BENEFIT

Boosting the telecommunications engineer profile to meet modern society and industry needs

Co-funded by the
Erasmus+ Programme
of the European Union

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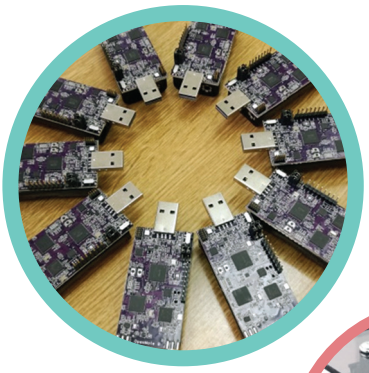

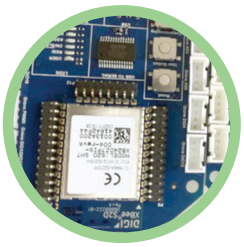

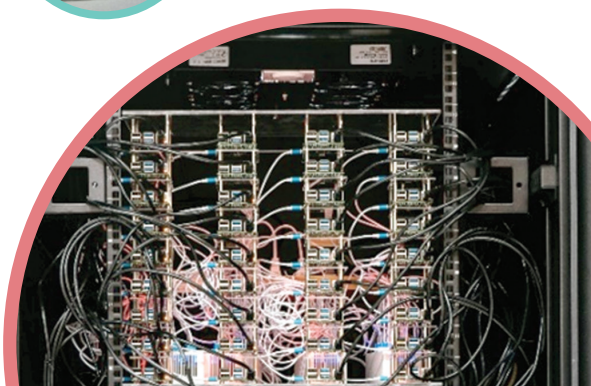

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Boosting the telecommunications engineer profile to meet modern society and industry needs [BENEFIT]

Project partners

University of Klagenfurt - UNI-KLU, Austria_ Coordinator
University of Ljubljana – UL, Slovenia
Josip Juraj Strossmayer University of Osijek, Faculty of Electrical Engineering, Computer Science and Information Technology – (UNIOS) FERIT, Croatia
Ericsson Nikola Tesla d.d. – ENT, Croatia
University of Banja Luka – UNI-BL,
University of Sarajevo – UNSA, Bosnia and Herzegovina
University of Tuzla – UNTZ, Bosnia and Herzegovina
University of Belgrade – UB, Serbia
University of Niš – UNI-NIS, Serbia
University of Novi Sad – UNS, Serbia
Bicom d.o.o. – BICOM, Bosnia and Herzegovina
BIT Centar Ltd. – BIT, Bosnia and Herzegovina
Cisco Systems – CISCO, Serbia
Nis Cluster of Advanced Technologies – NICAT, Serbia
RT-RK doo za sisteme zasnovane na računarima Novi Sad – RT-RK, Serbia

Associated partners

Schneider Electric DMS - SE-DMS, Serbia
Vojvodina ICT Cluster – VOICT, Serbia
Zesium Mobile Ltd. – ZM, Serbia
AlfaNum Ltd. – AN, Serbia

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Contents

1. Project overview

1.1. Aims and objectives of BENEFIT

A thorough ex-ante analysis and project preparation revealed that the universities in the Western Balkan (WB) region that offer study programmes in telecommunications were and are experiencing a drop in the number of students, even though telecommunications are a consistent pillar of our modern economy. The major reason for this is that the telecommunications industry is facing significant challenges to cope with the reduced revenues of the telecom services as compared to the over-the-top Internet services. New trends such as Internet of Things and Cloud technologies are driving the market needs away from the traditional telecommunication engineer profile towards the information and communication technologies (ICT) expert trained to understand and respond to new information-centric market needs. Great employment opportunities exist for a new class of experts. This consortium strongly believes that further industrial innovation and higher employment can be realized by strengthening the profile of telecommunications graduates to meet society and industry needs, through:

- HEI-industry (HEI= Higher Education Institution) cooperation and strengthened relations with the economic/social environment,
- broadening the conventional telecom engineering curriculum by inclusion of broader ICT contents,
- continuous training of teachers,
- introduction of new teaching/training approaches and tools,
- involvement of students in piloting classes where their feedback is collected to refine contents and methodologies,
- modernization of labs and the creation of joint labs with industrial partners,
- implementation of more internship opportunities for students and thesis co-advising,
- creation of an integrated web platform that includes: information on study programmes of the involved HEIs, information on training/internship opportunities, a catalogue of ICT companies in the region, job opportunities, information on events/seminars to reach a wider community,
- promotion of awareness to future generations about needs/skills/opportunities,
- stimulating better positioning in the job market, entrepreneurial actions and contributions to technological and economic challenges.

BENEFIT is a concrete response to the recently developed programmatic strategies of the WB countries for growth, stability and socio-economic integration in the EU.

So far, the conventional approach has been to educate students following either a computer engineering curriculum or an electrical/telecommunications

engineering curriculum with a clear distinguished profile and competence in either software and networking aspects, or in electronics and hardware. Industry is asking for graduates that can understand the full picture and can easily adapt to the challenges offered by the development of an ICT solution. Many new ICT companies appeared in the WB market, including some of the industrial partners of BENEFIT, requiring several ICT engineers that are beyond current capabilities of the WB HEIs (Higher Education Institutions). These changes introduced new challenges to HEIs in terms of renewing the traditional course of studies in telecommunications engineering to prepare graduates with a profile better matching the requirements of the labour market.

The consortium also believes that there are other two important aspects to consider for the development of a new modern curriculum:

- the adequate and continuous training of the teachers involved in the program,
- the introduction of effective teaching and training methodologies.

The first objective is aligned, for instance, with the document "Strategy for education development in Serbia 2020" (2012) that states: "for the purpose of total professionalization of the teaching profession, good initial education of all teachers is necessary, along with the continuity in development of their professional competencies". According to this strategy, measures have to be undertaken "to develop teacher training programmes that will strengthen their competences to encourage creativity, innovation and entrepreneurship in students". Both above-listed objectives can be found in the "Development Strategy of the Federation of Bosnia and Herzegovina", which states that the "primary need in the higher education is to harmonize curriculums at B&H (Bosnia and Herzegovina) universities with the EU, to increase mobility of students and teaching staff towards the EU, increase employment opportunities through quality education and incorporate e-learning methodologies". Therefore, BENEFIT will foster teacher education and implement teacher mobility and regional workshops on new teaching approaches bringing together regional HEIs and industry to share best practices.

According to the EU 2020 strategy, research and innovation are essential for growth. This is reflected in the document "Western Balkans Regional R&D Strategy for Innovation" (2013), which states that the WB countries should "strengthen their research and innovation capacity to pave the way to full integration into the EU". BENEFIT significantly contributes to the development of this strategy by enhancing and modernizing engineering education at both 1st and 2nd cycle levels. The activities will promote regional cooperation and mobility, which is required since "the small size of the regional economies limits individual research and innovation potential". The harmonization of study programmes will facilitate the cooperation between regional universities in the ICT domain, as well as their cooperation with other regions where higher education reforms are supported by the EU, including CIS countries and Central Asia.

The growing needs of the ICT industry and the strategic orientation of B&H and Serbia, demands the education of high quality ICT professionals. The BENEFIT project is exactly designed to respond to these needs and offers "benefit" to ICT industry and society-at-large.

BENEFIT is the result of the collaboration of the state universities in B&H and Serbia and the local industries. Telecommunication departments at these universities are facing similar problems and have set a common goal to solve them as a result of the meeting between chiefs of telecommunication departments from WB held in 2015. The ERASMUS+ project will offer the framework and support to foster the regional collaboration which is necessary to increase the quality and attractiveness of telecommunication studies and to harmonize the study programmes and methodologies with the highest EU standards. Collaborations between WB universities and UNI-KLU already exists, as well as with UL and FERIT, but these collaborations need to be strengthened. The preparation phase of the BENEFIT proposal has taken significant effort and it has been realized by face-to-face meetings in Tuzla, Osijek, Novi Sad and Klagenfurt partly supported by an Austrian MUNDUS+ preparation project.

To summarize, the aims of the BENEFIT are:

- To improve the telecom engineer profile, promoting interdisciplinarity, in response to industry needs and to contribute to advances in technology, economy and society.
- To enhance the quality of traditional telecommunication studies, to provide additional competences, to fulfil the gap between university education and the local labour needs.
- To increase the study programme attractiveness and promote women in engineering.
- To reinforce and broaden the collaboration with the industry and to increase employment opportunities.
- To increase the visibility and implement training/internship/job opportunities.
- To make young students and society aware of the great impact telecommunication technology has.

And the concrete objectives are:

CURRICULUM MODERNIZATION

- Determination of competences/skills that have to be included in a modern curriculum embracing ICT subjects.
- Development of courses content, taking into account industry needs for harmonization with the EU universities and to enable fast employability.
- Modernization, full accreditation, and delivery of the curricula in all 6 WB universities for both the 1st and 2nd cycle.
- Creation of a web platform that links the study programmes of all 9 HEIs.

TEACHING METHODOLOGIES and INFRASTRUCTURES

- Help teachers to adopt modern teaching methods, such as: video-based lectures, e-learning platforms, online tests, social means and Moodle for interaction and feedback with students.
- Modernize laboratories and build joint university-industry labs.
- Realize a shared platform to collect teaching material, including video recorded classes, in multiple languages.

TRAINING

- Define new training methods with industry partners.
- Implement student internships and training with partner companies in a systematic way.
- Implement teacher training especially on modern teaching methodologies, e-tools, and on preparing and running laboratory sessions with state-of-the-art tools.
- Realize a web platform for training/internships opportunities.

INDUSTRY COOPERATION

- Strengthen the cooperation with industry starting with the involved partners to reach a large number of ICT companies in the WB region, to increase employability and employment opportunities.
- Map competences and skills required by the job market.
- Involve industry experts to shape the modernized study programmes.
- Involve industry experts in training the new generation of teachers.
- Create joint industry-academia labs.
- Increase the number of offered internships.
- Create a web catalogue listing companies in the WB region working in ICT.

DISSEMINATION AND EXPLOITATION

- Organization of 3 open events to reach also the non-experts and show the impact that telecom technology has on the society.
- Organization of a yearly webinar to present study programmes, tips on study engineering, career opportunities and foster women to have an engineering career.
- Present the project results in media and through publications reaching a large amount of stakeholders.
- Put in place a monitoring methodology for continuous assessment of job market needs, employability and employment of graduates.
- Create partnerships with companies for joint labs operation.
- Create partnerships with companies for research cooperation including the EU funding opportunities.
- Establish bilateral agreements among the HEIs for future double degrees, joint teaching, and student mobility beyond the project duration.
- Undersign an agreement for the maintenance of the created web platforms.

1.2. The project consortium

The project required the cooperation of HEIs (Higher Education Institutions) and industry in the ICT domain. Therefore, the consortium was created by including 6 western Balkan and 3 European universities, 4 companies in the ICT domain, 2 technology parks, plus 4 other companies and one technology park as associated partners. Most of these universities operate under different regulations and organizational schemes, but they share very similar problems and the intention to improve the quality and attractiveness of the study programme in telecom engineering and establish a tighter connection with industry. Industry in the region is facing a significant drain of engineers and has evolved rapidly, requiring graduates with a modern and skilled profile. It was of paramount importance that all these universities identified the deficiencies together with industry, developed and implemented a modernization of the curriculum in telecommunications evolving it into an ICT engineering curriculum. This was done by carefully investigating the needs of the local job market and confronting the stakeholders (students, teachers and industry representatives). The dialogue and work could not be done in an isolated way but needed the inclusion other EU universities and in particular the ones that already started this process and with whom there is geographical and goals proximity. All partners introduced compatible and complementary expertise from the area of telecommunications and specific knowledge on ICT applications. In particular, the following relevant areas are covered by BENEFIT's industrial partners: signal and information processing (AN), telecom networks (CISCO, ENT, ZM), smart systems and IoT (RT-RK, CISCO), HW/SW applications (BICOM), smart energy systems (SE-DMS). During the last decade, partner universities went through different higher-education reforms and structured the studies in different ways. Each university brought and continuously brings experience obtained in these reforms and shares best practices. The partner universities were motivated to improve current study programmes and enhance student mobility, introduce new interdisciplinary programmes and start with the long-term preparation of joined education and training programmes. Modernization of the teaching methodology, infrastructure and labs was also very important. The involved partner companies were committed to establish joint laboratories with universities and train not only students but also teachers to the use of new design and prototyping methodologies so that the labs could be operated well beyond the project life. Furthermore, the companies were and are committed to offer internship opportunities to students and wish to make such opportunities more visible so that more students can be attracted. Finally, the 3 ICT clusters (BIT, NICAT, VOICT) helped to reach a large number of other companies and obtain a good mapping of the ICT industry in the region for cooperation.

In detail, the BENEFIT consortium consists of the following institutions:

P1: University of Klagenfurt - UNI-KLU

With more than 10.000 students, the University of Klagenfurt (UNI-KLU) is the largest public university in Southern Austria and is organized in four faculties: The Faculty of Humanities, the Faculty of Interdisciplinary Studies, the Faculty of Management and Economics and the Faculty of Technical Sciences. The latter comprises 9 institutes responsible for teaching and research in the area of information and communication engineering, computer science and informatics, mathematics, statistics, informatics and mathematics didactic. In recent years, the Faculty of Technical Sciences has developed internationally visible areas of strength: "Networked and Autonomous Systems", "Modelling, Simulation and Optimization of Complex Systems", "Engineering of Software, Data and Knowledge-based Systems" and "Multimedia Systems". These areas of strengths are application-oriented and established in the international research landscape. Another special feature is the research institute Lakeside Labs GmbH, which deals with the theme of self-organizing systems in the information and communications technology and works closely with the corresponding institutions of the university. It has recently established an international master programme in information and communication technologies. The Institute of Networked and Embedded Systems (NES) is engaged in the design, modelling, and analysis of future networked and embedded systems and is leading the research cluster on "self-organizing networked systems". NES has a strong research record in wireless communications and networking, sensor and camera networks, autonomous aerial robot systems, embedded systems and smart grids. It provides dedicated laboratories for wireless communication, sensor networks and unmanned aerial vehicles (UAVs), electronics and communication for smart systems and hosts the Erasmus Mundus Doctoral School on Interactive and Cognitive Environments (ICE).

UNI-KLU is the coordinator of the project and is therefore responsible for the management (in WP7) of the consortium and the project.

The main project team from UNI-KLU includes the following persons:

- Andrea Tonello
- Davide Righini

- Francesco Marcuzzi
- Emma Schneider
- Nunzio Alexandro Letizia
- Federico Passerini
- Vitali Korzhun
- Erika Tonso
- Hermann Zunter
- Heidelies Aschbacher
- Ursula Rotter

P2: University of Ljubljana – UL

Univerza *v Ljubljani*

The University of Ljubljana (UL) is a public autonomous educational, scientific research and artistic institution of higher education. It was established in 1919 upon the tradition of semi-university institutions from the 17th century. It has 26 member institutions: 23 faculties and three academies. UL ranks among the top 500 universities according to the ARWU Shanghai. UL employs 5920 employees. Of these, 3196 are teaching and assistant staff, who are for the most part registered as researchers, 415 are full time researchers, 516 are junior researchers and others are professional, technical and administrative staff. UL is very active in the international research and education programmes. It participated and still participates in several hundred projects financed by the European Union (FP, TEMPUS, ERASMUS; Leonardo da Vinci, DAPHNE, SafeInternet, eLearning, eTEN, Lifelong Learning Programme and others).

The main mission of the Faculty for the Electrical Engineering is the education of electrical engineering experts and research work. There are 33 active research labs at the faculty, undertaking 15 research programmes, 1 infrastructure programme and 32 research projects of the Slovenian Research Agency (ARRS). The Faculty also participates in 4 bilateral projects with 3 countries and 118 commercial projects for domestic and foreign companies. The FE currently employs 123 teaching staff, 154 scientific workers and researchers. Department for ICT is part of the Faculty of Electrical Engineering and consists of 5 labs. Faculty of Electrical Engineering has strong cooperation with local and global industrial partners earning more than half of its budget with industrial projects.

University of Ljubljana is a crucial partner in this project, sharing historical, geographical and economical relation to partners in this consortium, becoming relevant with Balkan countries entering the EU and enlarged commuting of students and workforce.

The main project team from UL includes the following persons:

- Matej Zajc
- Urban Burnik
- Marko Meža
- Janez Zaletelj
- Borut Mikulec
- Klara Skubic Ermenc

P3: Josip Juraj Strossmayer University of Osijek, Faculty of Electrical Engineering, Computer Science and Information Technology Osijek - FERIT

The Faculty of Electrical Engineering, Computer Science and Information Technology Osijek (FERIT) is one of the three technical faculties of Josip Juraj Strossmayer University of Osijek. The Faculty has six departments with 56 PhD scientists and around 2000 students. There are over 20 laboratories, among which the Laboratory for Renewable Energy Sources as well as two accredited laboratories, the Electromagnetic Compatibility Laboratories and the Laboratory for High Frequency Measurements, stand out. FERIT successfully participated in the implementation of several Croatian and European scientific and educational projects and has a long experience in providing education in the field of Telecommunications at undergraduate, graduate and postgraduate level. FERIT enables and continuously improves collaboration with the industry on common projects, workshops, student internships etc. FERIT provides a web platform called STUP offering students and associated companies direct contact related to student internship, training, workshops and job offers.

The main areas of expertise are: renewable energy sources and energy efficiency, mathematical modelling and optimization in power and electromechanical engineering, intelligent energy networks, image and video processing, intelligent control systems and robotics, wireless communication systems, communications networks and next-generation network services, applications and software quality, applied computational intelligence, embedded as well as distributed and ubiquitous computer systems.

The main project team from FERIT includes the following persons:

- Drago Žagar
- Snježana Rimac-Drlje
- Višnja Križanović
- Zdravko Krpić
- Ivica Lukić
- Dario Došen
- Krešimir Grgić
- Željko Hocenski
- Mario Vranješ
- Vanja Mandrić Radivojević
- Goran Martinović
- Željka Mioković
- Marina Skender
- Mario Miloloža

P4: Ericsson Nikola Tesla d.d. – ENT

Ericsson Nikola Tesla (ENT) is a Croatian company and is the largest specialized provider of telecommunications products, solutions and services in Central and Eastern Europe. The company employs more than 1900 people and has been in business for more than sixty successful years. Today, more than twenty years after Ericsson became its major shareholder, ENT is an expert centre in the field of information and communications technology and a significant constituent part of Ericsson in the market unit Central Europe. ENT employs 1100 people in the R&D division. ENT has a long successful tradition in cooperating with the scientific

community, which has been going on for more than 60 years. This cooperation is based on joint research projects and supporting education processes on both sides. ENT has been participating in several EU R&D project in the ICT framework programmes, mainly in technical roles (MPOWER, q-ImPrESS, CloudScale, eWALL, S-CASE, Care Well), and in one TEMPUS project lead by the University of Zagreb (OPUS project).

The main project team from ENT includes the following persons:

- Darko Huljenić
- Ivana Stupar
- Saša Dešić

P5: University of Banja Luka – UBL

UBL, established in 1975, is the second largest in B&H, with about 20,000 students. It consists of 16 faculties: Academy of Arts, Architecture, Economics, Electrical Engineering, Mechanical Engineering, Medicine, Agriculture, Law, Natural Sciences and Mathematics, Technology, Sport, Philosophy, Philology, Forestry, Political Sciences, and Mine Engineering. UBL has about 60 study programmes and is fully committed to the idea of a borderless area for research and knowledge exchange in Europe. So far, 30,571 bachelor degrees, 3047 MSc and MA degrees, 700 specialization degrees, 1,104 MPhil degrees, and 587 doctoral degrees have been awarded. Besides an excellent location, UBL has other competitive capabilities, including about 1,000 research active staff for teaching and research and 450 administrative staff members. The UBL staff has been involved in more than 90 Tempus projects, several FP6, FP7 and HORIZON projects, as well as in the Erasmus projects. The other international projects were financed by: The European Commission, the Council of Europe, United Nations, the World Bank, governments of several states. The UBL is bound by more than 200 bilateral agreements on cooperation with public and private universities from all over the world.

Faculty of Electrical Engineering (FEE) is the oldest faculty of the UBL, growing from the Electronics and Telecommunications department of the Technical Faculty, founded in 1962. The FEE consist of three departments: Electronics and Telecommunication, Computer Engineering and Informatics, and Power

Engineering and Industrial Systems. The FEE has a long-standing successful cooperation with industry. Following the trends in the field of ICT, the FEE specially emphasizes education and research in this area. The FEE started in 2009 with PhD in ICT, the first PhD study programme in B&H according to the Bologna principles, with four modules: Software Technologies, Software Engineering, Communications, and Multimedia.

The main project team from UBL includes the following persons:

- Zdenka Babić
- Gordana Gardašević
- Vladimir Risojević
- Mitar Simić
- Jovica Bulović
- Aleksej Avramovic
- Slavko Šajić
- Slavica Gajić
- Jovan Galić
- Vedran Jovanović
- Vladan Stojnić
- Boris Malčić
- Milica Lekić
- Vanja Starčević
- Miloslava Radonjić
- Nemanja Kitić
- Tomislav Livnjak

P6: University of Sarajevo - UNSA

Trying to become an equal partner to universities of superb standing in Europe and beyond, as well as to scientific and research organizations, in compliance with the European principles of creating a single higher education area, the University of Sarajevo gives considerable attention to different forms of international cooperation. Internationalisation is implemented in all segments of teaching and research: education and knowledge transfer, scientific research, artistic production, acquisition and recognition of competences, building academic solidarity, etc. The University of Sarajevo remains determined to continue to be the leader in

higher education in Bosnia and Herzegovina in terms of quality of its teaching and research, the number of students and faculty members. University of Sarajevo enjoys partnerships with 128 universities in Europe, the USA, Canada, and the Middle East. University of Sarajevo is an equal partner in mobility programmes for students and members of staff, and it is open to study and research activities: TEMPUS (103 TEMPUS projects in cooperation with 135 European universities - 83 as partner, 16 as academic coordinator and 4 as grant-holder), FP7 (with 38 FP7 projects, participating since 1980, becoming associated state as of 2009, and the first FP project coordinator from B&H), Erasmus Mundus (19 ERASMUS MUNDUS projects in cooperation with 55 EU universities with 179 EU incoming and 263 UNSA outgoing), CEEPUS, Mevlana, Fulbright, DAAD, and others. This public institution offers study and research opportunities at 22 Faculties, 3 Academies, 5 Centres, 5 Institutes, with National and University Library, Gazi-Husrevbey Library, National Museum of Bosnia and Herzegovina, Student Parliament, with over 100 study programmes and over 200 departments. Today, with around 34,000 enrolled students, it ranks among the largest universities in the region.

The main project team from UNSA includes the following persons:

- Dušanka Bošković
- Emir Turajlic
- Saša Mrdović
- Miralem Mehić
- Pamela Begović
- Mesud Hadzialić
- Meliha Bajraktarević
- Biljana Mandić
- Mirza Hamza
- Darijo Raca
- Nejra Selimović
- Amna Kopić
- Maida Islamagić
- Mehmed Brkić
- Vedran Karahodzić
- Merisa Kurtanović
- Almasa Tuhcić
- Aida Causević
- Mirnes Ibrić

P7: University of Tuzla – UNTZ

The University of Tuzla was established in 1976 and today includes more than 50 study profiles in various disciplinary fields. The University organizes and implements teaching-scientific process at undergraduate and postgraduate levels of study, spread across 13 faculties, and involving around 12.000 students, 741 academic and administrative staff members.

Teaching is organized in three cycles, in line with the Bologna Process, and the University offers study programmes in bachelor, master and doctoral studies.

Research, academic excellence, creative and critical approach are the central values of the University of Tuzla.

The vision of the University of Tuzla is to conduct relevant activities within the integrated European higher education and research area; furthermore, it aims to use the research and international achievements as a basis to provide students of all three cycles of studies with top-quality education, encourage fundamental research in the fields of natural science, technical science, biomedical and health sciences, biotechnical sciences, social sciences and humanities thus becoming a major generator of development in the Tuzla Canton in all areas of life, economy, education, health, culture and sports.

The mission of the University of Tuzla is to continuously transfer and develop internationally recognized high-quality of research in the fields of science, art, and higher education in three levels of the Bologna cycle and lifelong learning, by generating, transferring and applying knowledge gained in various science fields and thus position and maintain the position of the University as the leading higher education institution in the area of the North East Bosnia and Herzegovina and abroad.

Faculty of Electrical Engineering offers one study programme Electrical Engineering and Computer Science, with five modules: Power systems, Electrical energy conversion, Telecommunications, Computer science and Control and robotics.

The main project team from UNTZ includes the following persons:

- Nermin Suljanović
- Aljo Mujčić

- Suad Kasapović
- Nerdina Mehinović
- Asmir Gogić
- Munevera Redžić
- Sandra Ibrić Hodžić
- Nihada Kovačević
- Mensur Kasumović
- Siniša Marković
- Dervisa Zejnilagic
- Alma Secerbegovic
- Belma Mujcic
- Marina Pejic
- Amina Mujičić
- Amera Sinanovic
- Emina Bajrektarević

P8: University of Belgrade – UB

The University of Belgrade (UB) is the oldest and largest university in Serbia with over 89.000 students and 5.000 teachers and associates. It comprises 31 faculties, 11 Institutes, 7 Centres and a University library, which all work together on achieving academic excellence. As the largest learning community in this part of Europe, the UB offers 374 study programmes, of which: 88 undergraduate, 10 undivided, 132 master, 70 doctoral studies, 30 academic and 10 professional specializations, 94,458 students (of which 4,171 international) and 6,174 academic and research staff, 3,105 papers on SCIE and SSCI lists, numerous publications and scientific and research projects. The University of Belgrade takes active part in the European programmes as a grant holder and partner in many projects (Horizon 2020, Erasmus+, TEMPUS, FP7, CIP, LLP, Erasmus Mundus, EUREKA, COST, IPA etc.).

University of Belgrade - School of Electrical Engineering (ETF) was founded at the University of Belgrade in 1948, and today the UB is the largest engineering faculty in the region, and 3rd largest engineering faculty in Europe. ETF is a multidisciplinary research and higher education division of the University of Belgrade. ETF pursues research in power engineering, electronics, physical electronics, signals and

systems, telecommunications, computer engineering, and software engineering. It employs about 160 professors and assistants. Offering all the levels of academic studies (Bachelor, Master and Ph.D.), it enrols about 1100 students per school year. Today it is one of the foremost teaching institutions in Serbia with 10 chairs, with more than 250 staff members and with around 100 journal publications per year. Since its founding, the ETF always had an important role and position in the engineering society and high education, providing excellent experts, collaborating with national and international high education institution, industry, military, as well as many international partners from various business fields.

The main project team from UB includes the following persons:

- Mladen Koprivica
- Aleksandar Nešković
- Goran Marković
- Jelena Ćertić
- Natasa Nešković
- Vesna Blagojević
- Marija Šola Spasić
- Kristina Jovičić
- Kristina Josifović
- Milos Bjelić
- Tatjana Milijković

P9: University of Niš – UNI

The University of Niš was founded in 1965 as a state HE institution. It is a medium-sized, mature and well developed academic community, comprising 14 faculties and involving more than 26,000 students. The University of Niš has significant experience in international programmes such as Tempus, Erasmus Mundus, Erasmus+, FP6, FP7 and HORIZON 2020. Since 2001, the University of Niš has been participating in the international programme TEMPUS and Erasmus+ (KA2) with numerous projects, either as a coordinator or partner. Some of the latest coordinated projects are: Re@WBC, FUSE, SHESPS, IPROD, etc. One of the leading

principles of the University of Niš is to become a part of the European higher education area and to adjust its plans and programmes towards this aim.

One of the most prominent faculties of the University of Niš is the Faculty of Electronic Engineering. It is an educational and scientific higher education institution, and in the scope of its primary activity it organizes academic study programmes at all level of studies in the field of electrical engineering and information and communication technologies. Teaching and research activities of the Faculty include a wide spectrum of fields. Each academic year, the Faculty enrols up to 480 students for the bachelor level studies, 352 students for master level studies, and up to 100 students for doctoral studies. The teaching process at the Faculty is performed by more than 160 teaching staff members. A significant number of faculty staff members are very experienced in the coordination and implementation of TEMPUS and Erasmus+ (KA2) projects.

The main project team from UNI includes the following persons:

- Nataša Maleš-Ilić
- Nebojsa Dončov
- Vera Marković
- Nenad Milošević
- Daniela Milović
- Olivera Pronić-Rančić
- Zlatica Marinković
- Zoran Stanković
- Dejan Ćirić
- Dejan Milić
- Zoran Perić
- Jelena Nikolić
- Aleksandra Jovanović
- Goran Đorđević

P10: University of Novi Sad – UNS

The University of Novi Sad (UNS) was founded in 1960. It is the only state university in the Autonomous Province of Vojvodina, comprising 14 faculties and 2 research institutes. UNS enrols more than 50,000 students, employs around 5,000 teaching and non-teaching staff, and delivers 300 study programmes at all three academic cycles. The Faculty of Technical Sciences (FTS) is the largest of 14 faculties at the UNS.

The study programme on telecommunications engineering is the responsibility of the Department of Power, Electronic and Communication Engineering and is conducted by 17 professors and nearly 30 teaching and research assistants at the Chair of Communication Engineering and Signal Processing. The Chair has large experience in the development of teaching courses and research projects in the field of signal processing applications in telecommunication networks. Their leading researchers are the members of CEVAS – one of the first Centres of Excellence at UNS. Apart from study programmes in Telecommunications and Signal Processing, the Chair is involved in the new study programme of Biomedical Engineering at FTS and Data Science at Faculty of Sciences, UNS, and collaborate with ICT companies in the region working in the field of Telecommunications, Telemedicine and Power Management.

UNS is active in the international collaboration field participating in both educational and research projects (ERASMUS+, TEMPUS, HORIZON2020, FP7, EUREKA, COST, IPA, etc.), including a prestigious project Advanced Technologies in Sustainable Agriculture and Food Security (ANTARES) as the first teaming project within HORIZON 2020 in the region, initiated by the BioSense research group that originated from the Chair. UNS has participated in the TEMPUS projects aiming at restructuring and reforming higher education processes, structures and programmes. UNS has become a reform-oriented university, developing intensively international cooperation with universities and other institutions in the field of higher education.

The main project team from UNS includes the following persons:

- Vlado Delić
- Dejan Vukobratović
- Milan Secujski

- Milan Narandžić
- Nikša Jakovljević
- Živko Bojović
- Tatjana Lončar Turukalo
- Vojin Šenk
- Željen Trpovski
- Dragana Bajović
- Branko Brkljač
- Tamara Škorić
- Aleksandar Minja
- Branka Stojković
- Tijana Nosek
- Ivan Lazić
- Tijana Devaja
- Milica Petković
- Nikola Simić
- Siniša Suzić

P11: Bicom d.o.o. - BICOM

Bicom d.o.o. (Bicom) is a Bosnian company and is the largest specialized manufacturer of telecommunication products and solutions in Bosnia and possibly Eastern Europe. The company employs more than 40 people almost all in R&D and related support and has been in business for more than ten successful years. Its products are distributed around the world by other companies in the Bicom Systems Group of Companies, particularly in North America and Europe working with Service Providers. Customer type covers the full market range: Government, Enterprise, Business & Call Centres. Bicom has a long successful tradition in cooperating with the academic community: for more than ten years Bicom has been involved in closer and closer relationships with Universities to secure jobs for undergraduates. The cooperation is based on joint research projects and supporting education processes on both sides. Bicom has been investigating several EU R&D project in the ICT framework programmes with other companies in the Bicom Systems Group, mainly in technical roles.

The main project team from BICOM includes the following persons:

- Seudin Kasumović
- Sanjin Lišić

P12: BIT Centar Ltd. - BITP12: BIT Centar Ltd. - BIT

BIT Centar was established in 2005, in order to support and develop ICT SMEs and to manage seed capital fund in order to make smaller equity investments. BIT is focused on supporting and developing ICT companies and industry. For those purposes BIT developed several main services and programmes, which include support to SMEs, trainings, seed capital found (SCF) and cooperation with the University of Tuzla in R&D areas. Since its establishment, BIT partook in the creation of more than 500 jobs for graduates and undergraduates. There are 21 companies in BIT today, while 35 companies left the centre. BIT's mission addresses the generation of ICT business, ICT job generation business support, market linkages, and creation of an encouraging environment. The main goal of BIT is to provide opportunities to young prospective experts and entrepreneurs to start and develop their businesses.

BIT Centar was a lead partner on the project Support to Entrepreneurial Activities of Young People under the EU IPA Cross-border Programme 2007 between Serbia and Bosnia and Herzegovina. In 2015, BIT Centar was a partner on the project BESt 4 SMEs (Business Environment Strengthening for More SMEs in Tuzla and Neighbouring Municipalities) and in the period 2012-2015 R&D the NORBOTECH project (NORwegian – BOsnian TECHnology Transfer based on Sustainable Systems Engineering and Embedded Systems in the Fields of Cloud Computing and Digital Signal Processing, funded by Norwegian ministry of Foreign affairs, was implemented, carried out and accomplished in Tuzla, Banja Luka and Dramen.

BIT Centar is focused on creating new jobs and new ICT Companies. In 2015 and 2016 only, the BIT Centar implemented projects like "Partnership in innovation – My Practices and Work Ready Now" financed by USAID, "Start-up Academy" financed by the Norwegian Embassy in Sarajevo and "Start-up Camp" financed by UNDP under "Dialogue for the Future".

The main project team from BIT Centar includes the following persons:

- Robert Martić
- Vedrana Ajanović

P13: Cisco Systems (CISCO SRBIJA DOO BEOGRAD) – CISCO

Cisco designs and sells broad lines of products, provides services, and delivers integrated solutions to develop and connect networks around the world. Cisco brings integrated solutions that span network, data centre, cloud, security, collaboration, analytics, and IoT for faster business transformation with reduced risk. For over 30 years, Cisco has helped our customers build networks and automate, orchestrate, integrate, and digitize IT-based products and services. In an increasingly connected world, Cisco is helping to transform businesses, governments, and cities worldwide.

The company is nurturing the talents of problem solvers around the world by providing foundational digitization and entrepreneurship skills to individuals of diverse backgrounds, preparing them to thrive in the digital economy. In fiscal year 2016, through Cisco Networking Academy Program, they reached more than one million students in 170 countries. They also provide students with career resources and connections to employers seeking IT talent, which drives value for Cisco and our customers, partners, and communities worldwide. Cisco's goal is to achieve a milestone of two million students a year within the next five years.

Cisco Serbia office has been established in 2002. The Cisco office is responsible for market development by satisfying customer needs, solving their business issues, helping transformation of governments, cities and businesses. Sales is done through a channel of 150+ partners. In order to strengthen relationship with the ecosystem partners and customers, Cisco Serbia is organizing a number of educational events and seminars throughout the year. Today Cisco Serbia employs 25 highly educated professionals. Its widely-known Network Academy programme is educating more than 800 students every year at 10 Networks Academies in Serbia. Since their establishment, Academies are constantly evolving their curriculums to satisfy changing needs of businesses and modern society.

The main project team from CISCO includes the following persons:

- Ana Tolimir
- Đorđe Vulović

P14: Nis Cluster of Advanced Technologies – NICAT

NiCAT cluster is a non-profit association of successful companies, scientific research institutions (Faculties of Electronic Engineering and Mechanical Engineering) and economic development support institutions, founded in 2011. NiCAT is a leading institution working with Hi-tech industry in South East Serbia and has a catalyst role in community and the region.

NiCAT is self-sustaining from the beginning and the ultimate objective of the NiCAT cluster is to empower and modernise electronic, electro-mechanical and ICT industries in Serbia, and facilitate financing new development projects, and therefore expand the business scope of the Association's members and source new markets for their promotion. The cluster tends to strengthen the capacities of technological development and innovations for the members and promote the City of Niš as a favourable location for business operations in advanced technology fields. The cluster operates in Electromedicine, Electronics and Automation, Information and Communication Technologies, Mechanical Engineering, Optoelectronics. NiCAT main projects are: IPA CBC BG-SRB programme - ATM Integration project (2012); NARD (National Agency for Regional Development) programme - NiCAT cluster InterSTART project (2012/2013), Inter-sector project - Best national cluster project in Serbia (2013/2014), SLDP USAID programme - ICT Cluster Academy project (2014). NARD programme NiCAT Dermoskope project - Best national cluster project in Serbia (2014/2015), E-learning platform for employees learning and development (2015/2016). NiCAT cooperated with many stakeholders at the local level and managed strategic partnership with other three ICT clusters in Serbia. NiCAT is one of seven Founders and Board members of the Serbian Cluster Association, as well as member of the Council of Clusters of Serbia. Also, NiCAT is member of Digital SME Alliance and has signed MoU with 14 other clusters from the Balkans and Black Sea region.

The main project team from NiCAT includes the following persons:

- Goran Mladenović
- Jana Stevanović
- Jelena Igić

P15: RT-RK doo za sisteme zasnovane na računarima Novi Sad – RT-RK (Research and Development Institute RT-RK for Computer Based Systems LLC)

RT-RK is an R&D company and accredited national research institute. The company delivers development services and has its own brand of products of real time embedded systems. The company has a strong focus on consumer electronics, communications, multimedia, product design, and small scale production.

Headquartered in Novi Sad, with offices in Belgrade, Serbia, Banja Luka, Bosnia & Herzegovina, and Osijek, Croatia, with nearly 1000 employees, 950 of whom are engineers, RT-RK is one of the biggest developmental houses in south-eastern Europe. Ministry of Science and Technological Development of the Republic of Serbia accredited RT-RK Computer Based Systems LLC as a National Research and Development Institute, by stating that the scientific programmes of RT-RK contribute to the development of new products and devices, introduce new and improve existing technological processes, systems and services, and perform transfer of knowledge and technology. The company adequately deploys competent scientific researchers, programmes for young developers, and adequate facilities, equipment, and other resources for the implementation of programmes of general interest.

The rich experience and high expertise in the development of consumer electronics products, interdisciplinary, highly experienced team-work-oriented engineers with proactive approach to presented challenges, and galore of innovative solutions has been recognized by industry leaders such as but not limited to Google, iWedia, Microsoft, Phillips, Marvell, and Qualcomm with whom RT-RK has had a several years long collaboration.

In addition, RT-RK has strong ties to Universities of Novi Sad, Banja Luka, Osijek, and Vienna, and good collaboration with number of other academic institutions, particularly in curriculum development.

The main project team from RT-RK includes the following persons:

- Nikola Teslić
- Gordana Velikić
- Ivan Kaštelan

1.3. Project structure and management

BENEFIT comprises 7 work packages (WPs).

- In WP1 (led by UNI-KLU), preparation activities were carried out and a consolidated summary of the ex-ante analysis was done. The preparation included some organizational tasks, overview of planned actions and deliverables, partitioning of tasks and responsibilities. Considerable attention was given to the cooperation with the industrial partners to develop the curriculum modernization guidelines. This activity offered a shared view and lead to the implementation activities.

- In WP2 (led by UNTZ), the Western Balkan (WB) HEIs modernized and harmonized the study programmes in telecommunications engineering. This was done with the aid of the EU HEIs and following curriculum guidelines for telecommunications engineering study programmes, considering all the strategies, recommendations and other legal documents in the field of HE adopted in the partnership countries. The EU HEIs contributed to develop the class contents and harmonized curricula.

- In WP3 (led by UNS), new teaching methodologies with the direct involvement of the industrial partners were and are adopted, labs were modernized, and joint HEI-Industry labs in the WB HEIs were developed in specific areas of ICT (smart systems, IoT, e-health, smart energy, cyber security, cloud based networks, information systems and processing).

- In WP4 (led by UB), training of both students and teaching staff was executed. Industrial partners offered and are still offering internship and training opportunities to students.

- WP5 (led by UL) is about quality control. The QC board included one external QC expert and consulted two High Education Reform Experts (HEREs). QC covers two main areas. Firstly, quality control and contingency planning of the project activities and results. Secondly, monitoring the level of achievements with regard to the targeted goals: graduates profile improvement, employability/employment improvements, increased collaborations with industry, dissemination actions to reach a wide audience.

- WP6 (led by FERIT) is about dissemination and exploitation. WP6 strictly cooperates with WP7 so that an effective series of meetings, events and workshops are delivered.

- WP7 (led by UNI-KLU) coordinates and manages the consortium and project activities. To render the management effective, a Management Board (MB) and a Development Board (DB) were formed. It is led by the project coordinator (PC) UNI-KLU and overviews the overall project activities, delivery of results,

progress, quality, conflicts, contingency plans, project meetings, project events and workshops, financial aspects, project reporting. The MB consults the DB, which controls and manages the concrete activities carried-on in the core WPs, i.e., WP1-WP6, led by WP leaders (WPLs). A financial officer (FO) and a project secretariat (PS) were also appointed at the beginning of the project. A management e-platform was put in place to enable collection and circulation of material and information and clear planning of activities.

Project meetings: A kick-off meeting took place at the project start in 2017, where all roles and committee members were established: MB, DB, QB, PC, FO, WPLs. Each year a physical project meeting took place in order to discuss and give insights into each WP's completed, current and future tasks so that the whole consortium gains insight into the overall progress of the project. In 2018 the project meeting took place in Novi Sad, Serbia, whereas in 2019 in Osijek, Croatia. In 2020, due to the COVID-19 pandemic it was not possible to meet physically and an online project meeting was organized on 26 November 2020.

Figure 1.1. 2018 Project Meeting in Novi Sad

Figure 1.2. 2019 Project Meeting in Osijek, Croatia

1.4. Quality control and monitoring

Quality Control and Monitoring (QCM) activities will be performed continuously during the project realization. The WP leader will be the UL. The QCM Board (QB) will be established at the kick-off meeting by assembling a team of representatives from UL, UNI-KLU, FERIT, UNI, UNSA, ENT and two student representatives. One external QCM expert will be appointed. In addition, it will be assisted by two external High Education Reform Experts (HEREs) that will act as advisors to provide inputs and independently assess the project results. The main activities will comprise:

- Consolidation of areas to be monitored with selected indicators and correction strategies (both internal and external).
- Internal control of project progress and outcomes.
- Monitor graduates profile, improvements in skills, and correspondence to industry needs.
- Collect questionnaires and surveys, taking advantage also of social networks.
- Monitor student enrolment statistics in the region.
- Establish a monitoring system for employment statistics of graduates in telecommunications engineering.
- Establish a monitoring system for entrepreneurship attitude and new companies created by graduates in telecommunications engineering.
- Organize board meetings in addition to regular conference calls: one planned in Ljubljana and one in Banja Luka) plus an assessment visit by the QCM leader from UL to UB, UNS, UNTZ.

The project activities and deliverables will be constantly monitored in consultation with the management board. Deviations and difficulties will be examined and actions for quick solution will be determined.

The external QCM Board member and advisors activities will be to overview and verify the internal QA report, to give recommendations on areas that could be further developed and improved, and to provide an opportunity for dialogue among evaluators and strengthen the self-assessment process.

Indicators will be measured through report analyses, surveys and questionnaires. QCM activities will also include evaluation of student reactions, achievement of objectives and impact of the project on the institutions as a whole, as well as the project results in terms of increased cooperation with the socio/economic environment, the correspondence between the graduates' skills and job market needs, the time-to-employment of graduates and statistics of employment, student awareness of their skills and their entrepreneurial attitude, and job opportunities. In particular, the QCM Board will assess and monitor the correspondence between objectives and graduate profile, alignment of professional and academic requirements. Quality indicators will follow: the development of QC guidelines adopted and distributed to all partners, reports on project implementation made by WP leaders and evaluated by QB, reports on graduates' profile improvements and correspondence to industry needs, tools for monitoring student enrolment and employability/employment/entrepreneurial statistics of graduates developed and delivered to partners, reports on reached stakeholders beyond the consortium.

1.5. Expected impact of the project and targets

BENEFIT aimed to affect students, universities and ICT industry considering telecommunications engineers as pillars of modern ICT technology/innovation development.

The WB HEIs improved their study programmes and the teaching methodologies through collaboration with regional and international ICT industry partners. Sharing good practices and strengthening their relations, inducing a better understanding of the job-market fast evolution are mandatory. HEIs and industry mutually profited by collaborating in the assessment of existing curricula and in defining newly required competences.

Indeed, key beneficiaries are students, who gain access to state-of-the-art curricula, infrastructures and easier connections to WB ICT industry. Modernized curricula are supposed to result in higher student attractiveness/enrolments. The improved profile of graduates will translate in higher employability chances and stronger impact on the industry human resources capacities and innovation ability in the long run.

Figure 1.3. UB student seminar on IoT Security

In summary:

- the expected number of partner country (PAC) HEIs students trained is more than 120
- the expected number of PAC HEIs academic staff trained is 100
- the expected number of PAC HEIs administrative staff trained is at least 12
- overall, the number of direct beneficiaries per year in the PACs will comprise 120 academic staff members from HEIs, 12 administrative staff members from HEIs, 1050 HE students, 200 individuals working in the industry.

Particular attention was and is given to attract more female students to engineering. The modernized teaching tools should facilitate integration of groups of students with impairments.

Figure 1.4. University of Tuzla Open Day

Other target groups are: teachers, universities, industry, people involved in higher education reforms and the society at large. The modernized curricula, the up-to-date teaching methodologies, the increased number of internships opportunities in industry should attract more students in partner universities. Better connected to the real-world ICT programmes are supposed to convince more students, including women, to study engineering. The collaboration with industry initiated with this project allows a continuous exchange of information to keep the curricula up-to-date with the job market needs. The valuable know-how acquired produces long-term benefits and serves as a guideline for the preparation of new study programmes in ICT engineering by other universities. The collaboration with industry in education shall also serve as a model, for instance, for the creation of joint labs, student co-supervision, staff training beyond the end of the project.

BENEFIT is regarded as a fundamental step for the internationalization of studies in telecommunications engineering in the region and a step for joint/double degrees between the participating HEIs. It allows departments to improve self and external evaluation of study programmes, adopt English for increased internationalization and attractiveness. It is expected that other universities follow the same steps, not only WB but also EU universities (especially those with geographical proximity) that have an interest in a harmonized system and to foster collaborations and student exchange. Developed guidelines are disseminated and therefore exploited by university leaders and people involved in higher education reforms.

The web platforms and material repositories developed allow reaching a wide audience and provide concrete information. In particular, the lectures/training material should be kept updated allowing students, trainees and staff to easily retrieve information and simplify the teaching/learning process. The catalogue of ICT companies in the region should render them more visible and more attractive to students and trainees even beyond the WB region. This web platform will be maintained beyond the project duration and its update will be facilitated by the cooperation with the ICT clusters in the region. This will have a direct impact on the ability to map employability and employment offers. Better graduates will reflect in more qualified engineers that will work in WB companies and that will contribute to the innovation process of such companies.

It is expected that research visits, bilateral and multilateral research projects will be initiated due to a better cooperation between ICT departments and companies of the project consortium. One of the planned collaboration activities included the settlement of bilateral agreements for student exchange and joint study programmes (exploiting local government funding and/or EU funding) as well as agreements with the industry for internship and job placement. Academic staff further cooperated for instance in exploiting the university-industry labs developed and maintaining them beyond the project lifetime. The annual webinar offered in turn by the involved universities stays alive to outreach a wide audience of students and pupils and promote a career on ICT. The format of the open events realized to show the impact/opportunities that ICT offers in solving big societal challenges, served as a model to be replicated in future events in the WB region to reach the wide society at large.

2. Ex-ante analysis and guidelines aimed at boosting the telecommunications engineering profile

The starting point for desired changes of the existing study programmes has been the identification of the study programmes in all involved universities as well as the preparation of unique templates for self-assessment in both domains – academic and industry. For this purpose, a template for self-assessment for the academic part has been prepared by FERIT and distributed to nine universities included in the project. Furthermore, an industry survey has been prepared by the UL and delivered to BENEFIT industry partners.

Based on a consolidate initial analysis of data obtained from all HEIs and industry partners, we formulated guidelines for the curriculum modernization that guided the project activities in the development work packages.

2.1. Ex-ante analysis

The academic survey has been conceived to collect information from academic partners in form of a unique template, which was the basis for the essential comparison of study programme structures, legislations, competencies acquired, industry cooperation, procedures and guidelines related to the curriculum implementation etc. The main objective is to gather all relevant information from academic partners in the region presenting similarities and differences as a basic point for the process of modernization of the study programmes in telecommunications engineering and necessary curricula harmonization as well.

The survey is based on the questionnaire giving an overview of the study structure, general competencies obtained through the study programme, subject distribution by Compulsory/Elective and by groups Fundamental/Professional/General. Furthermore, it provides an overview of the main documents, procedures and guidelines related to the curriculum implementation as well as some information about cooperation with the industry. Study programme courses have been classified into preselected categories/groups of familiar courses.

The acquired data has been analysed aiming at identifying current status of the academic study programmes in fields of telecommunications engineering and related to ICT professionals. The analysed data gives a good insight into main objectives, competences, specifics, highlighting the aspects important for this deliverable, as well as determining main similarities and differences between universities.

The industry survey has been prepared to collect information on job market needs and to map skills and knowledge areas required from ICT engineers and specialists in the ICT sector. The aim is to gather relevant information from industry in the region so that academic partners would have current information in the process of modernization of the study programmes in telecommunications engineering.

The survey is based on the data collected from the questionnaire composed of two parts: for employers and for employees. Based on the internal analysis and the evaluation of the surveys, the following conclusions can be made.

Most of the companies have problems with ensuring adequate employee skills (5 out of 7). Moreover, 6 out of 7 companies experienced difficulties in filling vacancies.

The highlighted obstacles which cause difficulties in filling vacancies for ICT specialists, developers and researchers are mainly "Insufficient supply of qualified candidates who poses adequate skills" and "Candidates do not have work experience" followed by "Wages are not high enough to attract qualified candidates". The qualifications offered by the national education and training system are on average partially known. The survey points to the changes that are necessary in the vocational education and higher education institutions to meet the job requirements. All interviewers suggest to "define and update educational profiles in line with labour market needs" followed by "readiness to review and change curricula in order to align them with technological change" and "focus on practical training, organization of practice, internships at the company, etc." (6 out of 7).

2.2. Guidelines

The guidelines are based on relevant international curriculum guidelines, such as ACM and ABET, taking into account common needs and goals for the transformation of the curriculum in telecommunications into a modern ICT engineering curriculum for the WB universities.

Following the Bologna process, the BENEFIT project activities followed the process taking into account the autonomy of the universities and changing needs of industry, students and society. From the Bologna process we identified the importance of the following:

- Adoption of a system of easily readable and comparable degrees
- Introduction of transferable system of academic credits to assist in promoting European cooperation and quality assistance
- The position of higher education institutions and students as essential partners.
- Promotion of European dimension in higher education through inter-institutional cooperation, curricula and mobility schemes, etc.

Short overview on Learning outcomes was prepared as part of D1.1, followed by a workshop on new teaching methodologies and instructional approaches in ICT engineering education with emphasis on learning outcomes and competence development for engineering profession, held at the University of Ljubljana between 25 and 26 September 2019.

As specified in the Bologna Process, all programmes in the third level institutions in the EU need to be written in terms of learning outcomes. Following this, all courses within the BENEFIT project were prepared using the guide for writing and using learning outcomes.

Applying the concept presented in the ACM curricula guidelines for undergraduate degree programmes, the telecommunications engineering body of knowledge was created as a three-level hierarchical structure. Seventeen knowledge areas were identified during the analysis of the existing study programmes. These areas include subjects in telecommunications engineering, mathematics and physics.

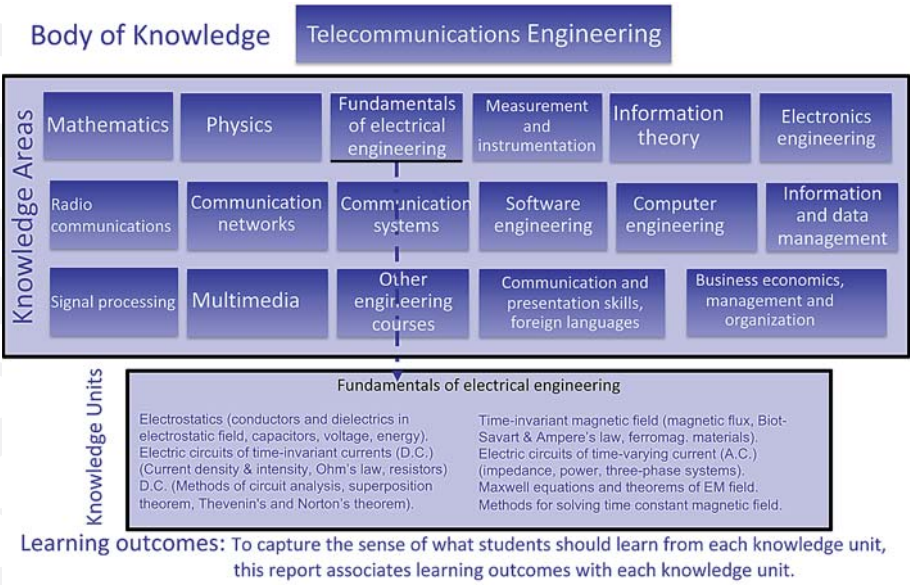

Figure 2.1. The creation of BENEFIT's Telecommunications Engineering Body of Knowledge

The proposed procedure is based on contemporary documents provided by ACM and ABET, adopted to meet specificities of universities in Western Balkan countries. The procedure follows:

- adjusting contents according to the identified trends in the area,
- providing learning outcomes that will meet the industry activity,
- providing knowledge that will enable the graduates to continue with the next cycle of education/job.

The proposed procedure takes into account several inputs, collected in a series of steps, organized into two phases:

- the preparatory and development phase with 10 steps
    - Collect information from surveys and analyse current status and needs;
    - Analyse the study programme and identify its deficiencies;
    - Analyse industry activities, needs and possible exchanges of knowledge;
    - Identify body of knowledge and knowledge areas that can modernize the selected study programme by following specific guidelines, e.g. ITU, IEEE Com. Soc., IEEE Comp. Soc., ACM, ABET, etc.
    - Select courses/subjects to be modernized;
    - Identify lab equipment to modernize and new joint labs with industry;
    - Identify training activities for students and teaching staff;
    - Identify flexible mechanisms for student internships;
    - Update class content based on the identified Learning outcomes;
    - Accredit the study programme at faculty, university and national levels.

- the execution and evaluation phase with 7 steps
    - deliver the courses/subjects;
    - buy lab equipment and create new joint labs with industry;
    - deliver training activities for students and teaching staff;
    - deliver web platform for student internships;
    - collect feedback from students and external experts;
    - analyse data and propose further improvements;
    - disseminate lessons learned to the regional stakeholders.

3. Modernized and accredited study programmes in telecommunications engineering

The process of modernisation of telecommunications engineering study programmes at 3 B&H and 3 Serbian universities has begun with the survey of telecommunications engineering study programmes, done within WP1, and the industry feedback obtained through the industrial survey. The 6 HEIs in the WB region are developing modern ICT engineering study programmes enabling adequate competences for future students and produce a highly qualified work force and stimulate entrepreneurship. These efforts have been done in accordance with the guidelines developed in WP1, which was taken as an input to WP2.

The activities in WP2 can be categorised into three main categories:

- Identification of the classes to be modernised in the scope of the project BENEFIT and class contents in cooperation with the regional industry.
- Preparation of class materials and restructuring the curricula.
- Accreditation of the study programmes at 6 Western Balkan (WB) universities participating in the project BENEFIT.

The methodology, used in the project BENEFIT, for the enhancement and modernisation of telecommunication study programme is schematically presented in Figure 3.1. Modernisation of study programmes3.1. This schema shows main activities done within WP2 and interaction with other work packages. Modernisation of the selected courses is based on the body of knowledge concept, derived from the survey completed in WP1. New teaching methods are incorporated as a result of WP3 activities and included in the description of courses. New labs have been designed and equipped to support delivery of modernised and new courses. Activities related to the lab design and equipment purchase were coordinated between WP2 and WP3. New teaching materials (presentations, textbooks, lab session, video materials) have been developed to match the content of the modernised courses.

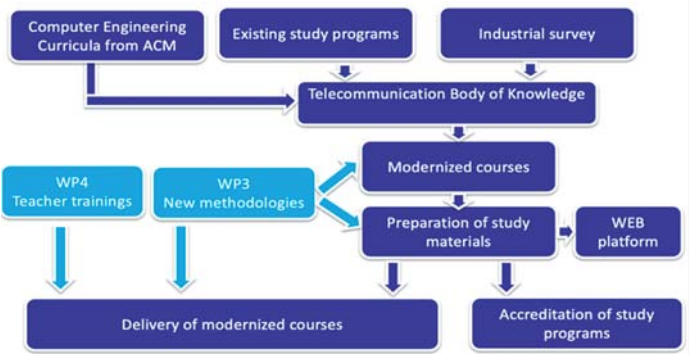

Figure 3.1. Modernisation of study programmes

The BENEFIT project targeted improvement of telecommunications engineering studies and its native transition into ICT engineering studies. On this road, a number of the existing courses have been enhanced and some new courses have been introduced. The methodology bases on Knowledge Areas and Knowledge Units have been adopted in order to determine course content that will reach aimed student competences, harmonise content between universities and avoid overlapping between courses, which was not uncommon for WB universities. The BENEFIT project has enhanced 30 courses and introduced 10 new courses in the first cycle of study at 6 WB universities. At the second cycle of study at 6 WB universities, 11 courses have been enhanced and 13 new courses have been developed. The full list of improved study programmes, courses that have been enhanced or introduced as new, together with associated Knowledge Units and Knowledge Subunits, are provided in the publicly available BENEFIT deliverable D2.1 "*Modernized and accredited study programmes in telecommunications engineering of 3 B&H and 3 Serbian universities in cooperation with ICT industry*". The majority of the enhanced courses have been delivered during project implementation.

The BENEFIT project introduced a web portal (https://www.project-benefit.eu) that links targeted ICT study programmes at 6 WB universities. This portal presented modernised study programmes and addressed courses, including digital teaching materials such as presentations, textbooks, lab sessions and video content. The BENEFIT with the list of improved study programmes is presented in Figure 3.2 The list of the modernized ICT study programmes2.

Within the WP2 activities, WB HEI partners have established a long-lasting cooperation with companies and technology parks in the region. A web catalogue was designed to foster collaboration and visibility of the industrial partners, promote their activities, internships for students and theses in collaboration with HEI partners. As a part of the main Central web platform (Figure 3.3.), the Industry web catalogue is available at: (https://www.project-benefit.eu/eplatform/?catalogue).

Figure 3.2 The list of the modernized ICT study programmes

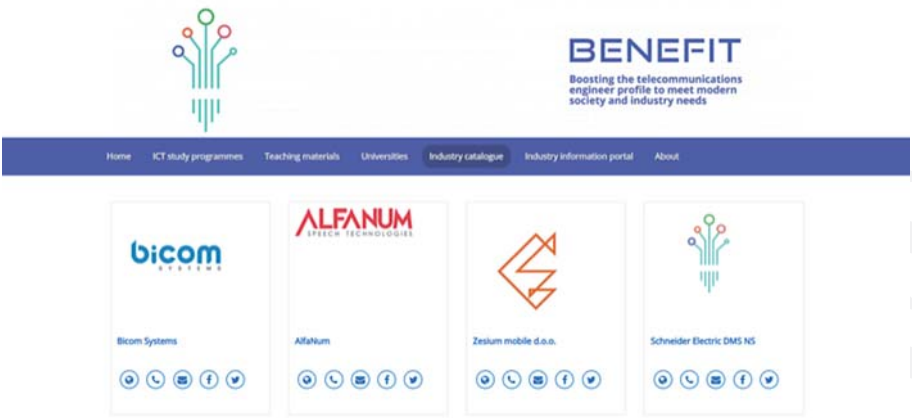

Figure 3.3 The Industry web catalogue

4. Modernization of teaching methodologies and infrastructures

The general aim of the project is to increase the attractiveness of ICT studies at six Western Balkan universities based on modernization of teaching methodologies and infrastructures. The main project goals are:

1. To modernize the curricula in telecommunications engineering modules of study programmes at 6 WB HEIs through modernized courses, the adoption of new learning/teaching tools/ methods, and the improvement of the lab infrastructure.
2. To increase HEI-Industry cooperation through the implementation of new trainings and internships and the creation and development of new thematic joint industry-academia labs that will translate into more job opportunities.
3. To increase the attractiveness of the telecommunications engineering curricula through a common HEI-Industry e-platform that collects and links: study programmes, video lectures, training/internship opportunities, industry profiles and job opportunities.

4.1. Teaching methodologies

The first goal has been to identify a manageable set of innovative teaching technologies that are convenient for exploitation at the selected courses of the modernized study programmes in the field of Telecommunications Engineering. We have identified nearly 30 innovative teaching methodologies, i.e., new/interesting teaching/learning methods that can be adopted for most of the selected courses within the BENEFIT study programmes. They are divided into three groups of

teaching methodologies oriented to student, activity or technology. A detailed description of the selected teaching methodologies can be found in the deliverable D2.1 at the project website.

The teachers of the selected courses at 6 HEIs have chosen some of the proposed teaching methodologies, but they have to reassess their selection because of the Covid-19 pandemic. The most frequently selected teaching methodologies before and during the pandemic are shown in Table 4.1.

Table 4.1. Teaching methodologies adopted at the BENEFIT project before and during Covid-19 pandemic

1) Student-Oriented Teaching Methodologies:	**Before**	**During**
S1 The case study method	12	12
S2 Teaching workshops	9	4
S3 Flipped or inverted classroom	7	3
S4 Brainstorming	6	3
S5 Teaching through student competitions	3	0
S6 Student-centred education	2	1
S7 Teaching through debate	1	0
2) Technology-Oriented Teaching Methodologies:	**Before**	**During**
T1 Teaching support via websites & social media	10	22
T2 Online courses (Video lectures)	6	22
T3 Learning method based on audio library	3	3
3) Activity-Oriented Teaching Methodologies:	**Before**	**During**
A1 Project-based learning	41	41
A2 Active learning	28	18
A3 Research-related teaching	24	25
A4 Z to A approach	10	7
A5 Creative assignments	6	8
A6 Pre-lecture based learning	5	6
A7 Peer group/team (Collaborative) teaching	5	0
A8 Work-based learning	2	0
A9 Self-learning	2	3
A10 Curiosity-driven learning	1	1
A11 Teaching following standardization process	1	0

Moodle is the most popular e-learning platform at the 6 WB HEIs, although Sova and Canvas are also used. They are used for delivery of teaching materials, offline communication with students and study group support, discussion and opinion pooling, quick quizzes for self-evaluation. The most popular tool for audio and video streaming is YouTube, while CABUNS is used within the project BENEFIT as a new and innovative tool. Web repository at the BENEFIT e-platform is also used.

Different online tools are used for teamwork, which enables chat, consultations, conversations, meetings & video conferencing (online classes and their recording): Microsoft Teams, Google Classrooms, Meets, Colab, Zoom, Skype, Cisco Webex, Discord, Big Blue Button, and Piazza.

4.2. New joint university/industry laboratories

Creation of joint university/industry labs and modernization of the lab infrastructure were among the most significant tasks at the project BENEFIT.

Every WB HEI is involved in a joint university-industry lab development (Figures 4.1. – 4.6.):

1. "Signal Processing in Telecommunications Lab", University of Banja Luka in collaboration with Bicom and AlfaNum;
2. "Telecommunications Lab", University of Sarajevo in collaboration with BIT Centar;
3. "Telecommunications Services Lab", University of Tuzla in collaboration with Bicom and BIT Centar;
4. "Networks and IoT Lab", University of Belgrade in collaboration with CISCO;
5. "Machine-to-Machine Communication Lab", University of Niš in collaboration with NiCAT;
6. "Wireless Communications and Information Processing Lab", University of Novi Sad in collaboration with RT-RK and Saga.

The upgrade of the lab infrastructure through the development of new thematic joint university-industry labs that will increase HEI-Industry cooperation through the implementation of new trainings and internships is described in more detail in the deliverable D3.2. Their joint activities with students have been implemented through specific agreements related to the operation of the joint labs. The partners collaborate on developing teaching methodologies that involve participation of industrial partners, including project tasks for students, implementation/ development challenges, hackathons and team competitions. Acquired equipment is adopted in the new teaching/learning methods. The creation of joint labs and advanced lab solutions will translate into more job opportunities.

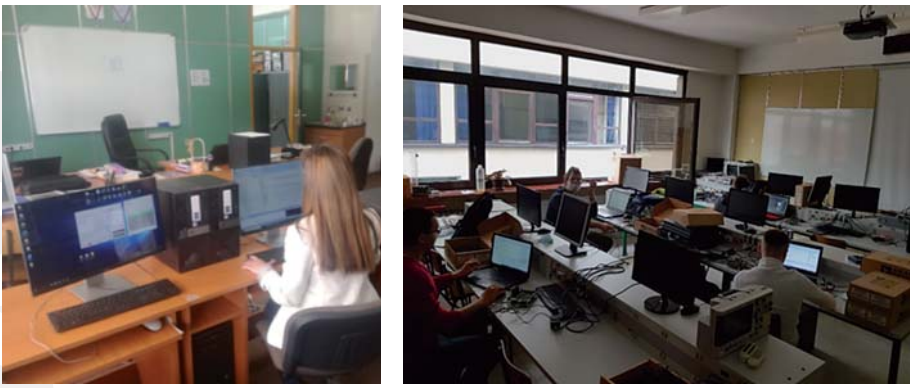

Figure 4.1. Laboratory for Signal Processing in Telecommunications (UBL)

Figure 4.2. Software-based LTE base station, Vector Network Analyzer 100 kHz, SDR equipment (UNSA)

Figure 4.3 Telecommunications Services Lab – layout (UNTZ)

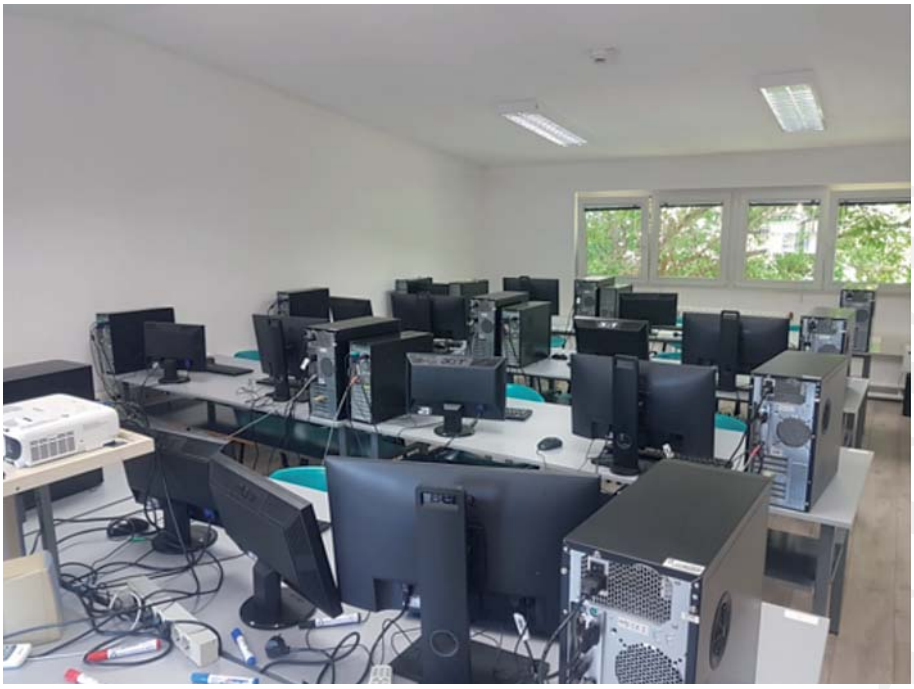

Figure 4.4 "Networks and IoT Lab" – layout (UB)

Figure 4.5. Some items of the purchased equipment in the M2M communications Lab. (UNI)

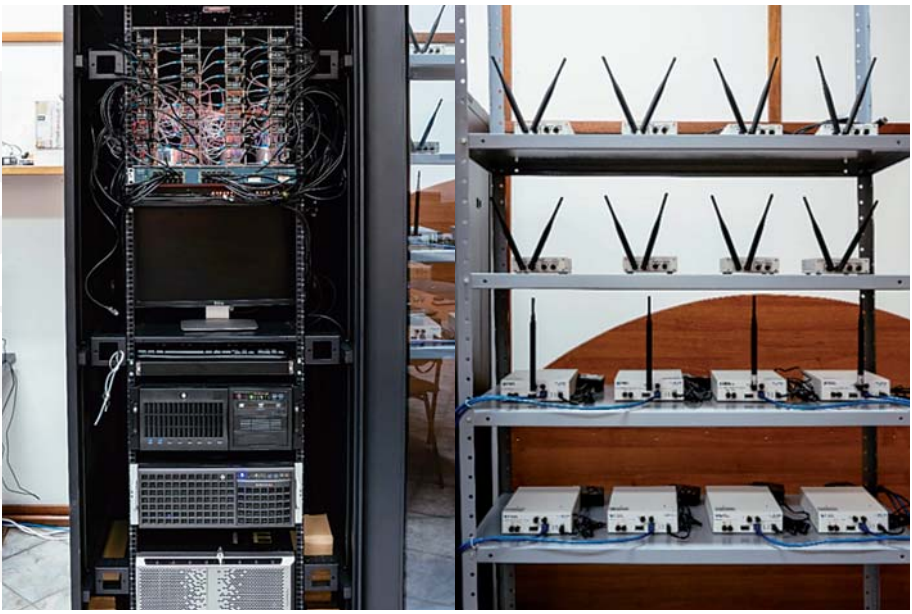

Figure 4.6. Wireless Communications and Information Processing (UNS)

The final goals of the task "Creation of joint university/industry labs and modernization of the lab infrastructure" have been the adoption of tools and equipment to enable innovative teaching methodologies and the inclusion of industrial partners in the development of joint labs and joint work with students. Organizational agreements were signed by industry and university partners. New industry partners may be added as part of the exploitation plan after the project termination.

4.3. Teaching material

The deliverable D3.3 "Collection of teaching material for new and modernized courses" reports the teaching material which is prepared and provided in electronic form for all the modernized courses (selected in WP2) and enriched with teaching methodologies (adopted in D3.1).

The collected teaching material is classified according to the type of the study programme (MSc and BSc) across the knowledge areas (Communication Networks, Communication Systems, Information and Data Management, Information Theory etc…), as well as other training materials (such as webinars). So far, the teaching material has been collected for most of 64 courses that are developed on both master and bachelor levels within the BENEFIT project. Additionally, three webinars have been uploaded covering common topics in telecommunications study programmes.

Maximum size per file has been limited to 500 MB in order to prevent overutilization of the storage space, and to restrict teachers to split their teaching materials into smaller chunks, making the materials more organisable and less monolithic. A total of 104 course repositories have been created with 352 documents uploaded. The total size of the repository is 2466.58 MB with the average storage taken of 63.25 MB per course.

The main objective of the D3.4 deliverable is to provide teaching/learning materials of new and modernized courses, class and lab sessions material, recorded remote classes, and network of audio libraries – altogether as a web service.

4.4. Teaching materials web repository

Teaching materials web repository is available as an integral part of the Web Platform. It enables the upload of the teaching materials in text, audio or video formats in numerous file types. The Web Repository itself is a single point of storage for all the teaching materials from all the studies and all the courses. It utilizes protection from the potential data loss by backup mechanisms, it is easily searchable and readily available. As shown on Figure 4.7., browsing the Web Repository is available by several categories: study programme (1) or other training materials (2), knowledge area (3) and course (4).

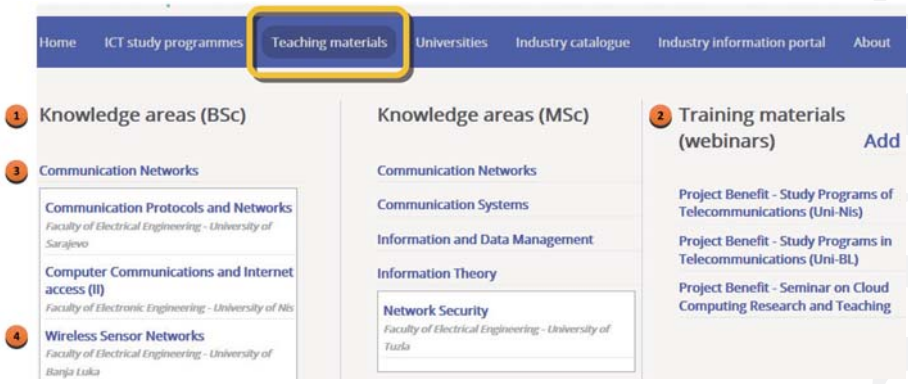

Figure 4.7. Teaching Materials Web Repository browsing categories

Teaching Materials Web Repository itself is a collection of course repositories. A course can have multiple repositories, thus enabling an easy organization of the course materials according to the arbitrary criteria. Course repositories are maintained within each course. The repositories can be created, edited and deleted. The list of uploaded files for a single course per repository is visible when a user clicks on a course. Basic information for each file is displayed when browsing a course repository, such as filename and size of the file. Also, the authorised persons can delete each file from a course repository or the entire repository can be removed.

5. Training and internship implementation

Activities of the work package devoted to the training and internship implementation can be divided into several tasks:

- Implementation of student training modules on technical and entrepreneurial subjects.
- Implementation of teacher training modules.
- Implementation of internship opportunities and co-supervised theses in the industry.
- Creation of training and internship web platform as support for these activities.

5.1. Student trainings

Training for students within the BENEFIT project assumed training modules on technical and entrepreneurial subjects. Training topics were devoted to different fields that are important for future ICT engineering development. Several student trainings were organized:

- "ICONIC Autumn Workshop 2018" organized by the Faculty of Technical Sciences in Novi Sad devoted to the topics of "Cellular Networks, IoT, 4G/5G, LP-WAN", "Systems, Algorithms and Applications (e -Health, Smart Buildings)", and "ICONIC Testbed and Tools".
- "IoT Security" seminar for students organized by the School of Electrical Engineering, University of Belgrade three times in January 2019, 2020 and 2021 (online).
- Training session "Central Audio Library at the University of Novi Sad as a New Teaching and Learning Methodology" was organized at the Zooming Innovation in Consumer Electronics International Conference - ZINC 2019.
- Training session "Automotive Communication (Car-2-X), Digital Image and Video Processing in Automotive Systems" was also organized at the Zooming Innovation in Consumer Electronics International Conference - ZINC 2019.
- Seminar organized by AlfaNum "Speech technology progress based on advanced signal processing and AI-ML paradigm - one lab practice - (experience in collaboration with university partners)" was hosted by the University of Banja Luka in December 2019.
- Online training "How to achieve a successful career and what is the first step – the key elements of success" organized by NiCATcluster in December 2020.
- Online training "Business in the field of application of artificial intelligence and development of a team of cyber security analysts" organized by NiCAT cluster in December 2020.

During student training events, training activities included more than 360 students.

Figure 5.1. Student IoT Security training – Belgrade 2019

Figure 5.2. Training cyber security and AI - NiCAT 2020

5.2. Teacher trainings

Training of teaching staff on new developing technology areas, effective teaching and training methodologies and also on pedagogical area, is recognized in the BENEFIT project as a basis for teachers to acquire needed skills and competences for implementation of modernized study programs. In the scope of the BENEFIT project, several teaching staff training sessions were organized:

- Training Workshop on lab equipment organized by the University of Klagenfurt (July 2019) devoted to joint training activities in the framework of the ERASMUS+ projects BENEFIT and SGT-MAP.
- Workshop on new teaching methodologies and instructional approaches in ICT engineering education organized by the University of Ljubljana (September 2019).
- Teacher training seminar "Deep Learning in a Classroom – Education, Research, and Industry Needs" organized by University of Banja Luka (December 2019).
- ICT Teaching Practices Training organized by University of Osijek (February 2020).
- Teacher training "Designing a Course for Stimulating Entrepreneurship in Higher Education" organized by the University of Sarajevo (July 2020 online training and September 2020 face-to-face part for exercises).
- Teacher training seminar "Role of Software in Education, Research And Practice" organized by the University of Niš (September 2020).

In the domain of these training activities more than 230 teaching staff members were trained.

Figure 5.3. Joint BENEFIT & SGT-MAP Training Workshop on Lab Equipment - Klagenfurt 2019

Figure 5.4. Teacher training "Role of Software in Education, Research and Practice" - Niš 2020

5.3. Internships and co-supervised theses

One of the BENEFIT project goals is to enable internship for many students who want to experience work in an industry environment but are currently not provided with many opportunities to do so. An internship is a valuable tool for preparing students for real life from the view of education institution and testing real working life approach to better choose potential career and employer. The other partner in the process of internship realisation is the industrial side that sees great opportunity to present themselves to the young people, potential future employees, and build interest for their working environment while also testing potential candidates for future cooperation.

Another option for students are company announcements about topics of interest and application for one topic to have co-supervised thesis in the industry. Working on the student thesis is a demanding process for all parties involved and requires very good preparation and tracking process to enable final success and acceptance of provided result for everyone involved in the process.

Besides internship opportunities offered by the industrial partners, two major events with internship offers have been organized in the scope of the BENEFIT project:

- Ericsson Nikola Tesla Summer Camp 2019 during five weeks of the academic summer break. The main goal of the Summer Camp was for students to work on projects in teams, solving real industrial problems in an industrial environment.
- Cisco Summer School 2019 during two weeks in September 2019. Summer School was devoted to Internet of Things. Students attended the course „IoT Fundamentals: Connecting Things" at the Cisco Networking Academy and several technical sessions at the Cisco office organized by Cisco experts on Cisco IoT solutions, Security in IoT, Solution for LoRaWAN and Collaboration.

One more event is planed until the project end – Cisco Online Winter School 2021, which will be devoted to Big Data and Analytics. Students will be offered to attend the course „IoT Fundamentals: Big Data and Analytics“ at the Cisco Networking Academy, several technical sessions organized by Cisco experts.

In the scope of these activities, it is expected that more than 50 internships will be offered to students and more than 12 co-supervised theses in the industry will be finished by the end of the project.

Figure 5.5. Ericsson Nikola Tesla Summer Camp 2019

Figure 5.6. Cisco Summer School 2019

5.4. Training and internship web platform

The web portal for training and internship opportunities, named "Industry Information Portal" is one of the e-platforms linked to the Central Project Web Platform. The objective of the "Industry Information Portal" is to inform about available training and internship opportunities, job offers, seminars, information about new joint projects between industry partners and HEIs, open PhD positions, and all other relevant events in the WB region and wider. The designed interface of the portal consists of several parts related to the categories of tasks for which it should be used. These categories are Published Posts, Internships and Graduate Theses.

Published posts are used to make all opportunities for open job positions, educational and other related events (e.g., public lectures, seminars, webinars…), project participation calls, training opportunities, etc. more visible. Category internships are used to list information related to the available professional internship opportunities and to enable application procedures for students. The Graduate Theses part is used for all available final theses in cooperation with companies and to enable the related application procedure for students.

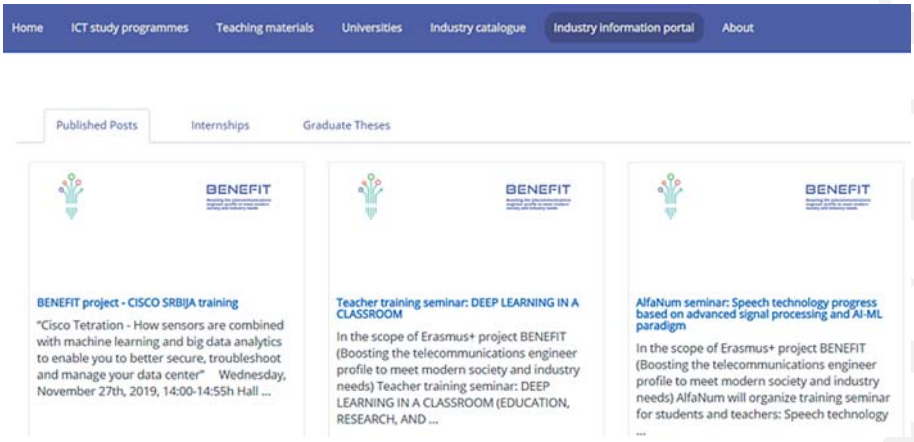

Figure 5.7. Industry Information Portal

6. Dissemination of project outcomes

The aim of dissemination was the promotion of project outcomes and studies in telecommunications engineering. Dissemination activities were carried throughout the entire duration of the project by means of:

- Permanently updated interactive project web site with all relevant information about the project activities as well as important links.
- Preparation of reports and white papers.
- Preparation of special sessions devoted to the project at the selected conferences, and relevant papers describing project outcomes. The presentation of the project results to the industry through promotion materials, banners and papers, and university-to-business meetings.
- Presentation of studies in ICT engineering to students, teachers, industry and wider community during open events and yearly webinars.
- Promoting the developed modernized telecommunications engineering study programme guidelines to other universities and fostering modernization of the curriculum.
- Setting the base for future exploitations: cooperation and agreements, methods to monitor employment status and opportunities, maintaining the developed study programmes, implementing student and teacher mobility, creating partnerships with companies, maintaining the repository of documents and developed class material.

The objectives of dissemination were:

- Organization of three open events to also reach the non-experts and show the impact that the telecom technology has on the society.
- Organization of a yearly webinar to present study programmes, tips on study engineering, career opportunities and foster women to have an engineering career.
- Presenting the project results in media and through publications reaching a large amount of stakeholders.
- Putting in place a monitoring methodology for continuous assessment of job market needs, employability and employment of graduates.
- Creating partnerships with companies for joint labs operation.
- Creating partnerships with companies for research cooperation including the EU funding opportunities.
- Establishing bilateral agreements among the HEIs for future double degrees, joint teaching and student mobility beyond the project duration.
- Undersigning an agreement for the maintenance of the created web platforms.

Detailed dissemination and exploitation plans are given in documents D6.2 “Report on exploitation and dissemination plan” and “Preliminary exploitation plan”, respectively.

6.1. Central project web platform (E-platform) and project web site

The central project web platform is aimed to promote the achieved project results and to provide all relevant information related to the available modernized ICT study programmes, as well as the existing internship, training and job opportunities to students and a wider community. The tasks related to the platform development and implementation were assigned to project team members from FERIT, while development of the project web site and preparation of the material to keep the project website up to date with the current activities was conducted by the UNI-KLU. A detailed description of the web platform can be found in D6.1.

The central project web platform integrates the official project website as well as four e-platforms developed in different work packages (WPs):

- in the WP1:
  OFFICIAL PROJECT WEBSITE - a website for all relevant information about the project activities (https://www.project-benefit.eu/)

- in the WP2:
  STUDY PROGRAMMES WEB PORTAL - a web portal of HEIs' modernized ICT study programmes
  (https://www.project-benefit.eu/eplatform/?programmes)

  INDUSTRY WEB CATALOGUE - a web catalogue of industry capacities and companies in the WB region
  (https://www.project-benefit.eu/eplatform/?catalogue#4)

- in the WP3:
  TEACHING MATERIAL REPOSITORY - a web repository for the prepared class and lab sessions material –
  (https://www.project-benefit.eu/eplatform/?materials#5)

- in the WP4:
  INDUSTRY INFORMATION PORTAL - an information portal for training, internship and job opportunities
  (https://www.project-benefit.eu/eplatform/?iportal#6).

The **central project web platform** is available at:
(https://www.project-benefit.eu/eplatform/).

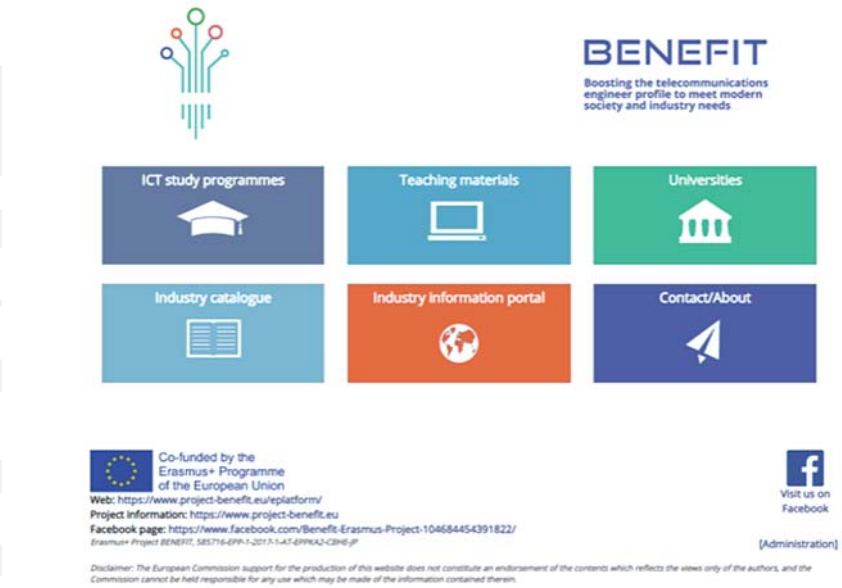

Figure 6.1. The central project web platform

Figure 6.2. The official project website

6.2. Open events and dissemination of results at ICT conferences

To disseminate project results and create an opportunity for presenting them to a wide audience, four main open events dedicated only to BENEFIT were organized during the project lifetime. The aim of these events was to present project goals and achievements to the wide community, including members of both the academia and the industry, public authorities, students, experts, as well as non-expert people. The open events also promoted studies in ICT engineering and showed the impact and opportunities that ICT offers in solving big societal challenges (environment, health, social inclusion, transportation, access to information etc.). They were organized by the University of Ljubljana (26 September 2018), University of Tuzla (17 May 2018), the University of Sarajevo (12 June 2019) and the last by the University of Novi Sad (29 January 2021). Two minor open events were organized by Ericsson Nikola Tesla (28 September 2018 and 4 October 2019).

In addition to the annual project-exclusive open events, several special sessions dedicated to disseminating BENEFIT took place during regional and international (scientific and non-scientific) conferences. Furthermore, web-based events were also organized during the project duration to increase outreach to a wide audience. The project results were presented at ten conferences: InTsikt 2018 (22 May 2018, Tuzla), ZINC 2019 (29 May 2019, Novi Sad), InTsikt 2019 (10-11 June 2019, Tuzla), IWSSIP 2019 (5-7 June 2019, Osijek), TELSIKS 2019 (23-25 October 2019, Niš), TELFOR 2019 (26-27 November 2019, Belgrade), ERK 2020 (21-22 September 2020, Portorož), SST 2020 (14-16 October 2020, Osijek), InTsikt 2020 (16-17 November 2020, Tuzla), and TELFOR 2020 (24-25 November 2020). Furthermore, two web-based events were organized: "Seminar on cloud computing research and teaching" (13 March 2019, Cisco Serbia and University of Belgrade) and "Joint BENEFIT & SGT-MAP Training Workshop" (10-11 July 2019, University of Klagenfurt).

The dissemination events were attended by more than 740 participants either on-site or online, indicating good progress in disseminating information about the project and its results. The estimated number of persons exposed to the information about the project is even higher due to the poster sessions, project dissemination materials exhibited at the conferences outside the special sessions, and recorded sessions and webinars available online.

Detailed report on open events, special sessions at conferences as well as web-based events is given in D6.4. "Offered open events to reach the community at-large and disseminate the results at ICT conferences".

Figure 6.3. IntSikt 2018, 22 May 2018, Tuzla

Figure 6.4. Seminar on cloud computing research and teaching (UNI-KLU team), March 13, 2019

Figure 6.5. ERK 2020, September 21-22, 2020

6.3. Yearly webinars

In order to reach new and prospective students and increase the impact on society-at-large, yearly webinars broadcasted to all involved HEIs and hosted by the involved HEIs have been organized. During each webinar, the study programmes have been presented and several tips on study engineering and career opportunities have been given to foster women to have an engineering career. Three webinars were organized and they can be found on the project YouTube channel: (https://www.youtube.com/channel/UCY1zj5NhaUQbuFeMP3IRKyA).

The webinar "Study Programmes in Telecommunications" was organized by the University of Banja Luka (23 May 2018), the webinar "Study Programmes of Telecommunications" was organized by the University of Niš (5 September 2019), while the webinar "Studying Telecommunications Engineering" was organized by the University of Belgrade (13 October 2020). More information about these webinars can be found in document D6.5 "Organization of a yearly webinar (hosted in turn by the HEI partners) broadcasted to all locations". The webinars attracted 86 participants and more than 180 YouTube views by the end of 2020.

Figure 6.6. Webinar "Study Programmes of Telecommunications", September 5, 2019

6.4. Facebook, YouTube channel, newsletters and media releases

Information about project activities as well as pictures and videos are posted not only on the project website (https://www.project-benefit.eu/?page_id=19), but also on Facebook (https://www.facebook.com/Benefit-Erasmus-Project-104684454391822/) and on the project YouTube channel (https://www.youtube.com/channel/UCY1zj5NhaUQbuFeMP3IRKyA). By the end of January 2021, the videos posted on the project YouTube channel had more than 500 views in total.

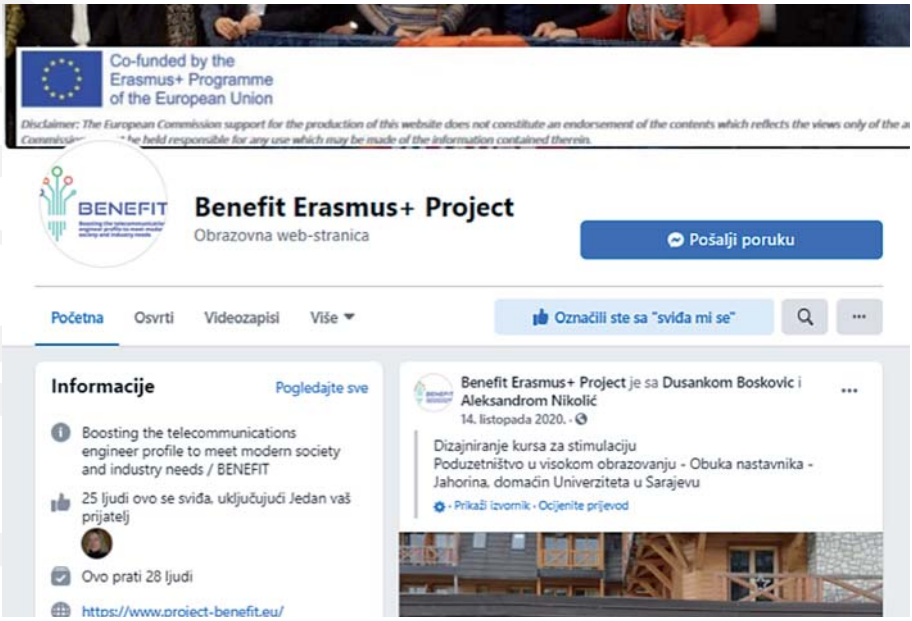

Figure 6.7. The Benefit project Facebook page

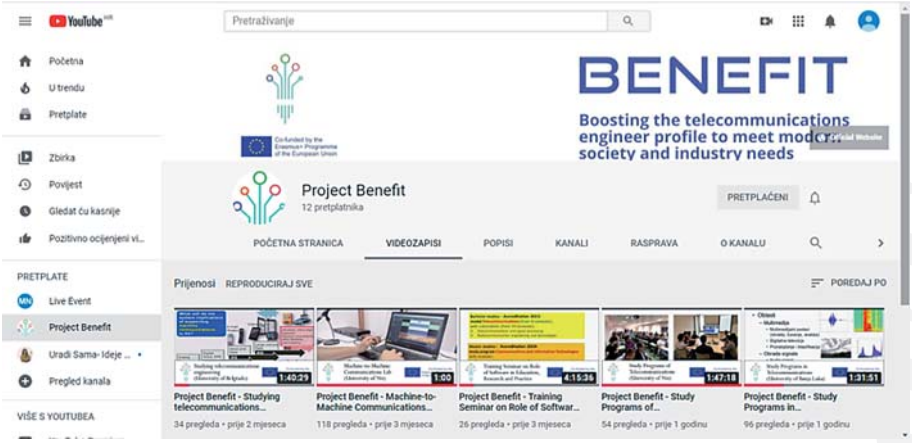

Figure 6.8. The Benefit project YouTube channel

Some activities of the BENEFIT project were covered by media releases, while four newsletters published in April 2019, February and August 2020 and January 2021 provided an overview of the activities carried out on the project in the given periods. A detailed overview of dissemination reports and materials is given in D6.3 "Preparation and delivery of dissemination reports and informative material".

7. Main project outcomes

During the 40 months of the BENEFIT project, the project partners carried out all planned activities and achieved all set goals. The main outcomes of the project are as follows:

- Ex-ante analysis of the current status of the academic study programmes in fields of telecommunications engineering in 6 WB and 3 EU universities as well as of job market needs, skills and knowledge areas required from ICT engineers and specialists in the ICT sector.
- Guidelines for the curriculum modernization based on the consolidate initial analysis of data obtained from all HEIs and industry partners.
- Methodology for enhancement of study programmes in telecommunications, based on knowledge areas and knowledge units, has been developed. The overall improvements can be summarised as:
  - Improvement in the structure of study programmes.
  - Improvements in the course contents.
  - Improvements in lab sessions.
  - Development of new teaching materials.
  - Enhanced collaboration between universities.
- Detailed procedure for the development of new courses has been developed and adopted, in line with the methodology for enhancement of study programmes.
- Study programmes in telecommunications at 6 universities in Bosnia and Herzegovina and Serbia have been modernised and enhanced.
- Project BENEFIT has enhanced 30 courses and introduced 10 new courses in the first cycle of study at 6 WB universities.
- Project BENEFIT has enhanced 11 courses and introduced 13 new courses in the second cycle of study at 6 WB universities.
- Comprehensive teaching materials have been prepared for enhanced and new courses, including presentations, textbooks, lab sessions and video materials.
- The curricula in telecommunications engineering modules of study programmes at 6 WB HEIs are modernized through 64 either new or enhanced courses, the adoption of new learning/teaching tools/methods selected from the collection of identified 30 innovative teaching methodologies.
- The lab infrastructures at 6 WB HEIs are improved through the creation and development of new thematic joint university-industry labs that will increase

HEI-Industry cooperation through the implementation of new trainings and internships that will translate into more job opportunities.

- More than 360 students are trained on technical and entrepreneurial subjects.
- More than 230 teaching staff members are trained on new developing technology areas, effective teaching and training methodologies and also on pedagogical subjects.
- It is expected that more than 50 internships will be offered to students and more than 12 co-supervised thesis in the industry will be finished by the end of the project.
- The central project web platform is developed as a central site for dissemination of the project information. The central web platform links the project website and four e-platforms: ICT study programmes portal, teaching material repository, industry web catalogue and industry information portal.
- The project results were disseminated at 6 open events, 10 conferences, 2 web-based events and 3 webinars. Information about project activities are posted on the project website, Facebook and on the project YouTube channel.
- Bilateral agreements among the HEIs for follow-up double degrees, joint teaching, and student mobility were established.
- Partners created partnerships for follow-up projects and EU funding for research projects on telecommunications engineering involving the industry.

Erasmus+ KA2 Capacity Building in Higher Education Program

Project „Boosting the telecommunications engineer profile to meet modern society and industry needs” - **BENEFIT**

585716-EPP-1-2017-1-AT-EPPKA2-CBHE-JP

15 October 2017 - 14 February 2021

Project website:
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