

NEW TRENDS IN CONSTRUCTION EDUCATION AND TRAINING

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Abstract

The construction industry, as in many other industries, is evolving intensively in the recent years. These changes are observed in different areas, such as for example: preventing wastewater pollution, raising the awareness of health and safety (H&S) issues on construction sites, data protection, waste management, urban mining, infrastructure maintenance management, risk and value management and controlling in construction. In order to prepare the proper training in these fields, an appropriate approach in terms of education and teaching methods needs to be implemented. In addition, attention should be paid to the expectations of people participating in training regarding those areas. The tendencies observed in recent years in the field of life-long learning and the continuous improvement of qualifications of people working professionally, result in the need to adjust the proper way of training. Time constraints of active professional people, combined with broad access to the Internet, increase the interest in correspondence courses. The article focuses on different educational methods, created within EU funded Erasmus+ educational projects, as for example distance learning and blended learning, as well as, their implementation perspectives with regard to new trends in the construction industry.

Keywords: new trends in construction, education, distance learning, blended learning

1 INTRODUCTION

The projects described in this paper are related with development of modern educational methods for different levels of construction personnel in European Union. Five different Erasmus+ projects assumptions and results are described, namely: LEANCO (2016-2018) - "Continuing V.E.T. Training Program in Lean Construction to support the transition of the Construction Sector towards a more competitive and productive model" (Project number 2016-1-ES01-KA202-025694), MENTORCERT (2017-2019) - "Business Mentor Training and Certification" (Project number 2017-1-HU01-KA202-035953), DIAGNOSIS (2017-2019) - "Innovating a Crucial Profession in Building and Construction Sector" (Project number 2017-1-ES01-KA203-038254), URBANBIM (2018-2020) – "Innovative Educational Integration of Urban Planning Based on BIM-GIS Technologies and Focused on Circular Economy Challenges" (Project number 2018-1-RO01-KA203-049458), IPCIC (2018-2021) – "Improvement of Professional Competences in Construction" (Project number 2018-1-PL01-KA202-050616). Projects develop different types of methodologies and didactic materials for fostering of construction and building engineers and managers in the area of widely understood construction industry, namely: technical aspects like Building Information Modeling (BIM), Lean Construction methods, Geospatial Information System (GIS), preparation of professional courses from secondary technical schools, as well as soft skills, more and more important for construction, like mentoring and coaching.



Figure 1. Links do detailed information about ongoing projects:

a) DIAGNOSIS; b) MENTORCERT; c) LEANCO

please note that websites of URBANBIM and IPCIC does not exist yet (September 2018).

2 ERASMUS+ LEANCO PROJECT

This project is Promoted in EU by Fundacion Laboral del la Construcccion Navarra (ES). Partners of the project are: Warsaw University of Technology, Civil Engineering Faculty (WUT, PL), Asociación de

Constructores Promotores de Navarra (ES), TIPEE (FR), Associacao Plataforma para a Construcao Sustentavel, (PT).

The LEANCO project developed and implementing a new continuing V.E.T. Training Programme [1], [2], [3], [4] in Lean Construction for Professionals from the Construction sector. Course provides professionals with the innovative knowledge and specific skills to apply and implement the Lean Construction approach within the companies, in view of improving their competitiveness and foster the transition toward a new construction model. The LEANCO Training Programme will mainly focus on mastering the principles of Lean Construction as well as its specific and related tools/methods/techniques; and on how transferring and materializing it within the companies.

LEANCO Training Programme will be made of 240 hours and will be composed of the four parts with eleven modules, which were established on the base of questionnaires and previous projects run by Partners [4], [5].

PART 1. CONCEPTUAL LEVEL (30 hours) aiming at providing theoretical and general knowledge about the Lean Construction in order to allow Professionals to know and understand the Lean Construction philosophy and its principles. This part will be focused on the concept of Lean Construction and its main characteristics: Lean Principles (6 hours); Systems Thinking (6 hours); Lean Enterprise (6 hours); Lean Management (6 hours); Integration to the Construction Industry (6 hours).

PART 2. OPERATIVE LEVEL (160 hours) aiming at providing the specific skills to master the different tools/methods/techniques related to Lean Construction in order to allow Professionals to apply and implement the principles and practices of the Lean Construction approach within companies of the construction sector. This part will be focused on the main tools/methods/techniques related to Lean Construction and will be composed of the following modules: Module 2.1. Integrated Project Delivery – IPD (30 hours); Module 2.2. Value Stream Mapping – VSM (20 hours); Module 2.3. Building Information Modeling – BIM (60 hours); Module 2.4. Last Planner Simulation – LPS (50 hours).

PART 3. TRANSVERSAL LEVEL (30 hours) aiming at providing complementary training to broad and enhance competences and skills of Professionals covers Transversal issues (e.g. Kaizen Lean, 5S, etc.) (30 hours).

PART 4. IMPLEMENTATIVE LEVEL (20 hours) aiming at providing Professionals with methodology to let them transferring and implementing Lean Construction in the context of their companies covers Methodology development for Implementation (20 hours).

Leanco course will be available at the beginning of 2019. The main page of the course is presented in fig. 1.



Figure 1. Main page of the Leanco course [1].

3 ERASMUS+ MENTOR PROJECT

Innovative [6], [7] MentorCERT project is promoted by Budapest Business School (BBS, Budapest, HU) and has main objectives as follows: develop the mentor skills matrix and refine it so that it can be used to benchmark and develop the skills levels of business mentors at a variety of levels (from novice to expert); to promote university – business partnerships through the development of cluster - based intelligence to enable business mentors to operate in clusters of strategic importance (e.g. Fintech, social enterprises, etc.) to the local economy; to develop progression pathways for business mentors and move towards international certification of business mentoring compliant with ISO17024. The partners (Leeds Beckett University (LBU, UK), Universidade Catolica Portuguesa (UCP, Portugal), Warsaw University of Technology (WUT, Poland), AdInvest International (France), EFCoCert (Switzerland) wish to deliver an internationally accepted multilevel recognition for business mentors, for their skills, competences and knowledge.

The certification scheme will be a ready for use tool but its practical experimentation goes beyond the scope of this project, in terms of time as well as budget, and will be carried out after the project's end, in further projects. Project's 4-4 vertical and horizontal issues of the training material development are as follows:

Vertical issues [8]:

tourism industry – working group led by BBS

Fin Tech – led by LBU

agro-food industry – led by UCP

construction industry – led by WUT

Horizontal issues:

transition – led by BBS

start-ups – led by LBU

nascent entrepreneurs – led by UCP

mature enterprises – led by WUT

The following optimisation methods will be described, as vital part of the mentoring and coaching skills [8], see figure 2.

INTEGRATED THINKING	LEAN MANAGEMENT	BUSINESS MODEL
STAKEHOLDER MAPPING (VISUALISATION)	WHOLE DESIGN SYSTEM	(OSTERWALDER&PIGNEUR)
FUTURES THINKING	BIM (CONSTRUCTION SECTOR)	
SHAPE	NPV	ISHIKAWA DIAGRAM
BUSINESS PROFILING	VALUE CHAIN ANALYSIS	STRATEGIC MAP AND BALANCED SCORECARD
FUTURE SEARCH	PESTEL	PERFORMANCE PRISM
INDUSTRY ANALYSIS	SWOT	PIMENTO MAP
SWOTS	PORTER'S FIVE FORCES MODEL	CONTEXT MAPS
AFFINITY DIAGRAM	FORCE FIELD ANALYSIS	PROGRESSION CURVES
SOAR	CRITICAL CHAIN METHOD	BACKCASTING
SYSTEM THINKING	TOWS MATRIX	FUTURE USER

Figure 2. Chosen MentorCert optimisation methods [8].

Results of the project will be available at the beginning of 2020.

4 ERASMUS+ DIAGNOSIS PROJECT

DIAGNOSIS project is promoted by Association RehabiMed from Barcelona, (ES). Partners are: Universitat Politècnica de Catalunya (ES), Università degli Studi di Ferrara (IT), Warsaw University of Technology, Civil Engineering Faculty (WUT, PL), Polish Association of Building Managers (PL), Association of Building Surveyors and Construction Experts (UK), Centoform (IT).

Building and construction sector in Europe is one of the sectors which suffered most the economic crisis in these last few years, and where for many reasons innovation and upgrading of competences is still difficult to develop. One important need of this sector is related to the lack of a specific professional profile: a diagnostic expert [9], an expert who can dialogue with owners of existing buildings or their representatives and at the same time with building and construction professionals, being the one who can use up-to-date technologies to analyse the building, detect and explain the needed interventions (i.e. for earthquakes prevention, for improving energy, structural and environmental comfort etc.). This expert could - with specific socio-psychological [10] and technical competences [11] - inform and guide owners and building managers in planning interventions through a really aware and informed decision based on real data on their specific building. The project general aim is to deepen knowledge about existing up-to-date technological tools for building assessment through the collaboration among

international partners, and consequently to upgrade existing training tools and professional qualifications curricula in order to create a renewed professional profile in building and construction sector. The desired professional profile should include competences in: the use of up-to-date diagnostic tools, cross-disciplinary instrumental techniques and communication. Specific objectives of the project are as follows: upgrade and innovate existing training programs about up-to-date technological tools and methodologies for building assessment; improve the effectiveness of teaching and learning of up-to-date technological tools and methodologies for building assessment; increase the synergic use of up-to-date technologies, in an integrated way, with a team work approach and personal development; increase the cooperation among educational institutions and enterprises in EU for better employability

New training programs [12] are sustainable through their adoption by educational institutions participating to the project and implementation in the university curricula on: structural diagnosis tools and energy and environmental diagnosis tools; BIM and socio-psychological skills; geomatics and remote sensing and 3D models production. The general subjects of the training program (initial, first draft for approx. 140-290 hours training with use of blended learning method [9]) is shown at figure 3.

Indicative Syllabus for Building Diagnosis Expert	Credit value (hours)		Section
	Minimum	Maximum	
Module 1.- General subjects			Time in %
Section 1.1 Introduction	4,5	9	3%
Objectives and general approach; Diagnosis Methodology.			
Section 1.2 Materials behaviour & Pathology	15	30	10%
Physical & chemical approach to materials; Pathology.			
Section 1.3 Soft and general technical skills	4,5	9	3%
Communication and negotiation; Problems solving; Teamwork & leadership; Planning and organisation; Health & Safety during surveys and inspections.			
Section 1.4 Final reports	6	12	4%
Different kinds of reports and targets; Conclusions and recommendations.			
General subjects	30	60	20%
Module 2.- Instrumental complements for diagnosis			
Section 2.1 Construction history and documentation	12	24	8%
Historic materials and construction systems; Documentation archives; Building as a document; Building values.			
Section 2.2 Legal and regulatory framework	4,5	9	3%
Construction European directives; National and local regulations Historical approach to legal framework.			
Section 2.3 Survey & Modelling (BIM)	20	50	20%
BIM system for diagnosis; Graphic survey of buildings; Data survey of buildings; Representation techniques.			
Section 2.4 Building inspection, tools and auxiliary techniques	6	12	4%
Sampling and representativeness criteria; Simple tools for building and materials geometry; Tools for materials properties; Tools for health and comfort; Other tools and auxiliary techniques.			
Instrumental complements for diagnosis	42,5	95	35%
Module 3.- Analysis elements			
Section 3.1 Structural safety	30	60	20%
Mechanical resistance and stability; Foundations and ground conditions; Walls and pillars; Beams, porticos and floors; Vaults, domes, copulas and arches.			
Section 3.2 Habitability and comfort	30	60	20%
Energy efficiency; Protection against noise; Dampness, moisture and humidity; Habitability; Hygiene, health and environment quality.			
Section 3.3 Safety in use	7,5	15	5%
Safety in case of fire; Accessibility; Services (water, sewerage, drainages, electricity, gas, heating and others).			
Analysis elements	67,5	135	45%
TOTAL TRAINING TIME	140	290	100%

Figure 3. Detailed suggested program of Diagnosis course [9].

Program [9], which will be available year early 2020, is as follows:

1.- General subjects: 1.1 Introduction - Objectives and general approach; Diagnosis Methodology. / 1.2 Materials behaviour - Physical & chemical approach to materials; Pathology. / 1.3 Soft skills - Communication; Problems solving; Teamwork & leadership; Planning and organisation; Health & Safety during surveys and inspections. / 1.4 Final reports preparation - Different kinds of reports and targets; Conclusions and recommendations.

2.- Instrumental complements for diagnosis: 2.1 Construction history and documentation - Historic materials and construction systems; Documentation archives; Building as a document; Building values. / 2.2 Legal and regulatory framework; Construction European directives; National and local regulations; Historical approach to legal framework. / 2.3 Building Information Modelling (BIM); BIM system for

diagnosis; Graphic survey of buildings; Data survey of buildings; Representation techniques. / 2.4 Building inspection, tools and auxiliary techniques; Sampling and representativeness criteria; Tools for building and materials geometry; Tools for materials properties; Tools for health and comfort; Other tools and auxiliary techniques

3.- Analysis elements: 3.1 Structural safety - Mechanical resistance and stability; Foundations and ground conditions; Walls and pillars; Beams, porticos and floors; Vaults, domes, cupulas and arches. / 3.2 Habitability and comfort - Energy efficiency; Protection against noise; Dampness, moisture and humidity; Habitability; Hygiene, health and environment quality. / 3.3 Safety in use - Safety in case of fire; Accessibility; Services (water, sewerage, drainages, electricity, gas, heating and others).

5 ERASMUS+ URBANBIM PROJECT

Universitatea Transilvania din Brasov (RO) is the Promoter of the project. Partners of the project constitute nice mixture of Universities, Professional Associations and commercial company, areas follows: Asociatia Romania Green Building Council (RO), Universidad de Sevilla (ES), Asociacion Empresarial de Investigacion Centro Tecnologico del Marmol y la Piedra (ES), Warsaw University of Technology, Civil Engineering Faculty (PL), Datacomp Ltd. (PL).

The general aim of UrbanBIM project [13] is to deepen the interconnection of the triple helix, both in an educational level, as governmental, as well as for professional and to implement interoperability between metadata generated by the emerging technologies of BIM and GIS, so that all information can be flow into these systems and reinterpreted to exhaustive knowledge of urban developments and rehabilitations from an environmental point of view. In particular, and in order to contribute to the solution of the above described, the objectives of this project are the following [13]:

- Integrate BIM/GIS tools across all strands of the triple helix in the construction sector: Public bodies - companies - universities.
- Implement on municipal public bodies the calculation of CO2 emissions at all stages involved in construction at urban level, both developments and rehabilitations.
- Increase on awareness of climate change problem in the most influence strata within construction sector.
- Provide information about the emissions of each product/building/urban plan.
- Improve interoperability between emerging technologies (BIM) and those already implemented in public bodies (GIS).
- To create a computer tool that is open to researchers, architects, engineers and civil servants in the construction sector, who can improve and refine the project beyond the end of the project to facilitate its adaptability of new metadata capable of being generated by BIM in the future.
- Contribute to the implementation of digital cities making everything related to urban planning and urban management in a database that multiply their benefits, with the applicability that this will entail in the development of other research areas such as Big-Data and IoT.
- Gradual implementation in municipalities and then grow nationally and internationally, contributing to a new and more advanced document management model of our cities at urban level.

UrbanBIM will help to strengthen knowledge of trainers and emphasises the “triple helix of knowledge” between high education, research, companies and public bodies so this project will be also closely linked to the HE priority.

The UrbanBIM is closely linked to restoration of cultural Heritage of historical buildings, thanks to it is an innovative synergy of improvement regarding the masonry buildings dating from the last century, where, due to the time of their construction, these buildings are insufficient in mechanical resistance capacity and energy performance. There is an obvious need for energy renewal of such buildings, therefore UrbanBIM will increase awareness of benefits of rational use of energy and resources materials for students and professionals of AEC (Architecture, Engineering and Construction) in rehabilitations and urban planning.

With the growing problem of the global warming, it is necessary to study the footprint and materials efficiency of the constructions in urban developments and rehabilitations to decrease it the maximum

from the earlier phases of the project, where the use of new technologies will help highly in a pedagogical way its implementation.

Today, there are numerous studies about carbon footprint of materials calculations with their Environmental Product (EPDs), on Energy Efficiency (EE) form the building ambition, such as the proliferation of regulations in that sense, but it is necessary a tool that allows life cycle analyse in our cities in view of future rehabilitations as well as urban developments, aimed at facilitating the territorial strategies from an energy and environmental point of view and, in this way, to mitigate environmental impact.

Generate an Online Educational Collaborative Platform (OECF) on previous EU projects related to LCA and BIM/GIS in construction sector to stablish synergies with UrbanBIM project, to connect associated partners and useful products. That is, Support HEI in implementing the strategy for collaboration with companies and public bodies [14], [15], [16]: studies on level of implantation of BIM/GIS and ecological challenges, previous training materials, specific curriculums, methodologies for calculation, European and national regulations related to CO2eq emissions and waste management in construction-related sectors and implementation of BIM/GIS in public bodies, enterprises, etc.

6 ERASMUS+ IPCIC PROJECT

This project is Promoted in EU by Polish Association of Building Managers (PABM, PL). Partners of the project are: Warsaw University of Technology, Civil Engineering Faculty (WUT, PL), Erbud S.A. (PL), Centro Edile A. Palladio (CEAP, IT), Vilniaus Statybininku Rengimo Centras (VSRC, LT), Centre for VET Training (CKZIU, PL)

Project will support the development of high quality VET with a strong work-based learning component [17]. The project is based on a strong partnership between education and construction industry. Cooperation of Technical University, VET providers, Professional Association and successful Construction Industry Company will ensure the use of best approach to education and training (WUT, is renowned university both in terms of research and education) combined with the needs of people working on the European market (PSMB is an organization that represent major construction companies in EU, and got access to over 360000 professionals from 12 countries in EU via their membership in AEEBC - Association d'experts Européens du Bâtiment et de la Construction - The Association of European Experts in Building and Construction = www.aeebc.org). Due to the fact that VSRC, CKZIU, CEAP are constantly monitoring level of education and qualification of their pupils and CPD courses participants, and the needs of both national (regional) and European construction sector labour market, relevance of VET will be improved and maintained. This project will also ensure reduction of skills mismatches and shortages in construction sector (related to finishing works and soft skills) through timely adaptation of curricula and qualifications profiles.

The need [18], [19] was confirmed through research that has been conducted by partners of the project and by research conducted by AEEBC (Association of European Building Surveyors and Experts) in countries of member's organization. The goal of the European Commission is to help the sector become more competitive, resource efficient and sustainable and to attract more people due to lack of well qualified construction professionals in the field of finishing works. Commission also lists the main challenges facing construction. Two of these challenges are: - Training: Improving specialized training and making the sector more attractive, in particular for young learners; - Innovation: More active uptake of new subject technician of finishing works in construction. The project will respond to the need of qualified professionals through creation of innovative didactic resources for training. The training will include innovative and modern approach to manuals supported by audio-visual resources (i.e. movies with participation of workers and trainees) and underline the need of soft skills. Partners plan to enhance Work Based Learning (WBL) model in construction, that is why one of the partner in the project is a construction company. The construction sector requires highly qualified workers due to continuous development of technologies (i.e. new ecological materials and sustainable technologies). The training of such workers requires preparation and creation of training materials, manuals and suitable methodology. Such materials will be prepared for both school pupils and participants of continuous professional development (CPD) courses. Didactic materials will also cover innovative aspects of soft skills, i.e.: bilateral relations between construction workers and teachers (mentors). The project will also raise the social status of construction workers. Underlining the ethos of construction worker should encourage young people to undertake construction courses in vocational schools. Another important issue is Health & Safety which will be underlined in didactic mat. Didactic mat. prepared for the courses in vocational schools and CPD will cover this very important issue. IPCIC adheres to the ET2020

framework by developing up-to-date VET ensuring the matching of labour market with skill requirements. It also complies with the initiative of "Opening-up Education" widening access to education through Open Educational Resources (OER). Developing skills through IPCIC training also support EU policies such as "Bruges Communiqué on enhanced Vocational education and training 2011-2010" and "Agenda for new Skills and Jobs".

The main objective of the project is to improve education in the field of construction, in line with new legal regulations and modern construction sector trends. To achieve that goal, training system and educational resources will be prepared as a result of the project. They will contain knowledge necessary for the finishing works specialists, with particular emphasis on efficiency of work and education, H&S regulations, and soft skills.

The main subjects covered in manuals and movies will be topics relevant for: plumbing installer, drywall fitter and tiler. Project will also help to improve mobility of construction personnel, due to its international content (presentation of practices from participating countries) and Multilanguage form (this will help users to learn vocabulary specific for finishing works). Output of the project will include also a movie about ethos of construction workers. Six main results of the project are foreseen:

- Creation of courses programmes ,
- Creation of courses methodology,
- Creation of didactic materials and scenarios of movies,
- Creation of movies materials (movies and text translations),
- Creation of materials for teachers training.

7 CONCLUSIONS

The main effect of the projects presented in this paper is not only strengthening of construction personnel education at all levels – from poorly educated labour personnel up to high skilled managers, but also the recognition of needs for qualifications of construction personnel, recognition of applied systems of education, certification of the personnel and accreditation of studies (like postgraduate studies at Warsaw University of Technology [14]), technical schools programmes and courses (formal and informal) in EU. Another important result of the projects is formulation of complex structure of managerial knowledge in construction, and the development of a curricula of relevant courses in the EU.

Innovative approach of education is used, as distance and blended learning. Projects aim to develop an European system, which would assure standardization of levels and transparency of construction managers qualifications. Erasmus+ didactical projects are extremely useful for strengthening co-operation between different players at European economic market: higher education institution, professional bodies, companies, secondary level education institutions and companies. Projects creates positive synergy of the economic and educational systems.

ACKNOWLEDGEMENTS

The Erasmus+ projects described in this paper have been funded with support from the European Commission. This publication [communication] reflects the views only of the authors, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

REFERENCES

- [1] LEANCO - "Continuing V.E.T. Training Program in Lean Construction to support the transition of the Construction Sector towards a more competitive and productive model" (Project number 2016-1-ES01-KA202-025694) - working materials, Pamplona, Warsaw, 2018.
- [2] P. Nowak, and J. Rosłon, "Leonardo da Vinci Projects-tools for building personnel qualifications recognition across EU." TTS Technika Transportu Szybowego, vol. 10, pp. 471-477, 2013.
- [3] J. M. C. Teixeira, et al., "Training needs in construction project management: a survey of 4 countries of the EU." Journal of civil engineering and management, vol. 12.3, pp. 237-245, 2006.

- [4] M. V. Książek, P. Nowak, and J. Rosłon, "Projekty dydaktyczne współfinansowane z UE prowadzone na Wydziale Inżynierii Lądowej Politechniki Warszawskiej." *Materiały Budowlane*, vol. 12, pp. 13-15, 2015.
- [5] A. Gonzales Martin, et al., "Engineers' and managers' education in construction-innovative approach." 9th International Technology, Education and Development Conference. IATED Academy, pp. 2124-2134, 2015.
- [6] M. Książek, et al., "Europejskie podstawy nauczania menedżerów budowlanych." *Materiały budowlane*, vol. 6, pp. 176-177, 2016.
- [7] A. Nicał, P. Nowak, and J. Rosłon, "Innovations in Construction Personnel Education." *MATEC Web of Conferences*, EDP Sciences, vol. 86, 2016.
- [8] MENTORCERT - "Business Mentor Training and Certification" (Project number 2017-1-HU01-KA202-035953) - working materials, Budapest, Warsaw, 2018.
- [9] DIAGNOSIS - "Innovating a Crucial Profession in Building and Construction Sector" (Project number 2017-1-ES01-KA203-038254) - working materials, Barcelona, Warsaw, 2018.
- [10] A. Minasowicz, et al., "Postgraduate European Common Studies in Construction Management", 8th International Technology, Education and Development Conference. IATED Academy, pp. 2639-2646, 2014.
- [11] M. Książek, P. Nowak, S. Kivrak, J. Rosłon, L. Ustinovichius, "Computer-aided decision-making in construction project development", *Journal of Civil Engineering and Management*, 2015, 21:2, 248-259.
- [12] A. Nicał, P. Nowak, and J. Rosłon, "Innovations in Construction Personnel Education." *MATEC Web of Conferences*, EDP Sciences, vol. 86, 2016.
- [13] D. C. Pérez, et al., "Working documents and application of Erasmus+ URBANBIM project", *Asociacion Empresarial de Investigacion Centro Tecnologico del Marmol y la Piedra*, Spain, 2018.
- [14] A. Minasowicz, et al., "Postgraduate European Common Studies in Construction Management", *8th International Technology, Education and Development Conference*. IATED Academy, pp. 2639-2646, 2014.
- [15] A. Nicał, et al., "Distance Learning within Management in Construction—Polish, Norwegian and Icelandic Experiences in Blended Learning." *Procedia Engineering*, vol. 196, pp. 483-490, 2017.
- [16] M. V. Książek, P. Nowak, and J. Rosłon, "Distance Learning Education for Engineers-European Projects." *Logistyka: czasopismo dla profesjonalistów*, vol. 6, pp. 6257-6264, 2014.
- [17] A. Minasowicz, et al., "Working documents and application of Erasmus+ IPCIC project", *Polish Association of Building Managers*, Poland, 2018
- [18] M. V. Książek, P. Nowak, and J. Rosłon, "Projekty dydaktyczne współfinansowane z UE prowadzone na Wydziale Inżynierii Lądowej Politechniki Warszawskiej." *Materiały Budowlane*, vol. 12, pp. 13-15, 2015.
- [19] M. V. Książek, P. Nowak, and J. Rosłon, "Leonardo da Vinci Projects—Innovative Approach for Engineers' and Managers' Education." *Logistyka: czasopismo dla profesjonalistów*, vol. 6, pp. 6251-6256, 2014.