee “the enterprising individual is a critical component of venture creation” [1]. Educational background and related industry experience of the entrepreneurs have well-established direct effects on the sales and company employment growth [2]. The same authors emphasize different capabilities required of the entrepreneur and employees depending on the companies growth strategy: creativities and technological capabilities requires in the case of external growth and innovation in the case of internal growth. Bush [3] lists three major entrepreneurial skill capabilities: visioning, bootstrapping and social skills. Markman and Baron [4] point out that the chances of entrepreneurial success grow in the presence of personal characteristics and skills such as self-efficacy, ability to recognize opportunities, personal perseverance, human and social capital and superior social skills.

<sup>1</sup> Recommendation of the European Parliament and of the Council of 18 December 2006 on key competences for lifelong learning. OJ L 394.

<sup>2</sup> Agreed on in Geneva on 18 January 2012 by a working group that included representatives from ETF, GIZ, ILO, UNESCO and UNEVOC.



## 2. ENTREPRENEURIAL LEARNING ENVIRONMENT

Modernization and development of the technical and engineering education system in Serbia is based on principals of social partnership, decentralization, accessibility, openness, program and organizational variety, professionalization of the teachers' and associates' work, as of outcome orientation [5]. Teaching contents have modular organization whereas modules, specific segments of learning, lead to achievement of clearly defined learning outcomes i.e. to acquirement of vocational competences (knowledge, skills and attitudes). Reformed technical and engineering education system is directed to strengthening vocational knowledge and acquiring of key skills necessary to join the world of work and the whole society. Strategy of technical and engineering education system development in Serbia [6] foresees possibility to acquire business and entrepreneurial skills and knowledge through education. Education Development Strategy in Serbia 2016-2020 [7] supports the concept of "entrepreneurial university" as nuclei of the creation of new industries based on knowledge. Strategy provides that all institutions of higher education should enable students to develop innovation and entrepreneurship.

### 2.1. Entrepreneurial Engineering Education

Growing businesses need to adapt to environmental and technological changes. This major will prepare students for the challenges of establishing and growing a business in today's dynamic climate. This major communicates the skills and techniques behind entrepreneurial thought and action, imparting expertise which enables managers and entrepreneurs to make crucial decisions and compete successfully. Business creation and business development competences are keys to the global business arena of the future. Furthermore, it is a requisite for a range of organisations, from large private and public companies to small and medium-sized companies, start-up companies, as well as public service and knowledge-based organisations.

It is no longer enough to come out of school with a purely technical education; engineers need to be entrepreneurial in order to understand and contribute in the context of market and business pressures. For engineers who start companies soon after graduation, entrepreneurship education gives them solid experience in product design and development, prototyping, technology trends, and market analysis [8]. These skills are just as relevant for success in established enterprises as they are in start-up's; students with entrepreneurial training who join established firms are better prepared to become effective team members and managers and can better support their employers as innovators. Entrepreneurship education teaches engineering students in all disciplines the knowledge, tools, and attitudes that are required to identify opportunities and bring them to life. Students who take part in entrepreneurship programs as undergraduates gain insights not available from traditional engineering education, such as understanding and designing for end users ("empathy"), working in and managing interdisciplinary teams, communicating effectively, thinking critically, understanding business basics, and solving open-ended problems [9], [10].

First models of dual university education in Serbia occurred at the areas of computing, i.e. software development and information technology. This model is

related to formal university education and informal acquisition of applicable professional knowledge and skills students work on practical problems in companies. Students are trained to acquire competences required employers. Students who are educated in this way, easier get a better job, but also get the opportunity to study free of charge and scholarship. According to the dual concept is expected that the average student spends 40 hours a week at the university. Half of the time the student participates in class (lectures and exercises), a half-time in the company where implemented continuous professional training during their studies. Company in this way ensure its future engineers educated in accordance with their needs. They are ready to provide them with employment after graduation, free studies and scholarships during their studies.

According these strategies the new concept of curriculum has been introduced which, among the others, contains teaching subject entrepreneurship as a novelty. Within this subject students acquire: skills of planning, organizing, analyzing, communicating, realizing and evaluating; abilities for team work; abilities for proactive behaviour and positive reacting to changes; abilities for risk overtaking; positive attitude toward changes and innovation.

Entrepreneurship as a subject represents consistent part of curricula of all educational profiles in technical education, secondary education level and elective course in engineering education level. The objectives of the subject are set as follows [7]:

- development of business and entrepreneurial knowledge, skills and behaviour;
- development of entrepreneurial values and abilities to recognize entrepreneurial opportunities in the local market and to act accordingly;
- development of business and entrepreneurial way of thinking;
- development of consciousness of own knowledge and abilities in further professional orientation;
- development of ability for active job seeking (employment and self-employment);
- development of ability to make a simple business plan for a small firm.

The program of the entrepreneurship subject is organized thematically and based on learning outcomes. Up on the end of defined themes, the student has acquired the outcomes of entrepreneurial knowledge and skills e.g. he/she will be able to:

- explain the significance of motivational factors in entrepreneurship;
- develop marketing strategy for his/her business idea and to present his/her marketing plan;
- collect information needed to lead a successful business;
- compose financial reports in the most simple form (balance-sheet, cash-flow of the enterprises);
- make a simple business plan according to adopted business idea.

Serbian education system define the concept of entrepreneurial learning as a entrepreneurial learning environment in which students acquire a wide range of competencies that may have broader individual, social and



economic benefits. Entrepreneurial competence can be applied in every aspect of life and throughout life.

## 2.2. National model of dual and entrepreneurship education

Elements of dual education have long existed in our educational system. It is assumed that the unsustainability of such a dual system in the past was the result of a separate and independent attending theoretical and practical classes. As research has shown, this model was an inadequate way for profiling students for comprehensive integration into modern trends based on innovative and dynamic systems of social processes. Such an approach makes it impossible to adequately involving students, future professionals, in a very demanding processes dictated by modern technology and the labour market. Serbia has created a dual national model of entrepreneurship education and support with respect to the experiences of Switzerland, Germany and Austria. The starting point in the objectives of this model consists of the needs of the economy and, in its formation equally involved the Ministry of Education, Science and Technological Development and the Serbian Chamber of Commerce. A significant step in advancing our secondary vocational education is signing of the contract by the school and parents with companies that will pay compensation to the student's work certainly represents. Benefit of this model, among others, presents opportunities for students that during formal education acquire functional knowledge in a real working environment. It also create the possibility that students after graduation employment. In this way will decrease the unemployment rate of young people up to 25 years. The role of companies in the framework of the active participation of young people in the production process is reflected in the significant reduction of the cost of the country which has so far invested heavily in equipment and raw materials classrooms-workshops in order to implement the students' practice. The introduction of dual education solves the problem of qualified workforce who would be through the formal process of dual education to enable active participation in the production process immediately after training and thus ensure the quality of company operations. New methodology for planning enrolment in secondary vocational schools has been developed and includes representatives of businesses, local governments, National Employment Service, school directors and representatives of the Ministry of Education.

Serbia is now possible to carry two models of dual access to education. One is **Dual-curricular education** that would be done since elementary school and would include all children in the education system. Another model is **Dual education aimed at the practice that takes place in businesses.**

The dual system is necessary to ensure the aspect of encouraging creative and conceptual approaches that give meaning and made a synthesis between the acquired theory and practice, and that students directed towards the creative pooling their knowledge, but also the directing of their knowledge and experience in a freely chosen areas of interest. National model of dual education allows students to develop an active approach to acquiring and linking different knowledge (theory) and experience (practice) and, in this way they were able to follow their educational evolution and define their identity, and to learn to value and preserve their work. Connecting representatives of

businesses and schools is an important activity in the framework of this model, which allows the permanent development of knowledge and skills of young people and gain experience and networking through different areas in accordance with the needs of the economy.

## 3. ENTREPRENEURIAL BUSINESS ENVIRONMENT

There is a close and continuous interaction between the business and its environment. This interaction helps in strengthening the business firm and using its resources more effectively. The term business environment refers to the aggregate of all forces, factors and institutions which are internally affecting the business through management structure and policies as well as which are external to and beyond the control of individual business enterprises.

All businesses have a common objective of earning profit, they differ from each other with respect to their size, nature, volume of transaction, management and ownership, etc. Thus, structurally they are different. Broadly business may be classified on basis of size, functions and ownership.

The category of micro, small and medium-sized enterprises (SMEs) is made up of enterprises which employ fewer than 250 persons and which have an annual turnover not exceeding EUR 50 million, and/or an annual balance sheet total not exceeding EUR 43 million. SMEs are the engine of the European economy. They drive job creation and economic growth and ensure social stability. In 2013, over 21 million SMEs provided 88.8 million jobs throughout the EU. Nine out of every 10 enterprises is an SME, and SMEs generate two out of every three jobs. SMEs also stimulate an entrepreneurial spirit and innovation throughout the EU and are thus crucial for fostering competitiveness and employment. SMEs come in many different shapes and sizes; however, in today's complex business environment they may have close financial, operational or governance relationships with other enterprises. These relationships often make it difficult to precisely draw the line between an SME and a larger enterprise. Small and medium-sized enterprises (SMEs) are key players in the transformation of the European knowledge economy. Their ability to apply, adapt and spread new technologies, as well as to create and develop them, is unique. Realising the full potential of SMEs is an essential part of the European Union's strategy for maintaining prosperity and high-quality employment. They are a major source of entrepreneurial skills, innovation and employment.

### 3.1. The engagement of SMEs with education

Employer engagement with education is a fairly common activity. However, there is a relationship between the size of businesses and their tendency to engage with education. Smaller businesses are being less likely to engage in education than larger companies. This trend continues within the overarching SME category as there is a positive association between SME size and level of engagement with education; as company size increases, so does the frequency, range of activities and formality of engagement with education. The most common ways for STEM-related (e.g. science, technology, engineering and mathematics, aerospace, electronics, mechanical, metals, automotive areas) SMEs to be involved with education include:

- links with universities and colleges;
- offering work experience placements;



- involvement in specific schemes and projects.

Other ways for SMEs to be involved with education include: subject talks and practical demonstrations; post-16 and post-18 apprenticeships; careers fairs, careers talks and mock interviews; company visits and tours; input to curriculum and course design; providing equipment, sponsorship and donations; and engaging with parents. There is evidence to suggest that size and sector may influence the nature of SMEs' engagement with education. For instance, company visits and tours, and apprenticeship schemes, appear to be less popular activities amongst smaller SMEs in comparison to their larger counterparts. Furthermore, there is some variation in the nature of SMEs' engagement with education depending on their sector. SMEs from advanced manufacturing and manufacturing sectors are most likely to participate in a broader range of activities with education, including apprenticeship schemes.

The literature and interviews [11] suggest a wide range of benefits for employers of engaging with education; benefits are both actually experienced by those that engage with education and perceived by those that do not. Predominantly these benefits include:

- professional development of staff;
- promoting a positive image of the company/sector;
- capitalising on young people's ideas, skills and productivity;
- direct recruitment to the company;
- personal satisfaction, enjoyment and motivation of staff.

SMEs also commonly identify the altruistic nature of their involvement with education and the benefits realised by young people as a result of them being provided with opportunities to engage with businesses and industry. This type of benefit is seen by SMEs as an opportunity to 'give something back' by passing on knowledge and experience. Young people gain experience of different practical skills, the real-world applications of STEM subjects, and advice, insights and inspiration for STEM careers, as well as more general employability skills, which they may otherwise not

have access to, or be able to develop, in school. Opinions vary regarding the extent to which this form of benefit for young people is also coupled with benefits for the company or sector. The smaller SMEs (with fewer than 100 employees) are more likely to identify engagement with education in altruistic terms than the larger SMEs.

The literature indicate [11] that many of the challenges in employer engagement in education are generic – they are common for most organisations but are often amplified within small organisations. The main challenges tend to relate to:

- time, capacity and financial constraints;
- low awareness and understanding of schemes and how to link with education;
- lack of commitment and interest of schools and pupils to engaging with industry;
- health and safety constraints and bureaucracy;
- lack of staff confidence and skills;
- low awareness of benefits;
- lack of skilled young people to engage with;
- issues in relating the business activities to the curriculum and making a relevant partnership;
- time constraints for schools.

#### 4. PARTNERSHIP MODEL

Cooperation between technical schools, technical faculties and enterprises represents one of the ways for development of social partnership. As it is the one of the strategic areas of technical and engineering education reform in Serbia, it needs to be improved. This improvement could be done only if the improvement happens in the two-way communications and dialogue between Learning Environment and Business Environment (Figure 1). Learning Environment consists of Ministry of Education, Science and Technological Development (MoESTD), Technical Faculties (Uni) and Technical Schools. Business Environment is formed of National Employment Service (NES), Small and Medium Enterprises (SME) and Chamber of Commerce and Industry (CCI).



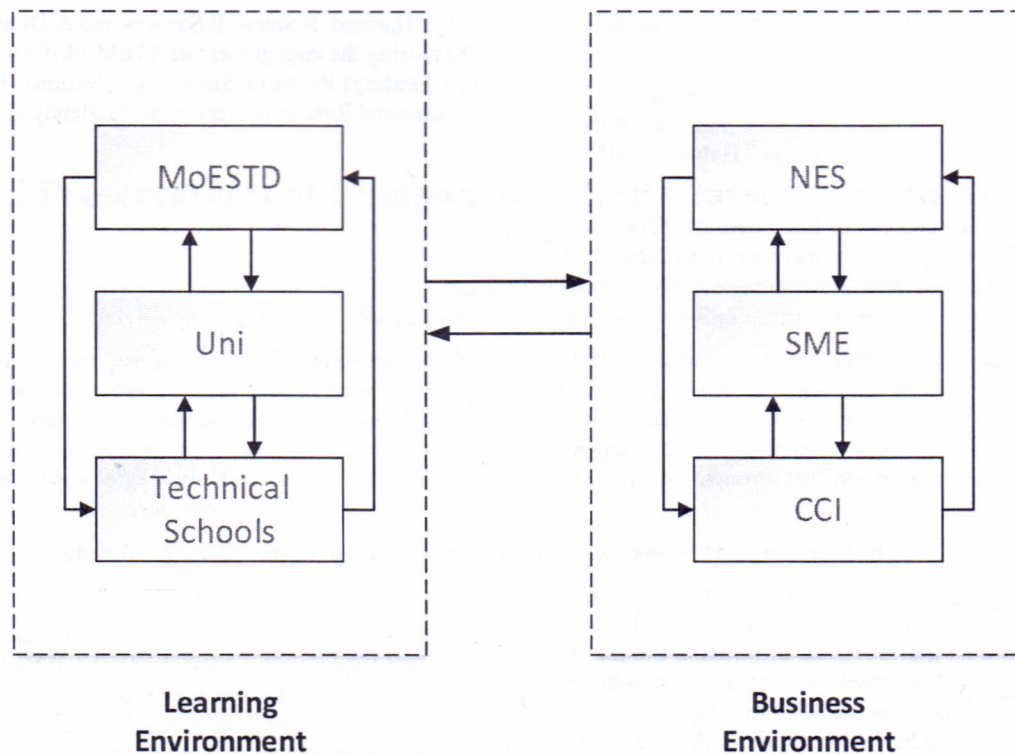


Figure 1: Partnership model

The purpose of this cooperation is the benefit of the enterprises of entrepreneurial education. In the same time, this should become the first issue on the list of the technical school and faculty priorities.

Necessity of the two-way communications and dialogue represents the essential need with the tendency to become long-term sustainable model. Few of the objectives of the partnership defined in this way are:

- organization and joint efforts with the purpose of gaining wider public;
- development and improvement of the program of entrepreneurial education.

### 5. CONCLUSION

Strengthened role of entrepreneurs, as a social partners in educational system and their active involvement in the creation of the entrepreneurial education program, will contribute to harmonization of the needs and demands in the employment system. Contemporary teaching methods based on the case studies' analysis, simulation of economy surrounding, establishment of social partnership with the entrepreneurs, but also based on their active involvement in the practical teaching of students in secondary vocational schools, undoubtedly will contribute to more qualitative entrepreneurial education and its implementation in practice. There may be a need to raise awareness of the support available, the opportunities for engagement with education and the benefits for SMEs of engaging with education. As the size of business appears to be a factor in engaging with education, SMEs, and particularly smaller SMEs, may need greater support and encouragement to engage with education than their larger counterparts. As smaller companies tend to

engage with education on a more ad hoc and infrequent basis, and with a narrower range of activities, some SMEs may have a limited view of what type of activity constitutes engagement with education and there may be scope to engage SMEs with education and schools in ways in which they had not previously conceived.

### REFERENCES

- [1] C. L. Shook, R. L. Priem and J. E. McGee, "Venture creation and the Enterprising Individual: A Review and Synthesis," *Journal of Management*, Vol. 29 (3), pp. 379-399, (2003)
- [2] B. A. Gilbert, P. P. McDougall and D. B. Audretsch, "New venture growth: a review and extension," *Journal of Management*, Vol. 32 (6), pp. 926-950, (2006)
- [3] C. Bush, "Pioneering strategies for entrepreneurial success," *Business Horizons*, Vol. 51 (1), pp. 21-27, (2008)
- [4] G. D. Markman and R. A. Baron, "Person – entrepreneurship fit: why some people are more successful as entrepreneurs than others," *Human Resource Management Review*, Vol. 13, pp. 281-301, (2003)
- [5] M. Gerasimović, Lj. Stanojević, A. Veljović and N. Cvijović, "Application of geographic information systems technology in entrepreneurship education," *Annals of Faculty Engineering Hunedoara – International Journal of Engineering*, Vol. 8 (2), pp. 197-200, (2010)
- [6] Official Gazzete RS – Educational Gazzete 9/2007.
- [7] Official Gazzete RS – Educational Gazzete 107/2012.
- [8] A.J. Nelson, T. Byers, "Challenges in University Technology Transfer and the Promising Role of



Entrepreneurship Education," Kauffman: Emerging Scholars Initiatives, (2010)

[9] ABET [Accreditation Board for Engineering and Technology], "The Vision for Change: A Summary Report of the ABET/NSF/Industry Workshops," Baltimore MD, (1995)

[10] NAE [National Academy of Engineering], "The Engineer of 2020: Visions of Engineering in the New Century," Washington: National Academies Press, (2004)

[11] J.Harland, S.Straw, E.Stevens and A.Dawson, "Exploring the engagement of STEM SMEs with education: Key Findings Research Summary," National Foundation for Educational Research, Berkshire (England), (2012)