

Implementation of Digital Technologies Into the Educational Process

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Abstract—Revolutionary changes in society are linked to digital technologies and affect all areas of social life, not excluding construction industry. This requires not only knowledge reform, but above all skills reform. The current demand of practice is to increase the knowledge and competences of graduates of civil engineering faculties in the field of introduction and use of digital technologies in the process of planning, implementation, and maintenance of buildings, as well as to support the skills development of civil engineers in teamwork while using BIM technologies. The presented, currently implemented project contributes to meeting the above-described Practice Needs. The expected direct impact of the project is to increase the competitiveness, employability, and quality of life of graduates entering practice.

Keywords—Construction Industry 4.0, digital technologies, educational process, skills reform.

I. INTRODUCTION

EU countries including Slovakia are currently exposed to an intense turbulence of digital technologies which affects all industrial areas and people's everyday lives: they are in the period of the Fourth Industrial Revolution. The Fourth Industrial Revolution is the name given to the current trend towards digitalization, the associated automation of production and changes in the labour market. The world is moving towards total 'networking', where people, machines, equipment, logistics systems, and products can communicate and collaborate directly with each other on an Industry 4.0 platform. At the heart of the digitization process is the drive to harness vast amounts of previously uncaptured information for significantly faster and more accurate decision-making. The close connection of products, equipment, and people increase the efficiency of production machinery and equipment, reduces costs and saves resources [1].

The Industrial Revolution with the serial number 4 is certainly not only about industry, but it also goes far beyond the gates of factories and industrial plants, touching perhaps all fields of human activity, including construction industry. Alongside the term Industry 4.0, the EU countries are also talking about Society 4.0 and Construction Industry 4.0.

The Government of the Slovak Republic has in the past initiated and is currently also focusing on steps towards a transformation of the economy based on innovative development and research excellence to promote competitiveness, employment, and quality of life. The "RIS3 SK" – Research and Innovation Strategy for Smart Specialisation of the Slovak Republic [2], approved by the Government of the Slovak Republic for the years 2014-2020, was built on the above-mentioned objectives [3]. The core of the strategy was the targeted support and stimulation of public-private research & development and innovation cooperation which unlocks growth opportunities for all stakeholders. The process also included the approval of the RIS3 Implementation Plan with the proposal of five domains of smart specialization [4]. This plan articulated the priority tasks set by the government in the context of the societal challenges related to the impact of the deployment of digital technologies on the economy and society. The construction industry is perceived here as an economic sector that contributes significantly to competitiveness and positively influences the economic and social development of society. The documents were and are the basis for the fulfilment of important tasks of modern society [5], [6].

The current question is how to move the entire construction sector towards digitization, efficiency, and improved communication. One of the commonly defined strategic goals in the official documents (such as RIS3 SK, the Smart Industry Action Plan for Slovakia, or the Smart Industry Concept for Slovakia) is to improve the quality of human resources for an innovative Slovakia and to increase the employability of secondary schools and universities graduates by linking the education system with the needs of practice.

The pace of transformation in the construction industry is high and smart buildings are becoming a reality in the world, as are the demands for new job skills and the shaping of new job roles. Digitalization and automation require new work skills, create new jobs, and offer new career paths [7].

Whether we like it or not, the current population needs skills to master digital applications, use computer, mobile phone, internet, machines, and devices equipped with digital technology. New working tools will surely evolve in the above-mentioned direction: the world of 3D printers and robots will penetrate the construction industry in the coming time certainly. While the digital revolution is bringing enormous benefits to the European economy, it may, at the same time, widely disrupt the labour market in all sectors. There is a growing need for a highly skilled workforce and, according to the Slovak government documents [6] already 90% of all job positions require at least a minimum level of digital skills, 45% of the EU population and 37% of the EU workforce lack digital skills. 40% of European employers say, they cannot find people with the required skills. In addition to technical knowledge and creative thinking, digital skills are now needed to get young people into the construction industry. Digitalisation is in fact a skills reform

The needs of the transforming construction industry require a change in the way education is provided by the educational institution. According to [7], it is important, to direct the strategy towards answering the following questions. What kind of graduates does the digital transformation in construction companies require? How to prepare the workforce for future workplaces, and what education is needed to work with advanced technologies? What skills will become necessary in the future workplace?

Based on real findings, it must be stated that the construction industry is the least digitalized sector of the economy in Slovakia. In the world for a long time, construction practice has not been solving the question "yes or no?" for introducing digital technologies. Instead, the answers to questions "which?", "how?" and "when?" use the properly chosen digital technologies are being searched. The answer strongly depends on the specific knowledge and skills of civil engineers and their competence to use advances in digital technologies in real-world conditions. Changes in this area must inevitably extend to changes in the methods and forms of teaching in universities [8].

There are many issues that need to be discussed in these contexts. Discussions are starting to take off slowly, and we need to move as early and as far as possible. Changes inevitably also affect methods and forms of teaching at universities. It is high time to innovate higher education for the needs of Construction 4.0. Without skilled workers, it is highly likely that manufacturers will not be able to fulfil and exploit the potential of the construction revolution [7].

Products in the digital environment, as defined in the RIS3 SK documents for the creative industries, have many common customers also in the construction sector. These are

technologies for visualisation and access to multimedia content, for virtual, mixed, or augmented reality, or even technologies for new interactive presentation technologies, procedures, and methods for project evaluation.

From the perspective of the construction industry, the applicable product lines for the trends defined for the Industry 4.0, Digital Technologies for Society and Creative Industry domains are also relevant. For example, Cloud solutions, big data, and high-performance computing, as well as collaborative systems at the technology, process and communication level, are strongly related to information modelling in the field of construction design, production and maintenance [9].

The near future reality will be that along with the key, the investor/user will require a digital twin in the form of user software for the building. Innovative information and communication technologies offer intelligent technologies for increasing the energy efficiency of building operations, mobile robotic handling systems for solving the logistics of construction resources or non-contact inventory and monitoring of equipment and stored materials on the construction site, or intelligent methods for object recognition. 3D scanning technologies are already used today to measure geometric parameters or to detect faults in building structures and objects.

These digital technologies, together with the focus on sustainable building development and new procurement requirements, are influencing the thinking of both public and private clients who are demanding new standards and new ways of working. The development of realistic graphical simulations for planning wider aspects on the physical as well as the operational appearance of a building or its equipment is now known as Virtual Prototyping. Building Information Modelling (BIM) is a digital representation of the physical and functional characteristics of a building and its facilities. It creates a source of shared knowledge and serves for information exchange, creates a reliable basis for decision-making throughout the life cycle of a building, from initial conception to demolition [10], [11].

BIM modelling has a specific application in the construction industry, as it provides a platform for all aspects of the construction product and process, which in turn allows simulate and optimise not only the design and construction of the building, but also the processes in the life cycle of the building. The models produced represent a virtual prototype for the production, management, and use of the building. These virtual 'smart objects' contain not only geometric information but also construction and building-related data. They also contain tools that allow automatic changes to the final structure or building in case changes are made in a partial area of the model. These are 'smart objects' within the model that will ensure full acceptance of the changes, helping all parties involved to understand the implications of the changes. As all users are working with a single model, they can be sure that they are always working with the latest information. BIM

goes beyond 3D modelling as it provides a basis for understanding the performance of a building from all aspects. According to Eastman [12] BIM is not just a change in technology, it is not a thing or a type of software, but a human activity that ultimately involves large scale process changes within design, construction, and facility management. The efficiency of collaboration between construction participants can clearly be increased through the sharing of information from the BIM model. However, it is essential that digital file sharing is ensured, not only between design applications but across all phases of the construction lifecycle.

The BIM platform serves the designer or architect for documentation creating, but the idea behind this concept is much more complex. It is about creating and managing data throughout the entire life cycle of a building. This life cycle involves investors, designers, building authorities, construction companies, building managers and building owners, and they all need to work together efficiently to realise and then use and dispose of the building in the required quality, cost, and time. The activities of the construction platform are not only about creating tools for BIM building modelling, the digitisation of all areas of social and economic life. It should not be perceived as an option, because it is a process that is irreversible.

II. METHODOLOGY

As a response to the requirement from practice to increase the knowledge and skills of graduates of civil engineering faculties in the field of introduction and use of digital technologies in the design, planning, production, and maintenance of buildings, a project was created, which is supported by the KEGA agency. The project is aimed not only at the innovation of teaching methods, but also at the creation of new or enhancing and updating of existing teaching texts and didactic aids, devices and equipment for the selected courses offered within the selected study programmes at the first and second higher education levels at the Faculty of Civil Engineering of the Technical University of Kosice.

The use of ICT in education plays a key role in providing new and innovative forms of support for teachers and students in the learning process. The future workforce needs to acquire the qualifications that smart practice requires. The current one must immediately start with upskilling and re-skilling to remain or become competent for the new era. The knowledge deficit of future civil engineers in the field of digitalisation of all construction processes can be filled by defining the missing competences.

Suitable conditions for the development of key competences of both students and teachers involved in the pedagogical process at the Faculty of Civil Engineering of the Technical University in Kosice can be created by changing of the established teaching methods, wider use of ICT and available student licenses for software products, as well as by a better use of tools in the TUKEmoodle environment.

The KEGA project is planned for three years and is divided

into three phases with the following outputs:

PHASE 1: Communication of teachers with representatives of practice and graduates; Output – basic competency profile of a graduate.

PHASE 2: Teaching innovation; Output – new course curricula that will include the implementation of BIM.

PHASE 3: Pilot teaching; Output – feedback from students and educators.

III. APPLICATION OF THE PROPOSED PROCESS

In the first phase of the KEGA project, a material was prepared which examined the requirements of practice [13]. This material has been developed by the faculty representatives in cooperation with the Centre for Scientific and Technical Information. As part of an innovative workshop, faculty teachers – members of the innovation team described the used forms of university-business cooperation for development of students' core competencies needed for their further development. At the same time, were contacted representatives of some companies – employers of our graduates. The contacted employers got the questionnaires, have chosen the critical competencies and then identified the difference between the expected and real levels of the given competence development. Employers, on the one hand, appreciated the theoretical knowledge of graduates and on the other hand, they pointed to the lack of ability to apply this knowledge into practice (the ability to use the expertise in practice, general knowledge and overview, conceptual thinking). The information obtained from the survey carried out with the successful graduates of our faculty also significantly contributed to the desired graduate profile definition.

The information obtained from the three above mentioned sources (business, faculty, graduates) provides a comprehensive view on the graduate and the profile of the required core competencies of graduates was elaborated.

The following key professional and specific competences of graduates were included [14], [15]:

- use of digital technologies and new processes,
- technical thinking, feeling for quality and safety,
- spatial intelligence in connection with feasibility,
- anticipating various impacts during construction,
- ability to understand the basic principles and procedures of various kinds of engineering and civil engineering constructions, and ability to comprehensively handle the related organizational and technological challenges and tasks.

Whether we like it or not, the current population needs skills to master digital applications, use computer, mobile phone, internet, machines, and devices equipped with digital technology. New working tools will surely evolve in the above-mentioned direction: the world of 3D printers and robots will penetrate the construction industry in the coming time certainly. While the digital revolution is bringing enormous benefits to the European economy, it may, at the same time, widely disrupt the labour market in all sectors.

There is a growing need for a highly skilled workforce and, according to the Slovak government documents [6] already 90% of all job positions require at least a minimum level of digital skills, 45% of the EU population and 37% of the EU workforce lack digital skills. 40% of European employers say, they cannot find people with the required skills. In addition to technical knowledge and creative thinking, digital skills are now needed to get young people into the construction industry. Digitalisation is in fact a skills reform

The implementation of digital technologies is needed in learning activities at all education levels. At universities in Slovakia and abroad, learning activities are carried out in the interaction of teachers, students, and practitioners. By changing the established methods of teaching, wider use of ICT and available student licenses for software products, as well as moving towards a better use of tools of the TUKEmoodle environment (LMS used within the e-learning portal of TUKE), it is possible to create appropriate conditions for the development of key competencies of both students and teachers involved in the pedagogical process at the Faculty of Civil Engineering of the Technical University of Kosice [16], [17].

The specified competencies can be developed while studying at university - within individual subjects, in cooperation with the practice, but also as the student's own initiative.

Fig.1: The implementation process and its benefits

Ability to integrate and apply the gained vocational theoretical and methodological knowledge within work performance was defined at the first place from among the desired soft key transferable competencies of a graduate.

The detailed analysis performed by the innovation team

brought the following recommendations for innovation forms of education and development of key competencies:

- teaching and lecturing done by experts from business,
- excursions to companies,
- scholarships for students provided by businesses,
- cooperation with companies in supervising student, bachelor's, master's, and doctoral thesis,
- learning by searching solutions to real problems and through experiences,
- participating in real projects with businesses.

The main goal of the KEGA project is to support the attractiveness of education at Svf TUKE with an orientation on the introduction of digital technologies into the teaching process, which is shown in Fig.1.

Assuming the completion of all three planned phases, it will be possible to summarize the project results as follows:

- Contribution to the content of teaching subjects that create professional competencies of graduates of the Faculty of Civil Engineering usable in planning and managing the implementation of construction work. As the Faculty of Civil Engineering profiles its graduates in a wide range of construction professions to which digital technologies are directly related its graduates can work in the position of a client (government employee, investor, developer, property manager, building operations manager, ...), designer (architect, project team manager, technologist, technician, ...) or construction contractor (main contractor, subcontractor, preparer, budgeter, construction manager, manager and coordinator of construction projects, quality, safety and environmental protection manager, ...).

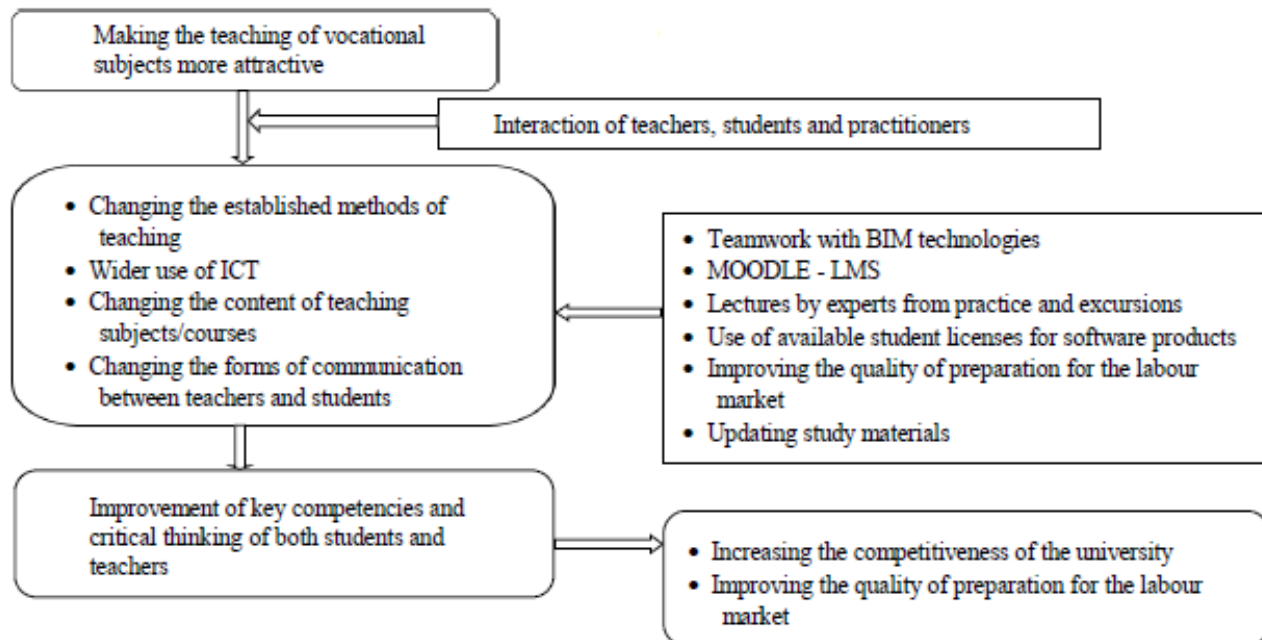


Fig. 1 The implementation process and its benefits

Based on the proposed composition of the research team, the activities will be focused on the use of digital technologies for the process of planning and implementation of the construction work and the promotion of graduates' skills in teamwork with BIM technologies.

- Supporting the efforts of the BIM Association Slovakia to implement BIM in Slovakia. It can be expected, also in Slovakia, that many large clients in the construction industry will direct engineering and construction organizations to use BIM more and more often.

- Involving students in solving partial tasks with the use of digital technologies and information modelling of buildings as part of teaching in the first and second levels of university study and creating space for increasing the interest of young people in the development of their digital skills; thus improving the quality of preparation for entering the labour market, which already today requires knowledge and digital and information and communication skills across the entire spectrum of professions in the construction industry.

- Making the teaching of professional subjects more attractive by using the potential of virtual reality and augmented reality tools to support the design, implementation management and control of building structures, as well as practical examples of the use of sensors for the control of structures and the management of construction processes.

- The attractiveness of the topic will increase the motivation of students to actively engage in the solution of university professional activities.

- Improvement of communication skills of educational process participants when solving team projects in the studio courses.

The project has set both, intangible and tangible goals. The goals fulfilment will create a technical and program background that will allow students to gain theoretical and some practical experience with the application of digital technologies.

Intangible objectives of the project:

- To transfer of knowledge in the field of construction digitalization and BIM modelling into the curricula of selected subjects of university studies at the Faculty of Civil Engineering.

- To innovate and digitalize teaching methods (e-learning portal, LMS TUKEmoodle),

- To increase the digital skills of the teaching process participants.

- To innovate the form and content of teaching in selected subjects at the 1st and 2nd levels university study at the Faculty of Civil Engineering by the information base of the Construction 4.0 platform.

- To support the knowledge and competences of the teaching participants by active use of digital technologies.

- To support students' management and communication skills and their teamwork competencies.

- To specify requirements for digital technology software tools and devices for selected processes within the

construction life cycle.

Tangible objectives of the project:

- To complete a virtual library of 3D models of building structural elements, objects, and site equipment.

- To create a repository of student projects solved in BIM platform software, intended for use in the educational process.

- To activate a repository of case studies on the use of digital technologies in different phases of the construction life cycle.

- To make information about the Construction 4.0 platform available to full-time and part-time students (TUKEmoodle portal).

- To equip classrooms with hardware and software resources for solving virtual reality problems in the field of design and implementation of construction projects (PC stations, touch screens, virtual reality goggles...) and equipment for presentations of BIM projects, semester, and final theses.

- The aim of the educational activities is to increase the competences of graduates of selected study programmes for the performance of their future professions in jobs where the use of digital technologies, including the technologies of the BIM platform, is desirable.

IV. DISCUSSION

In line with industry trends, the education sector is moving towards a revolution that can be described as Education 4.0 [18]. The essence of the process is the "fusion" of industry and education sectors [19]. One of the most significant changes in Education 4.0 is the fusion of digital technologies and teaching methods [20]. The educational process should be greatly supported by digital materials and tools that support students in self-study. The students who are most affected by the 4th revolution in education are mostly from Generation Z who are fond of using online learning tools, which certainly helps the process [21].

Addressing the knowledge deficit of civil engineers in the field of digitalisation of production, design and all the processes which are radically changed by digitalization, is an issue that has been successfully addressed in Sweden. To meet the needs of Swedish industry, the PRODUKTION 2030 platform was created within the INGENJÖR 4.0 national programme in cooperation with Swedish technical universities [22]. This is an educational initiative for support of the competences of technical engineers, especially civil engineers. The project is presented as a strategic tool to maintain the competitiveness of Swedish industry under conditions of enormous price pressure (especially from Asian countries) through the digitalization of the industry. The project involves 13 technical universities, which have jointly developed specially focused modules. These are offered to university students in Sweden, as a retraining programme for practicing engineers, but also for those with a technical background around the world. The INGENJÖR 4.0 programme is the result of national interest and strategic consensus between industry

and academia and can serve as the example of good practice for our country.

The KEGA project presents efforts to innovate educational methods, the use of virtual reality in education, the solution of practically oriented tasks, as well as efforts to open the university to companies, as presented in the recommendations for the field of education in the material prepared by the Slovak Business Agency [23].

V. CONCLUSION

Currently, the construction industry in Slovakia, as well as in the EU, functions in an environment of digital transformation of all sectors of the economy and public administration, where the online world is becoming part of the everyday life of people and businesses. It can be assumed that businesses, including the ones from the construction sector, are more likely to succeed only if they are able to innovate and digitise their processes, but above all offer services and products with high added value.

The Faculty of Civil Engineering of the Technical University in Kosice provides education for the whole spectrum of positions of civil engineers who are involved in the design, planning, preparation, and implementation of the construction projects, as well as in the management of buildings. It trains bachelors, engineers, and doctoral students in the field of civil engineering as well as civil engineering structures. The contribution of the presented project is:

- The use of the competency profile based on key competences in the creation of innovations in the educational process.
- Supporting students' skills by targeted work with software and tools of the BIM platform.
- Contribution to quality improvement and optimal decision making by solving real examples of construction practice.
- Digitalization and accessibility of educational materials in virtual space that supports not only full-time but also distance learning of full-time and part-time students.
- The processed educational materials represent a source of information for practitioners in the framework of lifelong learning.

The successful implementation of the presented KEGA project will increase the level of knowledge, skills, critical thinking, and key competences of the graduates of the selected study programmes.

Even though there are now many computer-sensitive jobs, the human factor will be always needed for the jobs where creativity and social intelligence is crucial.

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References

- [1] Basic elements Industry 4.0 (in Slovak Základné prvky Industry 4.0) [Online]. Available: <https://industry4.sk/o-industry-4-0/principy/>
- [2] Ministry of Economy of the Slovak Republic, Operational Programme Research and Innovation (2013) (in Slovak Ministerstvo hospodárstva SR Operačný program Výskum a inovácie (OP VaI)– RIS3 (2013). [Online]. Available: <https://www.opvai.sk/sk/ris3/>
- [3] Ministry of Interior of the Slovak Republic, Operational Programme Research and Innovation (2014) (in Slovak Ministerstvo hospodárstva SR Operačný program Výskum a inovácie (2014). [Online]. Available: <https://www.minv.sk/?operational-programme-research-and-innovation-2014-2020>
- [4] Implementation plan RIS3, 2017. (in Slovak Implementačný plán RIS3. 2017). [Online]. Available: https://www.vedatechnika.sk/SK/VedaATechnikaVSR/Rada%20vldy/10.%20rokovanie%20rady%2030-6-2017/IMPLEMENTACNY-PLAN_SK_final_EK.pdf
- [5] Ministry of Economy of the Slovak Republic et.al 2018, Product lines for the domain Industry for the 21st century (in Slovak Ministerstvo hospodárstva SR a kol. (2018) Produktové línie pre doménu Priemysel pre 21. storočie). [Online]. Available: https://www.opvai.sk/media/99316/produktove-linie-pre-domenu-priemysel-pre-21-storocie_web.pdf
- [6] Ministry of Economy of the Slovak Republic et.al 2018, Product lines for the domain Digital Slovakia and creative Industry (in Slovak Ministerstvo hospodárstva SR a kol. (2018) Produktové línie pre doménu digitálne Slovensko a kreatívny priemysel). [Online]. Available: https://www.opvai.sk/media/99313/digit_creativ_domena_final_22032018_pp.pdf
- [7] Industry 4.0, (in Slovak). [Online]. Available: <https://industry4um.sk/prieskum-industry-4-0/>
- [8] E. Kormaniková, K. Kotrasová (2015) “Increasing of Quality in Higher Education” Educational Alternatives. Vol. 13 (2015), p. 192-204. - ISSN 1314-7277
- [9] Through knowledge towards prosperity - Research and Innovation, Strategy for Smart Specialisation of the Slovak Republic, 2013. [Online]. Available: https://www.opvai.sk/media/100176/ris3_en.pdf
- [10] Ministry of industry and trade of the Czech Republic. “The concept of implementing the BIM method in the Czech Republic” (2017). (in Czech Ministerstvo průmyslu a obchodu České republiky (2017). Koncepce zavádění metody BIM v České republice) [Online]. Available: <https://www.mpo.cz/en/construction-and-raw-materials/bim/>
- [11] NJ. Wiley, D. Sinclair. (Ed.) (2012) BIM Overlay to the RIBA Outline Plan of Work, Royal Institute of British Architects - RIBA, RIBA Publishing, London
- [12] C. Eastman, P. Teicholz, R., Sacks and K. Liston. (2011) BIM Handbook (Second Edition)

- [13] CVTI SR. (2015) "Detailed recommendations for optimizing content and forms of study to the needs of practice: Study program - Supporting Structures and Transportation Engineering, 2nd grade" Technical University in Kosice, Faculty of Civil Engineering
- [14] R. Baskova, E. Panulinova, Z. Strukova (2017) "Research in the area of key competencies of graduates in Europe and in Slovakia" INTED 2017. - Valencia: IATED, 2017 P. 3897-3903. - ISBN 978-84-617-8491-2 - ISSN 2340-1079
- [15] INEKO (2017) "Monitoring of education reform" [Online]. Available: <http://www.ineko.sk/ostatne/monitoringreformy-skolstva>
- [16] R. Baskova, E. Panulinova, Z. Strukova (2016) "Application of educational innovation study program at the faculty of civil engineering in Košice" EDULEARN16. - Valencia: IATED Academy, 2016 P. 5002-5008. - ISBN 978-84-608-8860-4 - ISSN 978-84-608-8860-4
- [17] E. Panulinova, R. Baskova, M. Kozlovska (2017) "Cooperation with practice as a support of education and research at universities" INTED 2017. - Valencia: IATED Academy, 2017 P. 3872-3877. - ISBN 978-84-617-8491-2 - ISSN 2340-1079
- [18] G. Pallavi et. al. (2020) "A Comparative Study of Industry 4.0 with Education 4.0. International Conference on Innovation Advancement in Engineering and Technology [Online]. 21.02.2020 Available: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3553215
- [19] C. Graham (2018) "What is Education 4.0?" Intelitek 5.2018 [Online]. Available: <https://intelitek.com/2018/05/11/what-is-education-4-0/>
- [20] F. James (2019) "Everything You Need to Know About Education 4.0." [Online]. Available: <https://www.qs.com/everything-you-need-to-know-education-40/>
- [21] J. Stoffel (2016) "What are the 21st century skills every student need?" [Online]. Available: <https://www.weforum.org/agenda/2016/03/21st-century-skills-future-jobs-students>
- [22] Civilingenjör 4.0 (2020) "A National Education on Master Level focusing on smart and connected industry." [Online]. Available: <https://www.civing4.se/the-project-39616032>
- [23] Slovak Business Agency (2019) "Analysis of the needs of SMEs in the context of the smart industry agenda and specifically in relation to the need for human resources by 2020/2030" (in Slovak Analýza potrieb MSP v kontexte agendy inteligentného priemyslu a špecificky vo vzťahu k potrebe ľudských zdrojov do roku 2020/2030) [Online]. Available: http://www.sbagency.sk/sites/default/files/analyza_potrieb_msp_v_kontexte_agendy_inteligentneho_priemyslu.pdf

Contribution of Individual Authors to the Creation of a Scientific Article (Ghostwriting Policy)

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