EIT HEI Initiative

Innovation Capacity Building for Higher Education

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D6.5 Transferability Plan Phase 2

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Executive Summary

Deliverable D6.5 focuses on the development of a plan for the transfer of key transferable elements of the Skills2scale project after Phase 2 to external stakeholders in the Beyond 5G technology field, government organisations and academia in order to achieve the project goal of the Consortium becoming a leading centre of innovation and entrepreneurship in this field by 2030. Deliverable D6.5 is closely related to Deliverable D6.1 "Communication and Dissemination Strategy", which presents a coordinated communication and dissemination strategy for Skills2Scale and Deliverable D6. 4 "Transferability Plan Phase 1", which includes information about the developed project website, the creation of a Massive Open Online Course (MOOC) and the establishment of communication channels with stakeholders to ensure that the project results have maximum impact on society and stakeholders. The developed handover plan outlines a detailed strategy for expanding the use of the project results in the participating institutions after its completion. The implementation of this plan, through a combination of cutting-edge research, education and entrepreneurial initiatives, will facilitate the development and commercialization of new technologies and products that will help transform the industry and take a leading position in the Beyond 5G technology escosystem, driving innovation and economic growth in the region.

About the EIT HEI Initiative

The EIT HEI Initiative: Innovation Capacity Building for Higher Education has been designed with the aim of increasing the innovation and entrepreneurial capacity in higher education by bringing together HEIs in innovation value chains and ecosystems across Europe. A central philosophy of the EIT is the integration of the EIT Knowledge Triangle Model into all its activities. HEIs selected to participate in the HEI Initiative will also leverage and use the Knowledge Triangle Model as an enabler, facilitating the creation of systemic, institutional change. Additionally, HEIs selected to participate in the HEI Initiative will contribute to and leverage Smart Specialisation Strategies, the Regional Innovation Impact Assessment (RIIA) Framework, as well as align to the goals of the EIT Regional Innovation Scheme (EIT RIS). This will strengthen the links between HEIs and their local and regional ecosystems and provide an impetus to leverage additional funding sources beyond the HEI project funding period of the selected HEI projects.
HEIs are encouraged to prepare applications which will support the development and implementation of six Actions in their institutions, cumulatively leading to institutional transformation, an increase in entrepreneurial and innovation capacity, and integration with innovation ecosystems.

1 Introduction

The purpose of this deliverable is to present a plan for transferring key transferable elements of the Skills2Scale project to achieve its objectives. This document outlines the plan developed by the Skills2Scale Consortium to transfer the project results to Beyond 5G stakeholders, government organizations and academia. It includes recommendations such as updating and maintaining the website after the project is completed, promoting massive open online MOOCs, integrating student courses into the curricula of other higher education institutions, implementing best practices for developing the innovation ecosystem, maintaining established communication channels with stakeholders, identifying potential risks and mitigating them to ensure the realization of the project's goals. In addition, a long-term sustainability plan is envisaged to provide ongoing support and resources to those involved in the implementation of the Skills2Scale project, including potential partnerships and funding opportunities.

2 Analysis of the obtained outcomes

2.1 Outline of the Phase 2 Project Results

This subsection provides information on transnational peer-to-peer training activities for students, administrators, academic and non-academic staff of higher education institutions on best practices for fostering institutional engagement and change in the field of 5G and beyond. The training was delivered through webinars and covered topics such as innovation and entrepreneurship, partnership building and knowledge sharing. A list of all training webinars held as part of the Skills2Scale (Phase 2) project is provided in Table 1. Local and networking events were also organised to bring together higher education institutions and external partners to establish effective cooperation in the field of innovation and entrepreneurship (Table 2). An important task was the organisation of a digital conference to promote the IVAP results and future plans for cooperation between Consortium partners and stakeholders (Table 3).

Table 1. List of Skills2Scale project information and training webinars

Date	Event	Speaker
February 29th, 2024	How can one effectively showcase their startup during a pitch?	Kateryna Skubenych, Head of the Research Department, Uzhhorod National University
March 26th, 2024	Intersecting Horizons: Physics, Internet of Things (IoT), and 5G	Oleksandr Gomonnai, Associate Professor at the Department of Optics, Faculty of Physics, Uzhhorod National University
April 12th, 2024	Hitting the target, with Telefonica	Ruth Gamero, Head of Global CTIO Office at Telefónica

April 15th, 2024	Skills2Scale Acceleration Programme	Maria G. Anagnostopoulos, Co-Founder of One & Olive, Envolve Entrepreneurship
April 18th, 2024	AI Applicability in 6G Systems for Trustworthiness Provision	Dr. Harilaos Koumaras, Head of FRONT research group at NCSR Demokritos
June 6th, 2024	Funding opportunities for higher education institutes	Christina Skoubridou, Director of EU innovation department, Envolve Entrepreneurship, Natalie Cernecka, Manager of the deep tech talent initiative

Table 2. Networking Events for Collaboration Between Universities and External Partners in Innovation and Entrepreneurship

Date	Event	Speaker
February 1st, 2024	Innovation Hub East at the Technical University of Liberec	Ales Kocourek, the dean of the Faculty of Economics, Technical University of Liberec
March 27, 2024	The preliminary round of the competition "Start-up-UzhNU: Forward to innovations!"	Kateryna Skubenych, Head of the Research Department, Uzhhorod National University
April 11th, 2024	Bizarre Business Event at the University of Lapland	Tiina Mäki-Petäjä, Project Coordinator, University of Lapland, Arctic Centre, Arctic Governance Research Group, Laura Ulatowski, Research Assistant, University of Lapland, Arctic Centre, Arctic Governance Research Group
April 23rd and 24th, 2024	3rd Peer Learning Event of Skills2Scale project in Liberec	Jana Simanova, Vice-Dean for Conception and Development at the Faculty of Economics, Technical University of Liberec, Ales Kocourek, Dean of the Faculty of Economics, Technical University of Liberec, Jana Vitvarova, Vice-Dean for external affairs at the Faculty of Mechatronics, Informatics and Interdisciplinary Studies, Technical University of Liberec
April 24th, 2024	Innovation picnic: Regional delicacies from Lipolnk (Liberec Incubation Centre)	Jana Simanova, Vice-Dean for Conception and Development at the Faculty of Economics, Technical University of Liberec, Ales Kocourek, Dean of the Faculty of Economics, Technical University of Liberec, Jana Vitvarova, Vice-Dean for external affairs at the Faculty of Mechatronics, Informatics and Interdisciplinary Studies, Technical University of Liberec, Lenka Koskova Triskova, Faculty of Mechatronics, Informatics and Interdisciplinary Studies, Technical University of Liberec, Jindrich Cyrus, Head of Department of SW Architecture and

		Development, Institute for Nanomaterials, Advanced Technologies and Innovation at Technical University of Liberec. Phillip Roden, director of Liberec Incubation Centre LipoInk
May 2, 2024	The final round of the competition has been held: «Start-up-UzhNU: Forward to innovations!»	Kateryna Skubenych, Head of the Research Department, Uzhhorod National University
May 17th, 2024	Policy Forum – Lessons Learned from Skills2Scale project	Jana Simanova, Deputy Dean for Concept and Development at the Faculty of Economics Technical University in Liberec, Ales Kocourek, Dean of the Faculty of Economics, Technical University of Liberec Pavel Pelech, Faculty of Economics, Technical University of Liberec
June 7th, 2024	Business Picnic	Tiina Mäki-Petäjä, Project Coordinator, University of Lapland, Arctic Centre, University of Lapland, Arctic Governance Research Group, Laura Ulatowski, Research Assistant, Arctic Centre, Arctic Governance Research Group

Table 3. Digital conference as promotion of the IVAP results and future plans for cooperation between Consortium partners and stakeholders

Digital conference "Beyond Speed: Harnessing the Full Potential of 5G"	
Presenters	**Title of presentations**
Alejandro Fornés (Universitat Politècnica de València)	B5G Innovation: Technological enablers for designing novel 5G-based services & applications
Lukas Abazid (T-Mobile Czech Republic, a.s.)	5G and Use Cases
Rauno Rusko (University of Lapland)	The use of digitising in the Finnish circular economy
Michal Kapinus (Brno University of Technology, Czech Republic)	5G & Connected Robotics Platform
Katerina Giannopoulou (FOGUS)	5G and beyond: Technology advancements and business opportunities
Spyridon Georgoulas, George Makropoulos (NCSRD)	AI Applicability in B5G: A UAV Use Case
Tetiana Babuka, Artem Pohodin, Ivan Babuka	Connection between 5G and Science
Michael Mandamadiotis, Christina Skoubridou, Eirini Ozouni (Envolve Entrepreneurship)	Envolve Entrepreneurship: Enhancing Deep Technologies
Oleksandr Gomonnai, Tetiana Babuka, Andriy Popov, Ivan Babuka, Vadym Popovuch (Uzhhorod National University)	Study of nonlinear phenomena in core optical network by simulation software

Hanna Kostovyat, Viacheslav Rogov (Uzhhorod National University, Admiral Makarov National University of Shipbuilding)	The impact of 5G technology on economic processes
Kateryna Skubenych, Inha Besehanych (Uzhhorod National University)	Advancing Scientific Frontiers: The Impact of 5G on Open Science Principles
Yevheniia Haiovych (Uzhhorod National University)	AI in cybersecurity: new aspects and ethical dilemmas
Oleksandr Gomonnai, Andriy Popov (Uzhhorod National University)	Simulation of EDFA Amplifiers' Operation in Core Optical Networks for 5G
Nadiya Boyko (Uzhhorod National University)	5G technologies and Telemedicine in Ukraine: legislation and actual tools
Yevhen Kostenko (Uzhhorod National University)	Introduction to digital dentistry start-up projects
Myroslav Goncharuk-Khomyn (Uzhhorod National University)	Start-up projects in dentistry based on modern dental technologies

A significant impact on the implementation of 5G technologies in different ecosystems was achieved through the meetings held in Liberec and Thessaloniki. The peer learning events made it possible to bring together higher education institutions and external partners to share experiences and best practices in the field of Beyond 5G technologies, to attract innovation and to expand networks. A very important task of this project was to strengthen partnerships. It is worth mentioning that all project participants were able to share experiences and strengthen partnerships during all events organized within this project. In particular, thanks to the Skills2Scale Digital Policy Forum, the Consortium partners had the opportunity to discuss the achievement of key project indicators and share best practices, as well as outline potential future areas of cooperation.

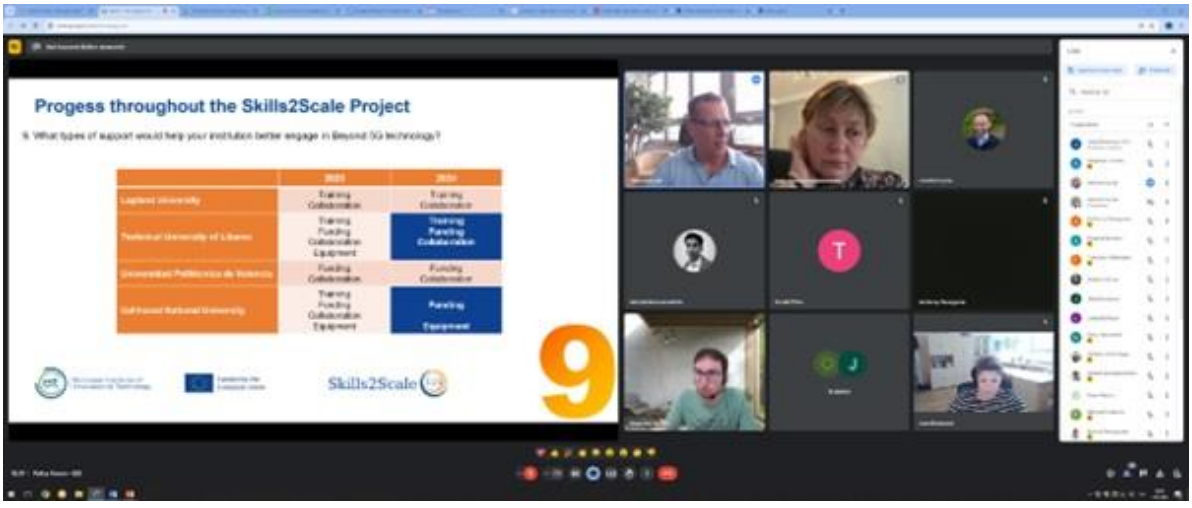

Figure 1. Policy Forum – Lessons Learned from Skills2Scale project, May 17th, 2024

As part of the digital conference "Beyond Speed: Harnessing the Full Potential of 5G", almost every participant had an idea for the creation of new projects for further cooperation after the end of the Skills2Scale project. The digital conference provided an opportunity to share experiences in the field of 5G technologies. It promoted the development of a culture of innovation and entrepreneurship in higher education institutions.

Figure 2. Digital conference "Beyond Speed: Harnessing the Full Potential of 5G", June 19th, 2024

Thanks to the events held, each partner is closer to becoming a leading centre for innovation and entrepreneurship in the field of Beyond 5G technologies, as the Consortium moves closer to implementing its Innovation Vision Action Plan (IVAP).

2.2 Outcome Documentation

The training events showed that there is a need for awareness raising and training of students in order to raise awareness of 5G technologies, opportunities and impacts on different communities, including stakeholders, businesses and higher education institutions. Numerous webinars, peer-to-peer learning events, mentoring and acceleration activities have been conducted to provide HEIs with the knowledge, skills and networks needed to support and develop the Beyond 5G ecosystem. These activities have become a solid foundation for the introduction of new courses in higher education, which in turn will enable the training of a skilled workforce in the field of Beyond 5G technologies and help stimulate innovation and economic growth. As a result, new courses have been introduced at various faculties of participating universities

2.2.1 Uzhhorod National University

Faculty of Physics

At the Faculty of Physics, training courses using 5 G technologies will be included in the specialties: General Secondary Education (Physics), Physics and Astronomy, Cybersecurity, and Biomedical Engineering. In the specialty of Telecommunications and Radio Engineering, the Faculty of Physics has already introduced training courses where 5G technologies are considered: "Telecommunication systems and next generation networks, "Mobile communication systems".

The introduction of training courses on 5G technologies will allow graduates specialising in telecommunications and radio engineering, information systems and technology to apply advanced 5G technologies in business.

In other words, telecommunications and radio engineering is what surrounds us, what we are interested in and benefits every day and improves the quality of human life. The main activities of the specialist are the use of modern means of mobile, satellite communications and computer networks, design and operation, ensuring the reliability and survivability of infocommunication systems and Ethernet networks; solving problems of information protection by technical and software mean.

Faculty of Information Technology

Starting from 2024, the Department of Information Management Systems and Technologies conducted the discipline – "Modern 4G/5G Networks". The introduction of 5G technologies helps students to expand and master special knowledge in: designing software and hardware platforms that provide modern Internet services and services operating in a global environment; designing cloud data centres in combination with modern 5G networks; creation and use of the latest technologies of the Internet of things and construction of information and communication computer systems.

Dental Faculty

The emergence, development and maturity of 5G technology has made it widely used in medicine, including dentistry. The combination of 5G network and medical treatment contributes to the development of remote oral medicine, increases the accuracy of treatment, speeds up the speed of treatment and improves the uneven distribution of

medical resources. It is also an important measure to improve the convenience of treatment in remote areas, which gives a new dawn to the development of medicine.

Thus, the introduction of the training course "The use of 5G in dentistry" at the Faculty of Dentistry is an extremely important step in the development of oral medicine.

Faculty of Biology

Elements of the Beyond 5 technological space are planned for implementation in the Educational and Professional Program "Biology", Biology and Biochemistry. In particular, the strengthening of innovative and entrepreneurial potential in higher education institutions in the field of Beyond 5G technologies is an element of the program result of the educational program (Use innovative approaches to solve complex problems of biology under uncertain conditions and requirements).

The implementation of the Beyond 5G innovation space will provide an opportunity to implement the Introduction to Genomic Biology at the faculty in the form of online practical trainings from scientific and practical laboratories, clinics, online lectures, interactive seminars. Research and pre-diploma practice, respectively - the creation of a virtual space of remote practice bases for familiarization with innovative methods and technological processes of modern laboratories and enterprises.

Educational and Scientific Institute of Chemistry and Ecology

5G covers the world, and the chemical industry as well including. 5G is the most environmentally friendly standard in the history of cellular communications. 5G technologies will play a key role in protecting the environment by reducing energy consumption and carbon dioxide emissions. As you know, the ability to connect to the network will directly allow you to move to a greener future with low carbon emissions and will affect the achievement of zero greenhouse gas emissions by 2050. Since experts advise accelerating the process of introducing the fifth generation standard, it is important to prepare society for such technologies, providing an explanation of the positive impact of 5G on environmental protection. It is the introduction of informative courses at the Institute of Chemistry and Ecology that will make it possible to better explain to the future generation about its safety and the need for early implementation.

UNU also introduced the educational discipline "Fundamentals of Startup Development" at the faculties of engineering and technology which trains a highly qualified specialist who will be able to integrate into the startup ecosystem of Ukraine and Europe, will be guided by the basic provisions for the development and implementation of startup project, will gain an understanding of how to develop their own startup project, and will be able to use modern technologies and software and hardware tools in the development and implementation of startups.

In addition to training specialists in the use of 5G technology, activities are also carried out to explain and popularize the use of 5G technology and implementation of the Open Science Policy at the university among academic staff, researches, young scientists and graduate students. 5G technology has a high potential to improve accessibility, collaboration, and transparency in scientific research, which are key principles of open science. The introduction of 5G in the scientific field requires overcoming certain technical, ethical, and security challenges, but in the long run it opens up new opportunities for the development of open science and international cooperation of scientists.

2.2.2 Lapland University

Faculty of Social Sciences

The incorporation of the massive open online course (MOOC) "5G and Beyond Technology & Business Innovation Potential" into the Faculty of Social Science's teaching at the University of Lapland is currently under discussion. There is a lot of potential in increasing Beyond 5G technology and applications related course content. At the moment digitalization themes are being taught as part of studies in e.g. entrepreneurship, administrative science and management. Further discussions with the faculty and study subjects as well as the teachers are required.

Faculty of Art & Design

There might be interest in including the MOOC as part of the studies at the Faculty of Art & Design. The Faculty offers teaching in technology and innovations as part of the minor in Creative Technologies introducing students to ICT, programming, computing, interface design and digital crafts and multimedia expression. Again, further discussion will be needed.

2.2.3 Technical University of Liberec

Key teaching and research staff from 4 faculties - Faculty of Economics, Faculty of Health Studies, Faculty of Mechatronics, Informatics and Interdisciplinary Studies, and Faculty of Mechanical Engineering - and the CXI research centre at TUL have been involved in the project from the beginning. Thanks to the S2S project, **a major innovation (new concept) of three courses** within 3 study programs: (1) Medical Systems, (2) Information Systems in Services and (3) Electrical Engineering Practice, and **minor innovations in four other courses** within 4 study programs taught at TUL - (i) Innovation Management, (ii) Introduction to Economics and Management for IT students, (iii) Artificial Intelligence and (iv) Automation and Robotics in Engineering) have been made.

The new concept includes a **practice-based 5G Interdisciplinary Innovation Lab**, which will be continued further in a similar scheme next year with the support of EIT Health in cooperation with Dex Innovation Centre Czech Republic. In other subjects, in particular MOOCs have been integrated into the curriculum as an optional part of fulfilling the credit requirements (we wrote about here), and a **specialist lecture "5G Key Aspects and Future"**(by Jindrich Cyrus, head of scientific department at CXI, TUL) has been included in the Innovation Management course at Faculty of Economics, TUL. The aim is to strengthen the links between research, innovation and education activities, which are still relatively fragmented. The project has also led to a broader promotion of 5G use cases and related research and development activities at TUL. Senior researchers from the 5G teams have been involved in the project throughout, and have also started to become more involved in teaching and disseminating their experience and knowledge to students in non-technical disciplines.

Figure 3. MOOC Certificate of Completion at TUL

A review of the "entrepreneurship" courses, which are now offered in a rather fragmented way by different faculties, has been undertaken. We plan to integrate them and involve experts from other disciplines and, in particular, practitioners (f. e. in cooperation with Liberec Incubation Centre LipoInk and T-Mobile CZ). The aim is to integrate university activities in entrepreneurship education, to focus more on deep tech and to link them with the activities of the Student Business Club and thus strengthening the base of teams competing in the TUL Best Startup competition. As part of the establishment of new partnerships, relationships with T-Mobile CZ, Urban Mobility Innovation Hub East, Dex Innovation Centre (EIT Health) and the Regional Development Agency of the Liberec Region were significantly strengthened. This expansion of the partnership network will be used in the future for both educational and research activities. With the support of the S2S project, we launched a new **5G Campus Network with an Open Core and Run solution** in September 2023. There are already plans to **extend the infrastructure of the 5G network on the university campus** to include short (micro) waves above 24 GHz and to cover part of the University Square. This will make **the 5G technology more accessible to students and other academics.**

The project has also made it possible to better promote research results in the area of 5G use cases and to activate partners who may be interested in collaborating on these results or putting them into practice.

2.2.4 Universitat Politècnica de València

Unlike the other HEIs, UPV's curricula in cellular technology was quite integrated in the HEI curricula. With respect to academic courses, specific subjects on 5G, previous generations and related technologies can be found (i) in the official Bachelor's Degree in Telecommunication Technologies and Services Engineering, from the School of telecommunication engineering, such as: mobile and wireless communications, digital communications (mostly focused on modulations and advanced techniques), antennas, optic communications, electronics, transmission fundamentals, digital systems integrations, radiocommunications, radio access technologies and systems, etc. The double degrees of Telecommunications plus Mathematics or Business Administration and Management also include some of these subjects; and (ii) in the official Master's Degree in Telecommunication Technologies, Systems and

Networks, form the same school, complementary subjects like: architecture and protocols in mobile communications, Next-generation wireless networks (including B5G), Next-generation wireless systems applications, Signal processing in wireless communications, Photonic technologies for wireless networks, Optical signal processing, System virtualization and nanophotonics, etc.

Besides, with respect to research, UPV has specialised research institutes, research centres and start-ups with specific focus on cellular and related technologies. Among them, the leading entity is the Institute of Telecommunication and Multimedia Applications (ITEAM), the largest university research institute from Spain (with 8 research groups, including Mobile communications, Photonics, Antennas and propagations, among others). Also, SATRD research group from the Communication department has proven experience in 5G technology, mostly in applications and service orchestration.

All the former supported by an innovation and entrepreneurship ecosystem that supports innovation and entrepreneurship in 5G and beyond technology. For instance, Fivecomm startup was founded a few years ago, and it is steadily growing thanks to the knowledge gained and people trained in the university ecosystem.

While from the technological perspective it was difficult that UPV could enhance its curricula (e.g., new subjects or courses) from the rest of the partners, best practices have helped prepare alternative ways to extend the offered knowledge and make it closer to the market. For instance, the MOOC on B5G has been intensively promoted internally, mostly (but not only) within the Telecommunication school, and also the Summer School on advanced topics in 5G-6G Communications for master students has been arranged and taken place during the first week of July, the latter inspired by TUL's 5GIIL best practice.

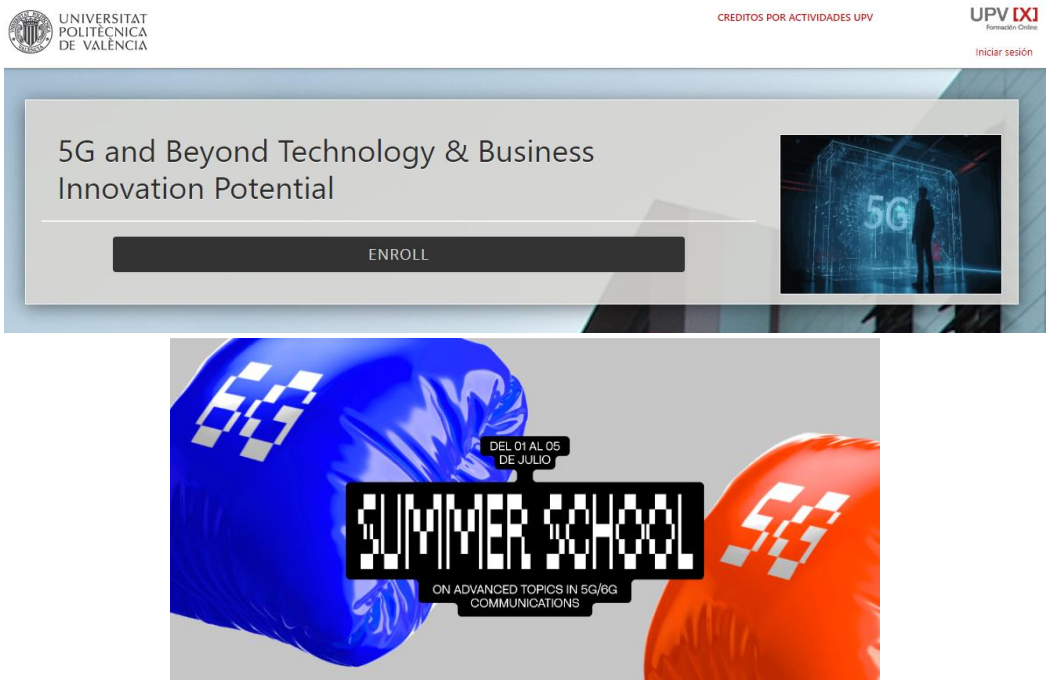

Figure 4. Courses implemented at UPV

3 Identifying Transferable Elements

This subsection provides information on the main transferable elements identified as a result of the Skills2Scale project, which contributed to the success of the project and can be replicated by other stakeholders in the field of Beyond 5G technologies. In particular, it presents the best practices of higher education institutions in innovative and entrepreneurial education in the field of Beyond 5G technologies, on the basis of which a massive open online course (MOOC) has also been developed. An important transferable element is the developed starter program of the Innovation and Business Development Accelerator for Higher Education Institutions (HEIs), which helps university students to develop entrepreneurial and business skills as well as to access the tools, resources and networks necessary to turn their ideas into innovative products and services.

3.1 Effective practices and methodologies

During the implementation of the Skills2Scale project, best practices for teaching innovation and entrepreneurship in the field of Beyond 5G technologies were identified and collected. Thus, the following best practices have been identified in the universities:

- At the Polytechnic University of Valencia, it is the Entrepreneurship Unit IDEAS UPV and the Entrepreneurship Ecosystem STARTUPV.
- At the University of Lapland, the Arctic Arts & Design Lab (ARCTA)
- At the Technical University of Liberec, it is the Student Business Club (SBC).
- At the Uzhhorod National University it is the UNU Startup Center.

In Phase 2 of the Skills2Scale project, the best practices of universities showed the following results:

3.1.1 Universitat Politècnica de València

The MOOC on 5G and Beyond Technology & Business Innovation Potential has shown great success, with more than 850 students registered on its first edition. While prepared by the UPV leveraging content prepared by all the Consortium partners, this best practice is relatively easy to integrate in existing academic ecosystems, as students can register and go through the course on their own. Also, this transferable element maps quite well the curricula of the training program designed in WP1.

While the develop MOOC is online and open to anyone, it is not certificated as an edX verifiable course yet. This means that, despite its interesting formative value, it does not have academic validity nor can issue certificates of completion at this moment. While UPV has this verification on its sustainability roadmap, it may take some time to achieve it, as some enhancements will be needed.

In any case, in the current digital era, these kinds of resources are very useful. On the one hand, they are very accessible as they are free and open to anyone from everywhere and any time. On the other hand, they are relatively easy to design, implement, release and maintain. Specifically, this was the timeline followed by the Consortium for the Skills2Scale MOOC, which could be replicated for any other HEI that aims at implementing one course of a similar nature and keeping full control on its content and formal procedures:

- First stage: MOOC design (in Skill2Scale, from 28/6/2023 to 30/9/2023). High-level course structure, target audience, lessons and material, professionals, publishing platform, etc.
- Second stage: Implementation (in Skill2Scale, from 1/10/2023 to 9/11/2023). Guidelines and templates for lessons preparation, creation of slides, videos and material, review of all the former, questionnaires, etc.
- Third stage: Publication and follow-up (in Skill2Scale, from 9/11/2023 to 31/7/2024 - Skills2Scale end of the project). Publication on an online platform, promotion and incentives, students monitoring, etc. Gathering feedback from students and staff as well as regularly updating the content are also key, for long term sustainability.

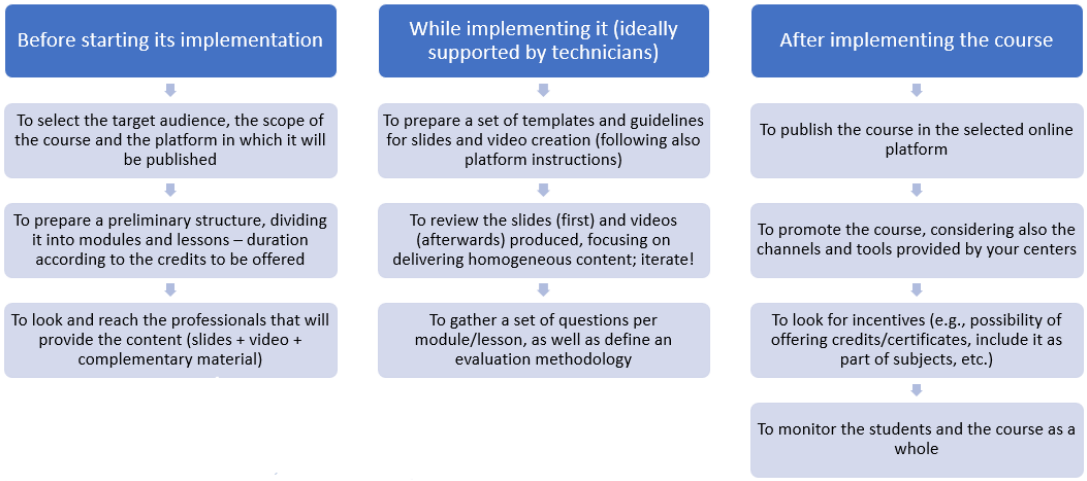

Figure 5. MOOC realization stages

3.1.2 Lapland University

At the University of Lapland, the Faculty of Art & Design has multiple Arctic Arts & Design Labs (ARCTA) including **Service Innovation Corner (SINCO)**, which can be utilized in fast prototyping of services. The laboratory was introduced to local businesses as part of a stakeholder event organized by Skills2Scale project. This prototyping environment for service and interaction design could be employed in the creation of services using Beyond 5G technologies in the business sector and also in teaching.

University of Lapland organized an **entrepreneurship event for students at higher education institutions** on the 11th of April, 2024. The event encouraged, inspired, and gave information on entrepreneurship, along with practical tips, ideas and support services available. The goal of the event was to motivate students to consider establishing their own company as a possible career option. The 2-part event agenda started with speeches from entrepreneurs, some of whom were university alumni, followed by workshops that allowed students to delve into the specifics of entrepreneurship. The event covered a variety of topics including characteristics of a successful entrepreneur, innovations, creating business ideas, productizing and pricing.

The event was organized by Skills2Scale and other projects from the University of Lapland and Lapland University of Applied Sciences. There are plans to make the entrepreneurship event as a series of events that would be held regularly in different faculties or units at the universities in Lapland. The event marketing and agenda can build on the good experiences from the first event offering students inspiring and informative events with fun elements. To attract even more students in the future, taking part in the event could be included in studies at the university and/or the event invitation could be extended to students in upper secondary schools.

Figure 6. Entrepreneurship event for students at higher education institutions, April 11th, 2024

3.1.3 Technical University of Liberec

As part of the Skills2Scale project, TUL created and piloted the **5G Interdisciplinary Innovation Lab**. The concept was very well received by students and teachers and was **nominated for the TUL Rector's Award for Pedagogical Achievement** for the academic year 2023/24.

In the second phase of the project, we have further refined the methodology of this practice-oriented learning, incorporated feedback from students and mentors (see D6.4), and **involved partners from the EIT Health community** (Dex Innovation Centre Czech Republic) as well as other **experts from the field**. The aim is to further **promote interdisciplinary collaboration** and **to give students a broader and deeper insight into the issues** they address in their innovative projects. The innovative 5GIIL concept, which will start again on 17th October 2024 as EIT Health i-Days, is already conceived more as **an intensive week of knowledge transfer** in collaboration with practitioners, followed by students piloting their projects within their courses. The winning student team will then represent the Czech Republic at the EIT European competition in Budapest. This will actually be **the first attempt to internalise** our university student entrepreneurship competition with support of EIT Health (via i-Days). We intend to disseminate the methodology and learning outcomes of this tutorial to a wide range of professionals at the IEEE Global Engineering Education Conference 2025. Revised concept of the best practice **5G Interdisciplinary Innovation Lab** has been submitted to the EIT HEI Initiative Resource Hub on behalf of the S2S Consortium (currently in the "assessment" phase).

3.1.3.1 Revised concept of 5GIIL

The 5G Interdisciplinary Innovation Lab encourages collaboration between students from different disciplines, including business, engineering and health. Teams **work together to develop market-ready solutions using 5G and beyond**, inspired by hackathons but run over a longer period to be integrated into regular courses. During **the preparation phase**, suitable courses and students are selected. Key activities include:

- Obtaining eHealth specific challenges from stakeholders - topic of the year 2024/25 is care for patients with Alzheimer's disease.
- Forming a team of expert mentors from academia, health care and industry to guide students in domain knowledge, technical skills and economic understanding.

During **the implementation phase**, activities alternate between intensive 2 days Ideathon (in cooperation with EIT Health), faculty-led workshops and, to a lesser extent, independent teamwork.

Stages:

1. **Education on the topic (mainly practitioners), challenges, ideation + competitive pitch deck** (within the 2-day Ideathon "i-Days" in cooperation with Dex Innovation supported by EIT Health).
2. **Prototyping**: Facilitate a workshop on prototyping techniques.
3. **Validation**: Run a workshop on validation methods.
4. **Winners Event EIT Health** in Budapest

The 5GIIL for eHealth is designed to be integrated into students' courses, with participation rewarded with course credits. In the lab, students develop entrepreneurial and project management skills and strengthen interdisciplinary links. Engineering students contribute technology and production knowledge, domain students provide eHealth industry insights, and business students provide business and marketing expertise. This project-based approach, combined with real-world challenges and expert mentorship, allows students to gain practical experience and understand the real-world impact of their work.

The eHealth sector is ideally placed to apply 5G technology to improve remote healthcare services, patient monitoring and telemedicine, thereby increasing access to healthcare, reducing costs and improving patient outcomes. 5G can also drive the integration of technologies such as AI, IoT, blockchain, VR and edge computing, enabling the creation of innovative solutions with significant transformative potential.

Key learning outcomes:

This best practice brings together students from different technical and non-technical disciplines to develop creative, market-ready 5G solutions. The specific objectives are:

- Apply 5G knowledge.
- Learning through multidisciplinary teamwork.
- Use learning-by-doing and just-in-time learning methods.
- Address real-world problems and network with experts, starting with eHealth.
- Develop ideas into working innovations.
- Find innovative, market-ready solutions in 5G and beyond.

Key success factors:

- Identify and synchronise student groups from different disciplines with the 5GIIL for eHealth curriculum.
- Choose an application domain with existing research experience, industrial collaboration or regional importance. The eHealth domain is suitable for universities with nursing or healthcare programs.
- Set up an education and mentoring team to guide students in professional, economic and technical aspects.
- Formulate engaging and feasible challenges to avoid demotivating students.
- Organise 5GIIL for eHealth at any university with engineering, business and healthcare programs. It can be a stand-alone course or a collaboration of several synchronised courses. Collaborative activities are essential, but some tasks, such as prototyping, can be done in separate classes with regular joint meetings.

How to replicate:

- Although focused on eHealth, this model can be adapted to other domains such as smart cities, industrial automation, IoT, autonomous vehicles, entertainment, and precision agriculture.

3.1.4 Uzhhorod National University

In May 2024 the UzhNU Startup Center organized the competition "Startup - UzhNU: Towards Innovation! The aim of the competition was to support students, Ph.D. students and young researchers under the age of 35 by teaching them the fundamentals of business management, implementing new research methods, gaining experience in public

presentation of their ideas and project proposals, presenting projects to sponsoring entrepreneurs, providing financial support to competition winners, supporting the implementation of ideas (projects) into production with the effective use of modern IT technologies, and implementing Beyond 5G networks and programs in various areas. The contest was held in three stages:

- First Stage (February 20, 2024 – March 21, 2024) – **Registration of participants' applications** on the official website of Uzhhorod National University (UzhNU).
- Second Stage (March 22, 2024 – April 19, 2024) – **Selection process, preparation of presentations, preliminary evaluation of participants' projects by the commission members**. Additionally, during this stage, startup founders received consultation support in preparing presentation materials for accelerator programs.
- Third Stage (May 03, 2024) – **Competition day**. Public presentation of ideas and project pitches; announcement and awarding of winners.

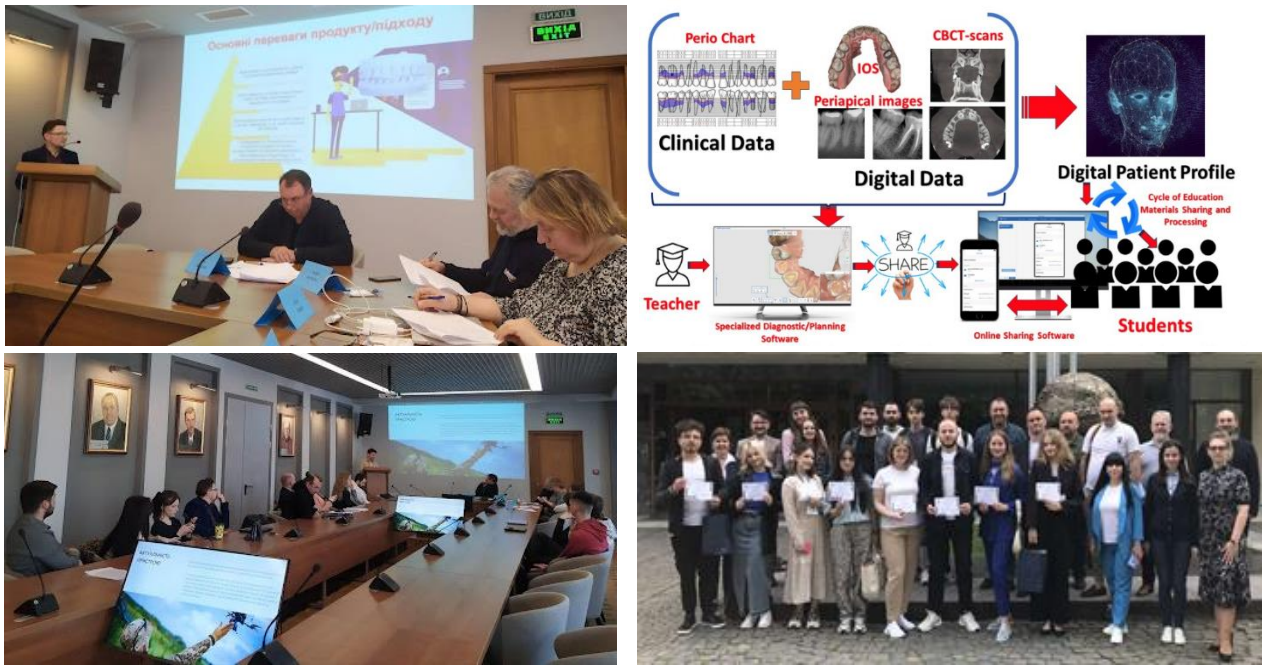

Figure 7. The final round of the "Start-up-UzhNU: Forward to innovations!", May 2, 2024

The expert jury selected the best startup projects, whose authors received initial funding for the implementation of their innovative ideas, mentorship, and introductions to potential stakeholders. The startup project competition facilitated the involvement of university specialists and teachers, business representatives, and influential public organizations in events that promoted intellectual and creative cooperation between students and scientists in the development of innovative startup projects using modern information technologies.

3.2 Training and Support

Continuous learning is a key factor in the development of the project goals and in the achievement of the project objectives. With the rapid development of technology, continuous improvement of training courses is extremely important. In this case, several effective learning methods can be identified:

- ***Active learning:*** involves students in the learning process by encouraging activities such as discussion, problem solving, and case studies.
- ***Blended learning:*** combines traditional classroom learning with online learning to provide a flexible and effective learning experience.
- ***Formative Assessment:*** Ongoing assessment that provides immediate feedback to learners and instructors to guide instruction and improve learning outcomes.

Thus, to enhance the quality of innovation and entrepreneurship education in higher education institutions in the field of Beyond 5G technologies, a Massive Open Online Course was created through new curricula and the integration of entrepreneurship education into existing courses (MOOC) https://www.upvx.es/courses/course-v1:TecnologiasAvanzadasDeComunicaciones+5g-tech-business+2023-01/about.

Figure 8. Massive Open Online Courses, certificate of competition

About this course:

5G is a highly disruptive technology that is transforming our world. 5G opens up possibilities for innovation in any sector, as well as innumerable opportunities for the creation or new business models or the critical enhancement of existing ones. With the emergence of B5G, the upcoming Mobile Wireless Generations, this vast innovation potential will be drastically multiplied.

Here, it is also worth noting that a significant contribution was made by the inclusion of new educational courses on innovation and entrepreneurship in the field of Beyond 5G technologies into the higher education institutions' curricula (as detailed in Section 2.2).

Another important step for the implementation of the effective transfer plan was the creation of the *Training Handbook.* This Training Handbook document (with the associated material integrated) should function like a good practice document that future HEI projects can learn from and even replicate. It includes: Executive summary of the training programme handbook and associated materials; The process, from start to finish of the training programme development; The training programme title, description, learning outcomes, assessment methodology and implementation results; Description of the delivery method (online, offline, hybrid etc.); The timeline of the training programme development and implementation; The lessons learned and an action plan for its improvement; Any other relevant information; Any other relevant document/link/resource that would help for the replication of the training (associated material).

4 Evaluation and Risk Management

It is important to identify the risks (Table 4) that would hinder the achievement of the project goals and provide appropriate recommendations to mitigate them in order to effectively transfer the key transferable elements of the Skills2Scale project to external stakeholders in the field of Beyond 5G technologies, government organizations, and academia after Phase 2. As a reminder, the specific objectives of the Skills2Scale project were the following:

1. To strengthen the innovation and entrepreneurship capacity of higher education institutions (HEIs) in the field of Beyond 5G technologies.
2. To develop and implement a comprehensive Innovation Vision Action Plan (IVAP) to guide HEIs in the development and integration of innovative ideas, research and entrepreneurship.
3. To facilitate partnerships between the higher education institutions and external partners in the field of Beyond 5G technologies.
4. To ensure the acceleration of the development and commercialization of innovations and businesses by students of higher education institutions through the Innovation and Business Acceleration Program.
5. To improve the quality of education in the field of innovation and entrepreneurship in the field of Beyond 5G technologies.
6. To promote the exchange of knowledge, the expansion and transferability of innovation and entrepreneurship between higher education institutions and knowledge and innovation communities.
7. To ensure effective project management and to assess and evaluate the Impact.

It is worth paying attention to the main risks that have the greatest impact on the progress of the Skills2Scale project objectives, in particular:

Figure 9. Main risks of the project

Resistance to changes

Risk Description: Stakeholders may resist the transition to Beyond 5G due to uncertainty, ambiguity, and lack of awareness.

Impact: High

Likelihood: High

Mitigation strategies:

Communication plan: each Consortium partner should maintain established stakeholder relationships during the implementation of the Skills2scale project to continue to engage their support in the process of training a new generation of skilled professionals and entrepreneurs who will contribute to innovation and economic growth in the region.

Training: Universities should conduct trainings, webinars, seminars and workshops to prepare future skilled professionals in 5G technology, while maintaining constant contact with stakeholders to regularly monitor market needs.

Lack of Resources

Risk description: Insufficient human, financial or technological resources to support the continued implementation and achievement of the Skills2Scale project objectives.

Impact: High

Likelihood: Medium

Mitigation strategies:

Funding: It is necessary to attract additional funding by submitting joint grant proposals to competitions: EIT HEI Initiative, HORIZON Europe, IEU GREEN, Erasmus+, COST, providing consultancy services, raising funds through venture capital funds and crowdfunding platforms, and through agreements with interested investors.

Outsourcing: in case of a shortage of specialists in the field of 5G technologies, it is necessary to provide for the transfer of certain tasks to external specialists in this field, if internal resources are insufficient.

Phased implementation: implement the transition to 5G technologies in a phased manner to effectively manage resource constraints and effectively prepare employees for new challenges in this area.

Compliance and Regulatory Risks

Risk Description: Potential non-compliance with legal and regulatory requirements related to the deployment of 5G technologies.

Impact: High

Likelihood: Medium

Mitigation strategies:

Regulatory due diligence: a comprehensive review of relevant regulations and compliance requirements for the use of Beyond 5G technology should be conducted.

Legal advice: Consult with legal experts to ensure compliance with all legal standards.

Regular Auditing: Schedule regular compliance audits to ensure ongoing compliance with regulations and requirements in accordance with applicable standards.

Regular audits: Schedule regular compliance audits to ensure ongoing compliance with legal regulations and requirements in accordance with applicable standards.

Compatibility issues

Risk description: Beyond 5G technology may not work seamlessly with existing systems and applications.

Impact: medium

Probability: medium

Mitigation strategies:

Compatibility testing: Perform extensive compatibility testing with existing systems.

Integration plan: Develop an integration plan to ensure that 5G technology interacts seamlessly with existing systems and applications.

Vendor collaboration: Work closely with 5G vendors to resolve any integration issues with existing networks.

Documentation: Document all integration processes and issues for future reference.

Training and skills gaps

Risk description: Insufficient training of academic, non-academic staff, graduate students and undergraduates in new technologies in the field of Beyond 5G.

Impact: medium

Probability: high

Mitigation strategies:

Curriculum: Develop a comprehensive curriculum that covers all aspects of 5G technology, including advanced innovation and entrepreneurial education programs, theoretical foundations of data transmission, communication protocols, IoT integration, cybersecurity, and open science.

Workshops: Organise regular workshops and seminars.

Ongoing support: Provide ongoing support and resources for effective learning.

Feedback loop: Establish a feedback loop to continuously improve the training content based on user experience and market needs in the field of Beyond 5G technology.

Table 4. Risk Prioritization Matrix

Risk title	Impact	Likelihood	Priority
Resistance to Change	High	High	1
Lack of Resources	High	Medium	2
Compliance and Regulatory Risks	High	Medium	3
Interoperability Issues	Medium	Medium	4
Training and Skill Gaps	Medium	High	5

Developing contingency plans for different risk scenarios is essential to ensure swift and effective responses to unforeseen events. Allocating resources for potential contingencies and ensuring flexibility in resource management will enable the project Skills2Scale to handle unexpected challenges efficiently. This proactive approach will help maintain project momentum and achieve the desired outcomes despite possible setbacks. Thus, taking into account all the identified risks, it is possible to achieve the goals of the Skills2scale project and take a leading position in the Beyond 5G technology ecosystem.

5 Sustainability Plan

During the execution of any project, an important phase of its implementation was the ability to adapt the project's key components to different contexts and settings, while taking into account local conditions and requirements. Thus, during the implementation of the Skills2Scale project, attention was paid, particularly in the development of the Sustainability Plan, to identifying target groups and methods of involving them in the project's sustainability after its completion. Therefore, the main organizations and sectors that needed to be involved in supporting the Sustainability Plan of the Skills2Scale project were:

- Local public authority
- Regional public authority
- National public authority
- Sectoral agency
- SME
- Business support organisation
- Local stakeholders
- Regional stakeholders
- National stakeholders
- Other specific institution
- Universities
- Experts in financial instruments
- Journalists
- Media
- Opinion leaders

Methods of engaging target groups:

- ***Seminars and training sessions.*** Provides for interactive seminars and trainings tailored to the needs of target groups that are stakeholders in the Beyond 5G technology ecosystem, including teachers, students and administrative staff.
- ***Focus groups and feedback sessions.*** Organize focus group discussions and feedback sessions with representatives of target groups to collect ideas and suggestions related to challenges, developments and opportunities in the field of Beyond 5G technologies.
- ***Online communities and forums.*** Create online platforms, such as forums, social media groups, or dedicated websites, where target groups can interact, share experiences with 5G technologies, and provide feedback.
- ***Surveys and questionnaires.*** Distribute surveys and questionnaires to collect quantitative and qualitative data from target groups about their experiences and needs.

- ***Joint projects and hackathons.*** Participate in joint projects of EIT HEI Initiative, HORIZON Europe, IEU GREEN, Erasmus+, COST, organize hackathons or other innovative events with the participation of students, academic and non-academic staff, and stakeholders. Dedicated information can be found in D5.3.
- ***Regular updates and communication.*** Maintain regular communication with target groups through newsletters, webinars, and meetings.
- ***Partnership with industry and academia.*** Maintain established partnerships with industry stakeholders in the Beyond 5G technology ecosystem, including mobile operators, research institutions, and other higher education institutions.
- ***Alumni networks and mentoring programs.*** Create permanent networks and mentoring programs with the participation of alumni who have significant achievements in the implementation of Beyond 5G technologies.

Cooperation between all target groups and universities is mutually beneficial. For example, universities offer academic expertise, research facilities and fresh perspectives, while business and government representatives offer industry knowledge, resources and real-world data. In addition, such cooperation in the future will provide an opportunity to develop specialized training programs and courses tailored to the needs of the industry, which will help create jobs and influence the field of advanced technologies.

One of the most important stages of such cooperation is technology transfer: universities often conduct cutting-edge research that has the potential for transfer and commercialization. Businesses can work with universities to license or acquire these technologies, bringing them to market and stimulating innovation in Beyond 5G technologies.

Thanks to the implementation of the Skills2Scale project, each of the Consortium partners was able to expand the range of stakeholders, attract new business representatives to cooperation, and strengthen the cooperation of educational institutions with external partners, which made it possible to develop strong partnerships with industry stakeholders in Beyond 5G technology ecosystem.

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