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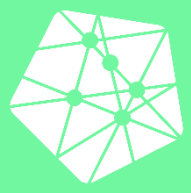
A REVIEW REPORT OF CLUSTER OF INTERCONNECTED NODES AND TRAINING PROGRAMME INCLUDING DEVELOPMENT SUGGESTIONS AND FUTURE TRENDS ON THE AREA OF CREATION OF CLOUD BASED SERVICES

DIHUB

DIGITAL INNOVATION HUB FOR CLOUD BASED SERVICES

Content


DIHUB

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1. Introduction

The aim of this report is to capture the tacit knowledge created in the project DIGITAL INNOVATION HUB FOR CLOUD-BASED SERVICES (DIHUB). We will present achieved outcomes, as well as detected fallouts. The report was composed by Algebra University College and based on the national node reports from Finland, Portugal, Bulgaria, Estonia and Croatia. As such, the report represents the final deliverable of the Work Package 5.

The report will give an overview of the activities carried out within WP 2-4, as well as their results and impressions of the participants. Most of the reported activities are related to WP 4: piloting of the hub concept in each partner country. The Pilot had two phases, the course phase, where curricula and teaching materials designed by partner teachers/professors was presented to selected students, and the second phase, where students worked on and/or implemented cloud-based solutions for concrete business cases of selected SMEs.

The main idea behind the pilots was to test the mechanism of connecting VET students with SMEs and to test VET providers' and SME's readiness for mutual collaboration on the topic of cloud-based services. In doing so, students were expected to gain market-oriented relevant knowledge and skills through solving real-business problems, while SMEs improved their competitive advantage by using cloud-based technologies in everyday business.

Each partner country had to include educational institutions and SMEs into the pilot to conduct preferably 5 development projects. Educational institutions prepared teaching curricula on EQF levels 4-6/7 for the pilot, in order to provide additional cloud-related knowledge to their students, in order for students to be able to offer quality solutions to SMEs. Those curricula were either included into the existing teaching curricula or a new VET training program was created. Subsequently, working on real-life cases with the SMEs ensured the practical knowledge students might have lacked.

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2. Implementation Activities – Year One

Conducted as a part of the WP 4 of the DIHUB project, Pilot 1 has been a great learning opportunity for all project partners. According to the feedback from the Pilot's participants, professors and students, as well as the SMEs who took part in it, found the project to be very relevant and pilot's results positive. Even though all the partners faced different challenges in the course of the pilot's implementation, many of which can be attributed to they were able to finalise the Pilot almost completely. The DIHUB project is considered as a great opportunity for all the students as they were able to acquire additional relevant knowledge and most importantly, they had a chance to work on real-life business cases by working with the SMEs. On the other hand, SMEs reached a new level of competitive edge using cloud-based technologies introduced through the project.

Country	No. of Students Enrolled in the Course	No. of Students who Participated in Projects with SMEs	No. of Professors Working on Pilot 1	No. of SMEs that Participated in the Pilot 1	No. of Delivered Cases
Estonia	15	15	7	5	5
Finland HBC	18	9	4	3	3
Finland Haaga- Helia	38	15	3	2	2
Portugal	19	1	4	25	1
Bulgaria	12	12	4	2	3
Croatia	53	23	21	6	6

In the following text we present experiences project partners had during Pilot 1.

2.1. Bulgaria

Besides the leading partners, Sdrudzenie Znam i Moga and Bulgarian Romanian Chamber of Commerce and Industry (BRCCI), who were the only members of the hub at the beginning of the project, later on, interested organizations joined the hub. Those organizations are The State Technical Universities in Sofia (its teachers conducted the first Pilot training), Ruse and Gabrovo, Vocational Schools in Audio-video and Telecommunications Sofia, Vocational School of Electronics V. Tarnovo and very recently the private University SoftUni, where the second Pilot training will be held.

BRCCI has communicated widely the DIHUB project via publications on the website of the Chamber, Facebook page, LinkedIn and weekly newsletter. The Chamber also contacted Bulgarian and Romanian companies by email and presented the DIHUB project and distributed the survey on utilizing Cloud-Based Services and Artificial Intelligence among those companies. The survey has been conducted among 43 Bulgarian companies and 6 Romanian companies. The majority of companies knew about cloud-based services and use them in their business activities. The most popular types of cloud-based products and services specified both by the Bulgarian and Romanian companies were Google products and Dropbox.

Through the survey, there were several SMEs that expressed their interest in participating in the DIHUB project therefore they were contacted by BRCCI. Those SMEs were additionally encouraged by the Chamber to share their projects, doubts, problems in using the cloud-based services or applications and AI. Two companies presented their cases to the students in the Pilot. A still existing challenge is the participation of SMEs in the project, their interest to understand and realize the practical benefits, to try with a foreign resource to solve at least one of their problems and to become active users and advertisers of the hub.

The situation with the COVID-19 pandemic was a very big obstacle in terms of reaching the SMEs due to lockdown in Bulgaria and Romania and the regular communication turned out to be quite an issue. Another significant issue that showed itself in the very beginning of the Pilot 1 was the lack of trained teachers in this field, especially after the survey showed a complete absence of such training. After some time, teachers with the required and adequate training were found and the preparation of the training program began, led by the Technical University in Sofia. The introduction of a new discipline, testing in a real environment before it

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becomes official in the university program is a challenge that was a sufficient motivator for professor to join the project. The competition between the Universities, such as diversity in programmes, modernity of curricula, applicability, perspectives of the taught subjects is also a strong motivating factor. The first Pilot training was attended by 4 professors, two of whom worked on the preparation of the theoretical material - Associate Professor Ph.D. (vice head of the department) and Assoc. Prof. Ph.D. from the Department of Telecommunications at Sofia Technical University. Both are long-term teachers in various disciplines, with extensive practical experience. Due to the illness of the incumbent, doctoral student joined the training at suggestion of other professors. the course was postponed twice due to the keynote speakers Covid infection, which somehow hindered its implementation, coinciding with the exam sessions in schools and universities.

The research showed that no institution at all educational levels had a comprehensive course on the use of cloud technologies. This led to the decision to adopt an experimental online course, close enough in content to the content discussed in the partnership, as additional topics in it would be holographic solutions and the use of virtual reality in the educational process, topics in which the Technical University has traditions and facilities for practical implementation. It was considered that the course is suitable both for students from all levels of higher education and for the last two courses of vocational high schools with relevant specifics.

After very active advertising of the free courses (advertisements were placed on specialized sites and also published on the website of the Know and Can Association, aimed at a wide range of educational partners and colleagues) and after the agitation campaign, the course started with 44 registered participants (12 of whom were students), which was considered by all interested as a great success.

New and modern things have always been a magnet for students interested in this field. In Bulgaria, most of the online resources on this topic are expensive for the Bulgarian standard and are also in English which might be the problem for students with levels of English below average. So, lessons offered through this project are considered as a unique opportunity and therefore a big motivator for students to attend quality lessons which were in Bulgarian and free. Of course, additional motivation would be if the idea of international cooperation is realized by all hubs in solving complex problems.

Due to the Covid illness of the keynote speaker, the course was postponed twice, which somehow hindered its implementation, coinciding with the exam sessions in schools and universities.

For the majority of those present, the information presented during the lessons was completely new, quite large in volume, presented in a short time so there was no need to make changes in the planned curriculum due to students' inputs. However, additional content did take place; Virtual reality as an additional tool in the online environment and Holography since the university has a long tradition in this field and is now trying to optimize it through cloud technologies, such as colour diversity, lead time and variety of displayed items.

Know and Can Association be responsible for the logistics of training and technical support of online events. Technical infrastructure used for delivering the first Pilot's results were e-mails and the closed VPN group allowing the use of educational theoretical resources, as well as paid ZOOM version for the meetings, Amazon and Microsoft cloud resources. VPN connection and paid (chosen by the trainers as they had no financial resources for them). FB group for communication on any issues.

After the education process, students were connected to the SMEs who expressed their interest in participating in the DIHUB project. SMEs presented the issues they would like to resolve with the cloud-based technologies. Some examples of projects students were working on are as follows:

- The first project was aimed at transferring a database located on a local server on a cloud with access levels, to facilitate online work.
- The second project was related to a mobile application for insurance agents in damage assessment, which helps them to quickly advance the quantitative assessment.
- The third project is a thesis of a student from the Agricultural Academy, who joined the course with a slight delay, on the collection and analysis of data obtained by drone on the state of crops and anticipation of optimal agricultural activities - watering, spraying, etc.

The second Pilot training will be conducted by another educational institution - formal and private, specializing entirely in the ICT field. An additional advantage is a fact that the training will deliver new content and it will also be bilingual, like all items in SoftUni. Regarding an additional part of the program, several options were discussed, the most promising from an applied point of view are the use of artificial intelligence to automate processes in various areas of business, environmental protection and air pollution, which is a big problem for almost every major European capital. As the course progressed, despite all the pandemic difficulties and the

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academic workload of students, there were more and more requests for second Pilot training (but on a less intensive schedule) and comments from both students and professors were very positive, they believe the course was well structured and the information was up-to-date. The level was basic, but in Bulgaria, that was the aim. SMEs also had positive comments considering their participation in the DIHUB project.
The lack of a certificate and perhaps the inappropriate time for finalization had a negative impact on the appearance to the final test. With the exception of the remarks about the overloaded program, there was no other negative comment on the students' part.

Now that the course on "Cloud Technologies" is already in the official curriculum of the Faculty of Telecommunications of the Technical University in Sofia and students from all over the country can enrol in it, it is clear that the work done on the DIHUB project has been a great successful.

2.2. Croatia

VUA and HUP participated in the Croatian node as main coordinators. The VUA acted as the coordinator for educational activities and the HUP as the promoter of the node initiative among enterprises, especially among SMEs. HUP brought together over 6,000 companies registered in Croatia, which employ over 500,000 employees in all industrial sectors. Through monthly internal meetings, HUP and VUA collaborated in planning the project's activities, analysing the challenges and finding the best solutions.

With the aim of raising awareness of the DIHUB project, VUA and HUP conducted workshops (presentations) for board members of different companies, emphasizing all the benefits of participating in the project, as well as the importance of their support. Similar workshops were conducted internally for VUA and HUP employees to gain internal support for the project.

All DIHUB project activities were communicated through the existing internal corporate VUA network, which includes over 250 SMEs. Through frequent meetings and newsletters, as well as social networks, all interested parties were informed about the objectives of this project, always with an emphasis on what opportunities are provided to them. The same procedure was performed by HUP. In this way, 6,000 companies received information about the DIHUB project and its activities. Corona virus slowed down and somewhat weakened the information process because it was not possible to organize in-real-life meetings, especially during March, April and May last year.

Croatian SMEs responded well to the survey. The survey was sent to just over 100 SMEs, of which 50 gave a very meaningful and complete responses. HUP received applications from 30 SMEs to participate in the pilot project. 6 SMEs which were actively involved in the pilot, and which showed the highest level of motivation to participate and were able to provide the necessary conditions for work-based learning were included into the Pilot. The SMEs that participated in the Pilot had from 5 (the smallest - a catering facility) to 75 employees. Seen across sectors, the SMEs came from catering, financial services, retail, business consulting. The SMEs were aged between 5 and 21 years. One of the projects was aimed at the public sector, for the SUVAG Polyclinic, which works with disabled children. The Policlinic employs 150 people and is one of the leading institutions working with children with disabilities in Croatia.

SMEs motivation to participate in the project was as follows: a desire to improve the business process, lack of their own IT experts, desire to better collaborate with the higher education institution that educates IT professionals, the need to correct the part of the business process threatened by the epidemic of the Corona virus, desire to gain new knowledge, desire for better cooperation with students of the IT industry (because otherwise, they do not have the opportunity to hire students for practice).

Following the activities mentioned above, applications were opened for students interested in participating in the first Pilot. The marketing department campaigned through internal communication channels and through the career planning office, to make sure all VUA students were informed about the DIHUB project. The focus was on systems and software engineering students and data science students. After that, mini online presentations were organized where VUA discussed with all the participants the importance of cloud tools, especially in the era of the pandemic, in which we found ourselves. In this way the importance of the project's topic was emphasized, consequently, it was easier for the students to relate to it and become aware of its relevance.

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The heads of mentioned departments were asked to present the pilot, explain what influence the participation might have on student's career development, the expected duration and the desired results. This direct communication had a very good effect and through such a more personalized approach most of the applications were gained. 53 students requested active participation in the pilot. Of these 53 students, 23 students worked on SME projects and the rest worked on start-up solutions. They all worked in teams.
Student activation has been somewhat hampered since the start of the pandemic, but with the great efforts of all teachers and tutors involved, enough interested was gathered. First-year students saw DIHUB as a ticket to enter the world of cloud technologies, while senior students from the DIHUB project saw an entrance ticket to the business world. For them, the greatest benefits were training and additional individual job opportunities, which were provided to them through individualised project consultations with the mentors involved in the project.

The younger students had no experience with such projects and their level of knowledge and skills in the field of cloud technologies was very limited. Older students have had experience with project-based learning, albeit not on topics in the field of cloud technologies (they worked on mobile and desktop application development during their first years of study). The desire on the part of the VUA-HUP team was not to maintain the existing clique in the pilot but to initiate and encourage cooperation between students who had no previous experience working together. In particular,intergenerational collaboration was encouraged, as it has shown in previous projects to be a very effective way of learning for all the students involved.

The team training phase followed discussions with SMEs. After formulating project ideas with the help of mentors and SME representatives, the students were invited to give their feedback - how they see projects can be executed, what are the challenges, what prerequisites must be met for their successful implementation. In the process of giving feedback, it was identified which students are most inclined to which topics and have formed teams based on their thematic preferences.

The teams working on start-up-type projects started from the conception phase. Further, in the research phase and by talking to potential buyers, they identified the problem. Then they formulated a draft solution and the persona who will use that solution. Eventually, they came close to developing a solution. In this case, the teams were formed partly by the intervention of the teacher and partly by the self-initiative of the students who expressed a desire to work on a particular project.

The teachers participated in two ways; 6 of them were responsible for educational programs in the field of cloud technologies and user interface, while additional 15 teachers have been mentors for student projects. For some teachers, the pilot project was a natural update of their existing teaching activities as they participated in the activities that were close to them, only in slightly changed circumstances. The mentors, on the other hand, were mainly driven by curiosity towards research projects in the SME segment, because their regular work is based on theoretical work or work related to projects for big companies (banks, telecommunications, large distribution, large media, hotel chains). It should also be noted that the teachers worked very hard at all stages of the pilot, which was quite time-consuming.

Two cases pointed out by Croatian partners are as follows:

The first project aimed at creating a machine learning models for identifying topics based on WhatsApp messages using NLP (Natural Language Processing) algorithms. In order to demonstrate the possibilities of cloud technologies and their application in the AI, specifically NLP field, this project aimed to develop a library called WhatsAppNLP that combines and, as a final product, simplifies the process of machine learning models training, its application and application of methods for analysing chat log records. The usage scenario involves user-saving conversations in text form that, using the WhatsAppNLP Python library, will forward the exported text to one of the natural language processing methods, it will do all the work of processing and analysing the data independently and will create a report for the user in the form of intuitive graphs, tables and text messages. The job of interpreting the data obtained by the analysis remains with the user. The project restricts message analysis from working only if it is exported from an Android mobile device.

The second project is related to identification of subjective image attributes using deep convolution neural networks. The aim of this project was to develop and understand models for predicting three subjective attributes of images – memorability, curiosities and positive sentiment, and to compare the effectiveness of simultaneous learning of multiple tasks with the effectiveness of learning a single task. Models for identifying subjective attributes have applications in a variety of fields, from marketing to education. Learning multiple concurrent tasks can be predictive and computer-efficient compared to learning a single task, and in the domain of subjective attributes is not sufficiently researched. The models developed in the project are based

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on deep convolution neural networks. When learning, students used the technique of transferring knowledge from existing known models developed for image classification: AlexNet, ResNet-18 and Inception v3. The most successful architecture in the prediction of all three attributes was Inception v3. The best results were achieved for memorability, while the prediction of sentiment proved to be the most challenging task. Learning all three tasks at the same time resulted in equal or slightly better efficiency than single-task models. Prioritizing the easiest task – memorable – in concurrent learning achieves better results in relation to a situation of equal importance of tasks and prioritization of the most difficult task. The application of the SHAP GradientExplainer and CKA techniques has shown that different architectures learn different information for the same attribute. Models based on the same architecture teach similar representations of knowledge when learning one or more tasks.

For implementation of Pilot 1, Croatian partners used private cloud computer infrastructure that was established for the purpose of performing teaching activities and projects. Other computer resources occasionally required for execution of the Pilot 1 were leased on a project basis (calculating or serving web content) with external service providers. To address additional specific needs, advanced computer infrastructure was also used, available at research centres through the services of the University Computer Centre (SRCE) and the Croatian Academic Research Network (CarNET). All the equipment used for research purposes meets technical requirements for performing complex computer processes and simulations. VUA also worked in 2 laboratories equipped for network technologies with CISCO Systems network equipment with switches, routers and hubs that meet the requirements of conducting research activities in the field of computer networks. Also, in those laboratories "next generation firewalls" security devices from Palo Alto and Fortinet (virtual) are available. As an Authorized Education Centre for Microsoft, Adobe, Cisco, Autodesk, IBM, RedHat, ECDL, VMware, Algebra Group has licensed complete software at all workstations used for research purposes and server solutions (Microsoft Servers, MS SQL, ISA, Exchange) as well as development software (Visual Studio, Java development tools...). In addition, through the status of an academic partner, we have access to specialized software (on-premise or cloud) for SAP Hana, HubSpot, Tableau and Microsoft licenses and content. Currently, 19 physical servers are installed in the premises of the institution, which provide infrastructural support for scientific and teaching activities. In addition, for the sole purpose of project activities, students and researchers have at their disposal a demonstration server environment (sand-box) with a total of 12 additional professional servers, network equipment and two data warehouses.

Despite all the existing pandemic constraints, Croatian partners believe the first pilot was successful. They use the success stories from this pilot project as communication material to raise awareness among the next generation of students, which they also want to include in the second DIHUB pilot project.

The fact that some students felt motivated to continue with the projects even after the pilot project was completed also shows that the project was successful. Furthermore, Croatian partners raised the awareness in the ecosystem of the low level of understanding of the ability and capabilities of cloud technologies to improve the business of SMEs. In this regard, they plan to organize educational activities, not related to the DIHUB project, during which SMEs will be educated on the benefits of cloud technology: just business, no technical aspects.

The pilot is considered a success also because it showed the possibilities for further improvement of the educational programs at VUA and their harmonization with the needs of the labour market. VUA realized that it is necessary to redefine some existing learning outcomes, that is to harmonize them with the great technological changes in the world of cloud technologies so that students acquire truly relevant skills. This is especially true for cloud technology skills, which are missing in the ESCO classification. Already this year, VUA is working through the DACUM process to define new educational programs.

The students are extremely satisfied as all their expectations have been met, such as the acquisition of new skills and new knowledge which they will apply and improve through work-based learning, as well as networking with potential future partners or employers. Students who have not been involved in the collaboration with SMEs, have worked on their own start-up projects which can be offered on the market and which also operate on cloud technology. This has shown as a quality solution because, although VUA could not provide all students with work-based learning, it still provided project learning and concrete application of technological knowledge for these students.

During the first Pilot, it was evident that students have great ideas for start-ups relying on cloud technologies in their business, as a novelty in the second pilot VUA will introduce the possibility of working on a start-up. The collaboration with established SMEs will not be neglected and will still be in the focus, but VUA believes

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that opening up to start-ups will bring new quality, especially since VUA wants to encourage, not limit, creative thinking and student's development.

The second thing that will be changed is the communication with SMEs. At the beginning of the first pilot, a lot of time was wasted through the communication of VUA technical experts and SME representatives, because of their scarce technical knowledge. It was only when VUA business experts were included in communication that communication gained clarity and speed. In the second pilot, VUA business experts will be involved from the very beginning in communicating with SMEs.

And finally, the third change is the beginning of education. That is to say,according to the application of the DIHUB project, the pilot starts with 21 days of the educational program, during which the participants acquire general knowledge regarding cloud-related skills. This will be changed in the year two, as the general introductory course ended up being superfluous for most students, who came with general knowledge of cloud already to the pilot.

The first and by far the most complex thing was the organization of very complex communication in the conditions of a pandemic, for which we were certainly not prepared. When partners at VUA finally got to grips with the new working conditions, they were able to focus more on the content of the pilot project itself. The biggest challenge was to reconcile SME expectations and student delivery opportunities. SMEs' initial expectations of students were completely unrealistic: they expected the level of service as if the students were already trained IT professionals with a high degree of experience. Mentors played a role in mitigating these expectations.

The most rewarding moments were watching the students who were starting to apply what they had learned in college. Their development through work-based and project-based learning at DIHUB has been significant.

2.3. Estonia

Tartu Vocational Education Centre and AS BCS Koolitus are Estonian partners in the DIHUB project. In order to raise the awareness of the DIHUB project, the project was presented to several stakeholders, such as the Estonian IT Cluster, National IT Teachers Network, IT Academy, etc.

Seven teachers participated in the project (4 teachers from Tartu and 3 guest experts from BCS). Teachers are IT experts and business expert, with 2 of them having previous experience on similar projects. It is believed teachers were motivated by the extra pay they received for delivering the course and couching to participated in the project.

After teachers introduced students to the DIHUB project through a workshop, students showed great interest and were keen to participate and work on real-life business issues. 15 students participated in the Pilot which was proposed as an elective course to IT specialists. It is believed that the main students' motivators were additional IT training, apprenticeship as well as gaining the diploma.

Students worked in teams of 3 which were formed by teachers according to students' knowledge and skill level.

Even though 150 surveys were sent out, the initial response rate of the SMEs was rather low, which is believed to be due to the Covid pandemics. Engaging SMEs to participate in the Pilot was recognised as the main challenge. Selected SMEs were personal contacts of teachers and BCS experts and their profile was as follows: Construction company, Training provider (adult training), A hobby school, Architecture and design company, IT solutions provider.

All development projects were proposed by selected SMEs after which students pitched their prototype solutions as well as the final working business case. Two examples of the student projects are:

- Development of a construction company´s infrastructure services, mainly focusing on an introduction to the Microsoft 365 platform and its gadgets. Under the DIHUB project, students had the task to ensure the company`s data is protected, integrated, but available only to dedicated user groups. The Project will result in full deployment, configuration, and integration of a private cloud solution.

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- Creation of a free virtual backup server solution for a training company. Young people are expected to come up with at least two solutions, with a thorough analysis of each solution; their functionalities, relocation capabilities, and original data-recovery plan.

Since all the students had previous IT knowledge no additional training was required. But during the apprenticeship, certain skill gaps were identified and students suggested additional lessons on the topic of a "private cloud technology". Additional changes that will be implemented to improve Pilot 2 are as follows:

1) suggestion to other Estonian VET schools to participate in the elective course - 2 specific schools to start consultations with;
2) To provide the students with the hybrid learning course (online and F2F)
3) Hackathons as a starting point to the apprentice period.

Students were engaged via the TOY methodology. 2 days of the week they spent in school, 1 day at the SME. Student teams were coached by their mentors.

The technical infrastructure used for delivering the first Pilot's results was vCenter virtual machines; Azure Online Academy provided resources; Office365. All the technical infrastructure was provided by the companies.

Estonian partners consider the Pilot to be a success as all business cases were delivered in full and in time, and the participating partners' expectations were met:

- Students had the opportunity to design and build a working, real-life solution and appreciated the chance to work with their teachers and coaches on this type of project;
- Teachers had a chance to pilot a new way of teaching but also, they pointed out that the most challenging and beneficial for them was the collaboration between teaching staff

SMEs got a free and working solution for their problem, even though at the beginning it was difficult for students to understand SMEs specific needs, after few weeks all came together and work continued as planned.

2.4. Finland

Helsinki Business College (HBC), Haaga-Helia University of Applied Science (Haaga-Helia UAS), and Helsinki Region Chamber of Commerce are Finland's lead partners in the DIHUB project. With time, other educational institutions joined the national hub. The most active ones have been the Laurea University of Applied Sciences and Satakunta University of Applied Sciences. Few outsourced experts have been used in promoting innovations and creating partly the view of the local ecosystem (Altogame and Mr PhD Tero Nurminen). These experts have close connections to Aalto University.

The hub also has business partners: Hotelwayai, Posti Group Oyj, CGI Finland, TietoEvry, and three smaller companies who participated in the Pilot; CRnet, Restaurant Knippan and Party Dream. HBC and Haaga-Helia UAS have connections to core cloud architecture companies like MS Azure, Google Cloud and AWS.

In order to raise the awareness of the DIHUB project, the lead partners have organised several activities, such as the initial Cloud technology & AI event, as well as two additional events, one for SMEs and one for VET providers. Furthermore, several info sessions have been organized with the Finnish National Agency for Education and events at the European level organised by EU officials, European DIHUB Webinar for Educator on the use of AWS in Education, dissemination to companies, to several educational institutions and to cloud service providers as well as releases on specialised channels.

Internally HBC has introduced the DIHUB concept and the experiences to the whole staff and especially among ICT teachers, while Haaga-Helia has disseminated to lecturers and organized a national DIHUB webinar on the use of Azure in teaching.

The Helsinki Business College teachers created learning materials for the first 10 days of the education part and also conducted it while the other 10 days organised by Haaga-Helia UAS was lectured through Haaga-Helia UAS teachers' materials which included AWS licensed materials as well. Students' curriculum was

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analysed and the modules which are overlapping the DIHUB training were included in the training program. The missing parts of the training program were thought of by online courses.

Later on, there was also a new version of the curriculum available and the AWS part was replaced by MS Azure. The core reason for this was that MS Azure already was inside the curriculum and it was convenient to teach cloud infrastructure in that way. Some additional programming and a deeper introduction to the cloud-based service training program were introduced. Also, material dealing with AI issues was included a bit more by utilising material created by Algebra University College.

The content of lectures in the Pilot 1 phase with the first group was as follows:

- Introduction to the Cloud-Based Services-Training Program and DIHUB environment (1 day)
- Service design through cloud interface (3 days)
- SCRUM as a project management tool (1 day)
- Foundations of cloud technology: Linux, Virtual machines, Microsoft Azure, Google Cloud, Amazon Web Services, Characteristics of Other Cloud providers (5 days)
- AWS foundations (11 days)
- Finding an industry-based service idea/platform for the development project (during days 1-21)
- Creating a solution/cloud-based platform for a company through a development (100 days) project

After the adjustments of the curricula, the content of lectures in the Pilot 1 phase with the second group was as follows:

- Introduction to the Cloud-Based Services-Training Program and DIHUB environment (1 day)
- Service design through cloud interface (3 days)
- SCRUM as a project management tool (1 day)
- Foundations of cloud technology: Linux, Virtual machines, Microsoft Azure, Google Cloud, Amazon Web Services, Characteristics of Other Cloud providers (4 days)
- Google Cloud Platform Fundamentals (4 days)
- Planning the cloud architecture for a company based project, (3 days)

When the company case is fixed, choosing the cloud, tools and preparing the service to be created and how it will be built to cloud:

- Coding in cloud-based services: machine learning, blockchain thinking, artificial intelligence, introduction to programming with Python (5 days)
- Finding an industry-based service idea/platform for the development project (during days 1-21)
- Creating a solution/cloud-based platform for a company through a development project (100 days)

For the second group of BCH students, additional courses were presented, such as Cyber Security and Microsoft Autopilot and Intune, which were guaranteed to be useful in DIHUB projects, as they increased student's overall view of cloud services. Other courses included: Modern Operating Systems (Windows, Linux, MacOS / IoS), Telecommunications, Ticket Systems (ITIL4), and Active Directory. The rest of the curriculum for the second group of students is still under online work for the students and the estimated time to finish all content is by the end of October 2021.

In Haaga Helia UAS the topics taught to the students in Pilot 1 were:

- AWS Foundations as found in the AWS Academy materials
- basics of machine learning
- business case examples
- machine-learning environments in the cloud environment
- Basics of techniques for implementing chatbots
- Implementation of a chatbot with the ability for informative dialogues with the IBM Watson Assistant cloud service

In the following text, we provide an overview of recruiting process and details on students' projects in Helsinki Business College and Haaga-Helia UAS. After the initial dissemination activities, activities of engaging students and SMEs took place.

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During Pilot 1 a survey was conducted with the SME's and these companies were later on contacted. SMEs were mostly micro-companies and they were really motivated to engage with the project as they realised that they could develop their processes through these kinds of cloud-based business cases. It was noticed that SMEs have scarce development resources so this was a cost-efficient way to foster the development of the company.

Helsinki Business College students were recruited by teachers from the regular secondary level Information and media technology student groups. Three of the Helsinki Business College teachers involved in the project had Master of Science degrees and one had a Bachelor of Science degree in the field of Information and Media Technology. They had some experience with similar initiatives.

Teachers were active in informing the students about the project and the chance to participate in Pilot 1. As the initial students' interest did not meet the expectations, a second group was formed, and the project manager gave students more thorough information about the project, and further students' engagement reached the desirable level. 18 students were selected by the teachers at Helsinki Business College from which 9 participated in the business cases. The main motivators for students to participate were the opportunity to gain practical experience and solve a business challenge, as well as to learn and acquire new skills related to cloud service and service design that are students' narrow interest domains.

Teachers believe that DIHUB student projects were a useful addition to the basic curriculum. Because students had a chance to take part in a real-world business case and thus utilize the theory studies, their learning process quality increased remarkably. The main motivation for teachers to participate in the DIHUB project was to deepen their own knowledge and skills by developing and teaching new courses. With time teachers' motivation deteriorated as the process was rather time-consuming. This was also emphasized as the COVID19 started (March 2020) to expand just when Pilot 1 had to be launched. Also, summer vacations came very soon (on June 2020) and student contacts were not taken care of enough. Because of all these reasons, the second student group was created and a new teacher took place in the project. This seemed to work very well. All in all, there were 4 teachers from HBC included in the process.

During the training program, students started to look for the appropriate business case. While having a limited number of contacts only one business case was found by the students. The two other business cases were initiated by VET provider staff (manager or teachers). Students introduced the solution to the companies in all business cases. In one of the business cases, HBC students trained the company staff as well to take the solution into effective use. They used the SCRUM method in managing the business cases. Trello was used as a cute software to manage the projects. Students documented the business cases as well.

Two examples of the business case are as follows:

- The company managing restaurant services in multiple locations (staff number around 50-60) needed a cloud-based platform for internal use in file management, work allocation, internal communication, etc. A group of five students started to create a platform for the company. Two of the students had extensive work experience in the field of catering and work at restaurants. They compared several platform options and selected MS 365 service platform for creating the solution for the company. They installed a testing environment and built a tailored service platform for the company. Finally, students installed the MS 365 tailor-made solution to the company's cloud server and even organised and implemented a one-day training for the company.
- The third business case was meant for a small company which offered products to the customers organising parties and celebrations. The company had already web pages but there was no chatbot solution integrated into it. Students had contacts with that company and they got an idea to create a chatbot solution for the company. Students started to get familiar with different chatbot service platforms and finally selected one of the platforms where chatbot was aimed to build. Students defined the chatbot service questionnaire structures and created the chatbot for the selected platform.

Even though students felt the relation to the teacher throughout the project was weak and the students felt that they did not have enough support, they were very satisfied with the end results and new skills they acquired and pointed out that they would recommend participating in such projects to their colleagues. Helsinki Business College used Linux, AWS, MS Azure, Google Cloud, different chatbot software, MS 365 service platform (also real demo environment), Trello, MS Teams during the Pilot 1 activities.

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Despite some challenges during Pilot 1, all the feedback from the SMEs was positive, they appreciated the fact they learned how a variety of digital tools can be deployed surprisingly easily and uncomplicatedly and they would be ready to join a similar project again.

The project objectives were met very well. There was only one SME who faced issues while the project was taking place since the entire project was rather challenging, students required support from teachers, but they could not reach them which resulted in the second part of the project not being finished. However, Pilot 1 is considered a success in HBC.

The Haaga-Helia UAS students were recruited using communication channels for degree students as well as channels that aimed at students outside Haaga-Helia. Three teachers who took part in the Pilot at Haaga-Helia had either a Ph.D. or an MSc in computer science or information technology and had some experience with similar initiatives. All of the teachers had previous experience in an internal project of curriculum development and the creation of new courses. Teachers' decision to join the project was motivated by the opportunity to develop and teach new courses and in that way also deepen their knowledge and skills. At the same time, developing and conducting courses was very demanding and time-consuming since the teacher had to learn all the new cloud-related technologies and get familiar with the new laboratory environments. Only after this, they were able to teach. In addition, the heterogeneous starting level of the students was a challenge. The first part of Pilot 1 involved 38 students and the second part, which was conducted through teamwork, had 15 students involved. Students were very motivated to participate in Pilot 1 because the course contents were very much related to what is asked by the job market. In Haaga Helia UAS the curriculum for the course was planned beforehand. However, as the level of the students varied, the students were offered extra classes after regular classes if they needed to catch up with something. In addition, they were given recommendations for independent study.

Students were organised into 4 teams of 3 –5 students. The students were offered the possibility of studying during the summer. The challenge students faced was an absence of IRL contact since some students were physically in Finland or Portugal and as the course was completely virtual, many of them had only met each other virtually. The students did pitch their projects to the companies. The companies need a workforce skilled in the domain of the projects and thus they were motivated to participate. In addition, they learned from the projects.

Haaga- Helia partnered up with two SMEs, one hotel operator and a financial company. The hotel contacted Haaga-Helia to conduct a project for them, therefore it was included in the DIHUB project. For the needs of the Hotel, students implemented a chatbot project built using IBM Watson assistant. The chatbot can carry out informative dialogue in the domain of travel. Thus, it is extended beyond a mere Q&A bot and it is now in the production phase. The company was present at the beginning and the end of the project. The content for the chatbot was created on a separate course by the students of the travel management program at Haaga-Helia. Thus, the students of the DIHUB Pilot could concentrate fully on the technical aspects of implementing the chatbot.

The financial company was contacted by students. The Pilot was based on the company's need to move the Robot as a Service (RaaS) service environment, which utilizes software robotics, from an external cloud vendor to the company's own management. The Pilot models the implemented solution and ended up using the solution implemented in the company's own network. The cloud-based solution is being researched and further developed.

At the end of the projects, both, SMEs as well as students gave mostly positive feedback with some suggestions for improving the course. For example, some students regarded the level of the course too difficult and some felt that it was too easy. Having both bachelor's and master's level students in the same course did create challenges. In Haaga Helia UAS the student's inputs and feedback are considered in the planning and implementation of the second Pilot.

Haaga-Helia UAS used the laboratory environment offered by the AWS academic initiative, the Watson Assistant from IBM and the Dualprism software for the RPA project. Moodle, Teams and the Haaga-Helia video service (https://video.haaga-helia.fi/) were also used. The AWS environment was used to teach AWS Foundations, the IBM Watson assistant and Dual Prism were selected because the company projects required them. In Hagga Helia UAS the first Pilot was very successful. With a short timeframe and regardless of the COVID pandemics Haaga-Helia managed to create new cloud technologies–related courses and to offer two cloud-related projects to companies.

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Already during the first Pilot, certain changes were adopted addressing the content of the training program. Also, changes were made dealing with the coaching of the business cases so that there was continuous and regular coaching available for the students and the company. There will be additional changes when the second Pilot starts at least dealing with the content of the training program. The aspects of virtual teaching will be given more attention to. For example, the virtual laboratory environments and the LMS have to be functioning at all times. Also, communication has to flow seamlessly between students, teachers and business partners even though learning happens in a virtual environment.

2.5. Portugal

Portugal's leading partners in the DIHUB project are TICE.PT, the Portuguese ICT cluster, and INOVA+, consultancy and training company. Through the contacts of the leading partners, a higher education provider (Higher Institute of Engineering within the Polytechnic Institute of Porto), as well as companies (including SMEs) and one Association were engaged with the project.

In order to raise the awareness of the DIHUB project, the lead partners have conducted dissemination activities through direct contacts with companies and ISEP as well as through the official website and the institutional communication channels. The interaction between lead partners and the ISEP, an education institution that mobilised students for the Pilot and supported the practical work, started in July 2020 with the presentation of the project to a representative of ISEP. After this initial contact, in total 4 professors with the PhDs in the fields of IT and industrial engineering joined the project. These professors did not have previous experience with issues addressed in the DIHUB project (AWS and Cloud-based technologies) but they are familiar with the mechanisms of cooperation with companies, organising internships for students and participation in international projects.

The lead partners provided professors with promotional materials to use in the process of engaging students. ISEP's professors promoted the project activities in their classes as well as at ISEP's Moodle platform. A total of 19 students registered in the AWS course (of which 4 were Professors from ISEP) and 13 in the Advanced AI course (of which 4 were Professors from ISEP). The 4 professors plus 3 of the students registered in both courses. Among these, 6 students concluded with success (approval with 5/5) the AWS course and 7 students concluded with success the Advanced AI course. The technical infrastructure was the one provided by Haaga Helia (it was not chosen by PT partners but provided by the WP3 leader).

Students' main motivation to participate in the project seems to have been the possibility to attend the AWS and AI courses offered by Haaga Helia, as this training is not provided by ISEP and, especially in the case of AWS, attending the training is a great advancement towards obtaining certification. It seems as the professors shared the same motivation as students since they also attended the courses provided by Haaga Helia. When students finished the DIHUB training, they were already engaged in other academic affairs or had previously committed to collaborating with other companies. Thus, only one student continued to the practical part of the Pilot.

The educational partner has its education curricula and invited students from the fields of industrial engineering and Informatics to attend the cloud and AI courses as complementary training so there was no additional training for the project's purpose. In terms of the skills of students, there was no previous assessment of skills. During the monitoring process with the participating student, further needs may be identified based on the experience.

When addressing the recruitment of SMEs, lead partners shared the survey for companies through their communication channels and received 25 submitted responses of which most were SMEs. Half of them were from the consulting and ICT sectors and around 96% were already aware of cloud services. Yet, majority was not aware of AI applications and not planning to adopt them.

This survey allowed the identification of those companies with more potential to host the practical component of the training program. Companies were then individually contacted by e-mail, phone, or video-conferencing to define concrete work proposals that were specified following a template using in ISEP from proposing MSc research works. Companies offered the project ideas in the frame of the needs assessment questionnaire, I.e. Companies were asked to describe one or more challenges in their organisations that could be addressed using Cloud-based technologies and/or AI.

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As explained earlier, there was a higher motivation from students' part to engage in the training component rather than in the collaboration with companies since there is a high demand for ICT and industrial management students in the labour market. For that reason, the practical work of collaboration between SMEs and students will be implemented in Pilot 2 and therefore the Pilot cannot be considered fully complete as there are no concrete inputs to the curriculum.

For the second Pilot, lead partners plan to organise sessions with pitches where SMEs will present their challenges/projects to students. Students will then choose the project they find more suitable for them and they will be organised into teams of 2 or 3. Students will begin the project by framing the challenge with the theoretical background (based on a template provided by ISEP). The real process of making the knowledge operative should last for around 6 months with support from ISEP Professors. Since the alignment of the project activities with students' schedules as well as their engagement in other projects was a challenge during Pilot 1, that will be taken into consideration during the organisation of Pilot 2.

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3. Conclusions for Year One

Pilot 1 has been a great success for all the project partners, even though all the partners faced some issues which were emphasized by the epidemic situation. All of the participants in each project of every partner country gave mostly positive feedback. This was a great experience for professors and students, as well as for the SMEs.

Even though the conduction of Pilot 1 was very time-consuming for both, professors and students, professors were very satisfied with the results, they appreciated the chance to be a part of the project and also deepen their knowledge of cloud-based technologies. This was also a great opportunity for all the students to gain additional relevant knowledge through the courses, but equally important, they had a chance to apply their knowledge in practice by working with the SMEs. SMEs recognised the value of participating in the project as this helped them to gain a greater competitive advantage.

The overall impression is that the Bulgarian and Portuguese students had a special interest since these types of lessons are not available in their countries and Haaga-Helia's lectures were a significant motivator for participation. Bulgarian partners also achieved great success since the Cloud Technology course was introduced into the formal curricula of the SoftUni. They did face some drawbacks as well. The Covid situation has shown itself as a significant obstacle, especially for the Bulgarian partners who, because of the lockdown in Bulgaria and Romania, faced a hard time recruiting SMEs since most of them did not know if they were continuing with their business. An additional problem was the lack of expert professors in the field of cloud-based technologies.

For Croatian partners, the DIHUB project crystallised some possibilities for further improvement of the educational programs at VUA and their harmonization with the needs of the labour market. some existing learning outcomes need to be redefined to meet relevant labour-market needs.
Estonian partners also had issues in motivating SMEs to join the Pilot due to the Covid situation, therefore all of the SMEs were personal contacts from participating teachers and BCS experts.

Profile of students who participated in the Pilot 1 of the DIHUB Project per partner country

Country	Student's Age (yrs.)	EQF Level	Level of Experience
Estonia	18-25	4	No previous experience
Finland	18-40	4-6	No previous experience
Portugal	20-20	4-7	N/A
Bulgaria	16-43	3-5	No previous experience
Croatia	17-28	4 and 6	Some experience

Despite challenges, students from all the partner countries were very successful in delivering their cases and new solutions to SMEs businesses. However, Portuguese and Finnish partners did face some challenges. As stated by Portuguese lead partners, they do not consider the first Pilot as fully successful, since there was not adequate planning or guidelines for the Pilot at the consortium level, so they tried to fit the activities with the calendar of training provided by Haaga Helia. As a consequence, students and teachers from ISEP were not engaged in the Pilot well in advance and they were not able, except one student, to follow up with the practical activities. This is considered the biggest challenge on their part. On the other hand, Finish partners from the HBC had some issues in the beginning, due to the Covid and the summer vacations, the first group of students fall apart, and the second group had to be formed. Also, there were some challenges with communication between students and professors, which resulted in one case not being fully realised.

Considering the curricula, most of the partners developed specific trainings and programs for students. The planned curricula have shown as a success as they mostly covered the field of cloud-based technologies and satisfied the needs of students. However, during the Pilot 1, most countries noted a necessity for some adaptions with additional classes covering new topics.

All the partners have taken obstacles into the consideration for planning activities for Pilot 2, as well as the students' inputs. Further improvements of the curricula and the entire process are being planned and it is believed that this will contribute to the realisation of outstanding results in Pilot 2.

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4. Implementation Activities – Year Two

The content of the report is based on the results of three surveys developed by partners participating in Pilot 2 from Finland, Portugal, Bulgaria, Estonia, and Croatia. The questionnaires were distributed to three target groups that effectively participated in the project – teachers, students, and SMEs. The purpose of this report segment is to gather information on the success of Year Two implementation activities of the project DIGITAL INNOVATION HUB FOR CLOUD SERVICES (DIHUB). In Year Two, partners performed Pilot 2: it consisted of involving students with different levels of technological development in the use of cloud-based solutions to solve specific but real problems in SMEs. The whole process was supervised by teachers/mentors. At the same time, Pilot 2 was used to review the changes to the educational programs that were a consequence of Pilot 1 and the report based on it. The report based on Pilot 1 shows which elements need to be improved and which need to be changed or modified.

The actions taken under Pilot 2 addressed the assumptions contained in WP 4 and were based on the implementation of a hub pilot in each of the partner countries. As in the case of Pilot 1, the pilot program consisted of two phases:

1. a course in which the curricula and teaching materials modified on the basis of Pilot 1 were tested. They were presented to selected students by teachers involved in the project and formed the basis for acquiring knowledge about cloud solutions.
2. implementation of solutions, where students develop problem-solving skills for specific business cases of selected SMEs based on the previously acquired knowledge and provide them with cloud solutions.

Pilot 2 was designed to:

1. test the mechanism for connecting VET students with SMEs in solving real SME problems by implementing cloud-based services and services.
2. testing the readiness of VET and SMEs to collaborate in the field of cloud-based services.

On the other hand, within this activity it was expected that:

1. students will acquire adequate knowledge of cloud services.
2. students will develop adequate market knowledge that will enable them to apply the acquired knowledge in practice.
3. students will gain practical experience by solving real business problems.
4. SMEs will increase their competitive advantage by using cloud-based technologies in their daily business activities.
5. SMEs will gain modern tools to solve everyday problems.
6. in addition, students will increase their competitiveness in the labor market.

The pilot program, which had to be organized in each of the partner countries, aimed to implement development projects by both educational institutions and SMEs. Educational institutions modified Pilot 1 curricula at EQF levels 4-6 / 7 for the pilot program to provide students with additional cloud-related knowledge and enable them to deliver high-quality cloud solutions to SMEs. These programs were either integrated into existing curricula or a new VET training program was created. This report includes feedback from participants: students, teachers and SMEs on the satisfaction and success of Pilot 2 in the above countries. The report is thus one of the outputs of WP5.

The Pilot 2 was for all project partners the perfect complement to the already existing knowledge. According to the pilot participants who took part in it, professors and students as well as the SMEs, the project is very rational and well thought out, and the results of the pilot are overwhelmingly positive. Although all partners faced different challenges in implementing the pilot program, they managed to complete it fully. The DIHUB project is seen by all students as an excellent opportunity to gain or enhance additional practical skills. Most importantly, they had the opportunity to work on practical business examples by collaborating with SMEs. However, the DIHUB project not only benefits the students, but also the SMEs, which have gained a new competitive advantage by using the cloud-based technologies introduced by the project.

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Number of students, teachers and SMEs active in year two

Country	No. of Students who Participated in Projects with SMEs	No. of Professors Working on Pilot 2	No. of SME cases Working on Pilot 2
Estonia	15	4	4
Finland HBC	7	3	2
Finland Haaga- Helia	42	5	2
Portugal	2	12	8
Bulgaria	15	2	5
Croatia	65	23	8

In order to present the results of Pilot 2, the WP 5 leader Algebra University College sent questionnaires (questions in the attachments) to the partners to be completed by the students, teachers and SMEs participating in the pilot.

Profile of students who participated in the Pilot 2 of the DIHUB Project per partner country

Country	Student's Age (yrs.)	EQF Level	Level of Experience
Estonia	15-25	4	Some experience
Finland	20-55	4-6	Some experience
Portugal	22-25	4-5	NA
Bulgaria	NA	3-5	NA
Croatia	20-30	6	A varied experience

In the following text we present experiences project partners had during Year Two of the project.

4.1. Bulgaria

4.1.1. Introduction

The Pilot 2 of the DIHUB project was conducted by the Bulgarian partner of the University of Forestry in Sofia. Two teachers participated in Pilot 2. The implementation was technically supported by K&C. Teachers managed to involve 8 secondary school students and 7 university students who formed three student teams. The secondary school where the students participated in the project is a private UniSoft educational institution specializing in the education of ITC students. In Bulgaria, this level of education corresponds to EQF3. The students who participated in Pilot 2 attend the University of Forestry and are at the EQF4 and EQF5 level, and the topics covered during the pilot are completely new to them.

4.1.2. Teacher feedback

To motivate students to participate in the project, educators worked closely together to implement the pilot. Their positive energy and commitment were reflected in the number of students who participated in the implementation of the project tasks. It can be concluded that the students' participation in the project was an opportunity for them to expand their knowledge and develop new skills in an area close to their future education. According to educators, the biggest motivation for students to participate in the project was that it was a new and rapidly evolving topic with great potential for implementation in many areas. Both high school and university students worked on team projects, and the ideas were born during the pilot itself. The teams, in turn, were formed based on the students' abilities.

According to the educators, the most motivating thing that encouraged them to participate in the project was the natural continuation of the educational path and the vision for the future. However, it turned out that personal considerations played an important role. Educators pointed out that the students' positive reaction to participating in the project also became motivation for the work. According to the educators, the project saved money and time, and most importantly, it became an example for others. In their opinion, it was the students who provided the impetus for the implementation of this and new projects and were the greatest source of motivation.

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To implement the project tasks, drones with integrated AI Precision analytics energy/agriculture teaching software were used, connected to a local virtual server via a server in the cloud to process the collected data. During the project implementation, 2 student teams migrated the enterprise system IT to the cloud. The teams were also tasked with designing drones to perform specific tasks. Educators assessed that the two prepared drone projects are very interesting and have not only a great economic but also civil effect. The first project is related to the observation of farmland and allows to increase yields while minimizing the labor, time and cost of surveying farmland. This drone can also be used to take pictures of crops and assess their condition. The second project is to study the role of trees in the urban environment. The basic function of trees in an urban environment is, of course, that they are a source of oxygen, but trees in the city also have other, less obvious functions – thanks to their shade they reduce excessive heating in summer, through the root system they help absorb more water and reduce the risk of flooding, they stop the chaotic movement of microscopic particles. In Sofia, as in any other city, there are many old and potentially dangerous trees, some of them also emit pollen and cause allergic reactions in more and more people. The idea implemented by one of the teams is based on the use of a pre-"trained" drone, which uses artificial intelligence to detect trees and create a map of them and prepare recommendations for government institutions. The third implemented project is one related to used spare parts, which turned out to be the easiest to implement, but with a greater (so far) economic effect for the SME partner.

All the companies invited to the project are in the SME sector. One of the SMEs was a small farm in the Burgas region. This farm, despite the fact that it is located in a region that, like many other similar areas, is depopulated and aging, has become a leading company with a wide horizon that is not afraid to innovate. In the second project, the partner was a non-governmental organization that works to protect nature and monuments in Sofia, but also to improve life in the urban environment. The last of the projects involved a small business owned by four personal friends of one of the students. The decision to work with this company was made in the context of seizing an opportunity. An extensive network of contacts and collaboration on other reforestation projects helped the educators reach out to the companies. Educators agreed that the primary motivation of the company was to be open to hiring a future manager. In the case of a non-governmental organization that works to protect nature and monuments, the motivation was and still is the mission to preserve the capital. With this type of institution, any outside help is welcome, so it is not surprising that it joined the project with great willingness and commitment. For a third partner, the main motivation was to find a solution to a complex problem related to inventory and sales. Two of the three projects implemented under Pilot 2 have been presented to the SME partners, and one project is waiting to be presented in the spring due to the need to implement it within a certain time (research on the role of trees in the urban environment). Teachers also assessed that MSE's expectations for Pilot 2 were definitely met.

For the University of Forestry, it was the first pilot project, but according to educators, the program was adjusted accordingly and the pilot was definitely a success, mainly due to the fact that it professionally enriches not only the knowledge of participating students, but also educators and allows to pursue hobbies. At the beginning of the Pilot 2 project, educators feared that they would not be able to complete all the tasks. They stressed that the distance learning format was not appropriate for this course. Another challenge was accommodating the educators to the students' free time. In their opinion, the project will have a greater impact than expected in a normal learning environment. The openness and commitment of the educators working at the University of Forestry is remarkable. They are willing and determined to further disseminate the knowledge and skills contained in the DIHUB educational materials and training programs, even to students in a non-specialized degree program. The biggest challenge for the educators was the short time to prepare and deliver Pilot 2 and the subsequent online training, "but the sparkle in the students' eyes was worth it."

4.1.3.Student feedback

In a survey addressed to students, they indicated that they were studying technical sciences. All also indicated that they could describe in detail or in general what cloud-based services are and how they can be used. After participating in the DIHUB pilot project, most of them are very interested for applying the cloud-based services in their field. They also pointed out that applying cloud-based services in their field can definitely be very useful, some of them pointed that they may be useful. Most of the students know exactly how cloud-based services can be applied in their field, the others are thinking about it, but they do not have a clear idea. All of the students found the DIHUB pilot project was very useful for acquiring a new set knowledge and skills, while the other half found it useful. Students also unanimously agreed that cloud-based services can increase business efficiency. Altogether also agreed that using cloud-based services can assure better organization of business processes. All of the participants indicated that their knowledge of applying cloud services had improved to a greatly. Half of the students indicated that the educational materials used in the project were useful and of high quality, while the other half indicated that they were too detailed. All of the students said that lecturers of the pilot managed to engage them for applying cloud services in their field of expertise all extent. Altogether are

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interested in cloud services and would like to participate in a learning program related to it in the future. Almost all already developed an idea for the application of cloud-based services during the pilot study, that were unrelated to do with the case solving during the pilot study. Some are encouraged to deliberate about how cloud-based services can be applying in the future.

4.1.4.SME feedback

5 companies from Bulgaria participated in Pilot 2 of the DIHUB project, they were: NGO "Save Sofia", Automarket Ltd, Municipal Motor Transport Company Ruse, Agricultural cooperative of the village of Krushevo, Burgas region and Elleya Ltd. The activity profile and thus the problems solved by the students differed significantly. Below are the assessments of the individual companies involved in the implementation of Pilot 2.

1. The non-governmental organization **Save Sofia** has been working for 10 years to green and preserve the historical heritage of Bulgaria's capital, Sofia. The NGO team knew the seriousness of the problem with old trees and had a preliminary idea for a possible solution, but did not know how to technically implement it. The idea of using a pre-trained AI drone to recognize and map trees was the best possible and environmentally friendly way to solve the problem. In implementing this idea, the organization received the necessary support from students involved in the implementation of Pilot 2. SME considers the cooperation with the University of Forestry to be very successful. Especially because the students and their tutor found a way to solve the problem of identifying the most polluted spaces in Sofia. They also helped with the visualization and the problem and found a way to solve it. An extremely positive aspect of Pilot 2 is the fact that the employees of Safe Sofia, initially skeptical about solutions based on artificial intelligence, found out how helpful it can be to use it in the implementation of specific activities and projects. They are also convinced that both entrepreneurs and educational institutions can derive mutual benefits from joint development projects. They also pointed to the fact that the project's goals have been achieved and they hope for further cooperation with students after the end of Pilot 2, and also as part of other educational projects. The institution is very satisfied with the work of the students and the support of their mentor. "It's good to know that there are innovative and business-minded young people in Bulgaria."
2. **Automarket Ltd**, whose goal is to grow and increase profits, decided used a complete inventory of available used parts with the possibility of a quick check based on a barcode system to reduce theft, and real-time delivery without duplicate a quick search and shipping. Together with the students, it analyzed the possible options to achieve the adopted objectives and chose the barcode inventory system. This system contains the maximum amount of information for each part. This part of the project (the addition of the information) proved to be the most time-consuming and is a process that is still ongoing as the company continues to add more new parts to its offering. Above all, the implemented solution enabled a more effective use of the employees' working time. Thanks to the training, Automarket Ltd employees have learned to work with computers, resulting in faster order processing in less time. The introduction of the barcode system also made it possible to obtain information about the quantity, type and value of parts owned by Automarket Ltd. The jointly developed model can be used in many industries, including supermarkets. A pre-built software solution based on the cloud was used for Automarket Ltd.'s needs. Pilot 2's key successes include:

    a. the introduction of more than 200,000 spare parts into the system, i.e. about 10,000 items per week,
    b. the introduction of a mixed contact form (e-mail and telephone), thanks to which the number of orders received by e-mail doubled compared to the same period last year.

The goals of the project are almost achieved, the only thing missing is the completion of the inventory, which, as mentioned above, is extremely time consuming. During the project, students have provided extremely useful feedback on the implemented solutions, and in the final phase, very good IT solutions.

3. One of the biggest problems with **Municipal Motor Transport Company Ruse** is the fact that the current bus lanes are often unusable due to the cars parked there, which slows down the movement of public transport or forces them to use the regular lanes where traffic is regulated by traffic lights, making the services even more difficult. Intelligent traffic management using smart traffic lights with video surveillance systems would help in registering violators and imposing fees, and consequently reduce the cases of blocking bus lanes by cars. The collaboration with the students of the DIHUB project has become a solution to this problem. In addition, Pilot 2 helped to look at the problem from a different perspective - "a smart solution to improve the quality of public transport in Ruse" and promote urban transport to residents to reduce the use of private vehicles. "The success of the partnership in this joint project means improving the quality of life in many ways, from reducing

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congestion-related gas emissions to creating more free time for social activities to encouraging more physical activity." Interacting with young people was both challenging and interesting for the company. However, the Municipal Motor Transport Company Ruse problems pointed out that a political initiative by the city authorities is needed to fully implement this project. However, they point out that other Bulgarian transport companies could also benefit from artificial intelligence and cloud-based services. The company recommends enlisting the help of college students who are capable of analyzing problems and making appropriate IT proposals, as well as demonstrating them in practice. "And chambers of commerce and industry can be the link between business and academia." The goals of the project were achieved at the stage of analyzing the existing problem and proposing a practical solution. The decision on whether to introduce smart traffic lights in the near future rests with city authorities. The company emphasized that it was difficult to work with students in an online environment. However, they understood their task very well and coped with the fact that they could not hold live meetings and discuss the different phases of the project.

4. The **Agricultural cooperative of the village of Krushevo, Burgas region** produces and trades agricultural products and is one of the most important grain producers in Bulgaria. The cultivated area is 14,000 hectares and it is not easy for the farmers to walk around the field and check it for diseases, drought and harvest. The farmers needed an AI-based precision solution to tackle the crop monitoring problem. The students' proposed use of drones to monitor crops helped increase yields and minimized the labor, time, and cost of crossing the field on foot or by vehicle. Thanks to the students' support, it was possible to transform the farm into one equipped with the latest technological solutions, which now uses precision farming databases and GPS analysis to increase yields and revenues. The first phase of the collaboration consisted of taking precise elevation measurements with the entire infrastructure. The areas captured and measured by the drone were compared to cadastral resources. With the help of artificial intelligence, the drone was trained to recognize different plants from the air, as well as the stages of their development. All these activities contributed to the acquisition of knowledge and skills in the field of the possibilities of using drones in agriculture. The investment in the drone and software paid off with this difference in just one season. The company pointed out that other growers could also benefit from the cloud-based services, as aerial imagery is key to examining plant systems and taking potential corrective action quickly. The company also pointed out that the project's goals had been met. It pointed out that there is one significant numerical result, plant honey production, which has increased by 75%. "Another effect is that poaching and theft have decreased significantly thanks to the remarkable flight of the drones."
5. The last company to work with Pilot 2 was **Elleya Ltd**, which is a project management and business development consulting firm based in Ruse, Bulgaria. The main obstacles were the problems that could occur during the transition to the cloud and the possible consequences. Project collaboration focused mainly on online consulting. The company, like most companies, has some concerns about AI and cloud services, as not all questions were answered as expected. The company stresses that "in Bulgaria there is still a need for active dialogue between state institutions, academia, business and the public" and the signing of an agreement that says Bulgaria will invest BGN 170 million in the first of its kind in Eastern Europe INSAIT Institute of Computer Science, Artificial Intelligence and Technology. Company points out that the best thing that can happen is the exchange of knowledge in the field of artificial intelligence and cloud services that will help companies solve their problems. The company also arguments that the goals have been fully achieved, as they now have a solid starting point to find a viable solution. It also pointed out that in recent years Bulgaria has created relatively well-qualified personnel with development potential at domestic universities.

Overall, the SMEs that participated in Pilot 2 in Bulgaria are very satisfied with the project results. They have all benefited from the students' help in solving everyday problems. For some, artificial intelligence and cloud solutions, which were once abstractions, have now become commonplace, without them they cannot imagine proceeding further. The opinions of the companies about the students and the program itself are very positive, and the solutions developed will serve as an example of good practice for other companies, universities, and anyone interested in modern technologies.

4.2. Croatia

4.2.1. Introduction

As in the case of Pilot 1, the coordinator in Croatia this time was Algebra University College. 65 students aged 20 to 30, EQF level 6 (studying for EQF 7), participated in the project. Their knowledge and experience with cloud solutions varied widely, ranging from a very basic understanding of cloud-based products and

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communication cloud-based solutions to a very complex understanding and ability to create cloud-based AI products.

4.2.2. Teacher feedback

This time, thanks to the success of Pilot 1, it was possible to engage up to 23 teachers who spent a lot of energy motivating students to participate in the project. Since Pilot 1 was heavily promoted to AUC students, all students continuing their studies had the necessary information. In addition, AUC organized additional workshops and presentations for new students who had begun their studies in the previous year. An important motivating element was teaching the faculty about the project and its benefits during regular school hours, which helped to gain more institutional support. With the coronavirus slowly subsiding, it was also possible to organize personal presentations and face-to-face meetings between SMEs and students and teachers, all organized by the Career Center. These meetings also helped to create a more motivated atmosphere and a sense of belonging to the project team. In addition, AUC introduced the DIHUB internship as a form of fully recognized college internship, which also helped to increase the visibility of the project. Faculty cited three main sources of motivation:

1. Acquisition of knowledge and skills related to cloud-based solutions. In this case, the main challenge was the proper selection of the team by the mentors, as well as the appropriate assignment of tasks, since the students participated in the project with different levels of knowledge about cloud solutions.
2. Gaining experience working in international projects. Students were given the opportunity to present their work at DIHUB student webinars and share all relevant information about other student projects in other DIHUB countries.
3. High-quality internships. AUC has made sure that students choose business cases that are really exciting, where they can learn a lot, but that they also enjoy. Business cases with simple or standard business problems were intentionally not selected because "students were clearly interested in working on new products and services that could be cloud-based in their implementation."

Students worked on team projects and the team building process was fully coordinated by mentors. The courses started by discussing the problems SMEs face in their daily business practice and students expressed their interest in a specific industry (tourism, insurance, education, etc.) or a specific part of the business process (product development, sales, marketing, etc.) or both. Based on their intrinsic motivation, the mentors set out to assemble the teams. They brought together students from different backgrounds (data science, software engineering, systems engineering, etc.) into teams that worked on topics they shared a passion for. The project ideas were the result of student brainstorming, which was closely linked to SME discussions and experience sharing. It should be mentioned that some students decided to work on team projects outside the DIHUB phase and continue them in the form of Master of Arts or Master of Science degrees. In their projects, students used tools such as: Microsoft Azure, Tableau, Google Cloud. According to the teachers, the best of all projects is:

1. PROJECT 1: MEDICRO platform - Reasons for visiting some country are not always related to holiday or business trip. Since many countries' health institutions have developed their medical services, people often decide to undergo an operation or a medical procedure in some other country. Their reasons vary from seeking high quality service to gaining good value for money, but one thing is common to all of them – they have to plan, organize and book their trip and medical procedures. This is the moment where challenges occur, especially if countries do not have some kind of platform where patients can find all relevant information.

Students from Algebra University College in Croatia recognized this as an opportunity for developing their own solution – unique platform MediCro for searching, booking and reviewing medical procedures in Croatia. Additionally, patients could find and book other necessary services with the help of the platform, such as transport and accommodation.

The students are working in an interdisciplinary team. The team consists of seven members that are skilled in different fields – software engineering, digital marketing and data science. Team members pointed out that their solution would provide numerous reliable information to potential patients interested in undergoing medical procedures in Croatia. Users of the platform could search for available medical procedures and filter search results based on treatment type, price, location and desired date. Furthermore, the platform would allow individual consultations with medical professionals prior to treatment in order to give patients the opportunity to discuss their medical situation with a specialist.

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Since it would be possible to book a treatment in different cities, and the users of the platform would often be from abroad, the team members are trying to enable users to book their transport and accommodation using the MediCro platform. This way platform would provide a lot of comprehensive information in one place. Students try to develop a MediCro platform as a simple, comprehensive and reliable solution.

2. PROJECT 2: PERSONALISED INSURANCE - The students are working in an interdisciplinary team called T-5. Team members point out that existing health insurances do not consider policyholders' different lifestyles and possible risks to which people expose themselves. Thus, people who nurture a healthy lifestyle pay for the insurance as much as the ones who do not pay attention to their life habits, live carelessly, or take risks. As a result, policyholders with quality and healthy habits often think that they are paying for a service they are unlikely to take full advantage of, which they find unfair and unnecessary.

This is why Algebra's graduate students started to develop a new web and mobile application that would enable users to choose personalized health insurance according to their lifestyle. Their team, T-5, consists of seven members that are skilled in different fields – software engineering, digital marketing, and data science. According to the team's plan, the application would collect data on users' daily activities and behaviors. Data collecting would be enabled by smart bracelets and smartwatch technology. Thus, the application would calculate and propose personalized health insurance based on the user's behavior. The prices of the insurance itself would be based on the policyholders' lifestyles. Those who exercise regularly, eat healthily and do not consume harmful substances would pay less for the health insurance than those who do not engage in physical activities and have poor eating and living habits.

Young, physically active individuals who are aware of the importance of a healthy lifestyle could benefit from using the app. Additionally, very young people who do not have any health problems would also find it very useful to use this app, since they do not want to spend a lot of money on health insurance. Contrary to the expectations, the application could also be useful for the elderly, because they are very careful and do not take many risks, so they often want to pay the health insurance as little as possible. The teams are also working on the application development to collaborate with the insurance companies.

Students had an opportunity to pitch their project to SMEs, but also to the wider business community. The DIHUB project is a project of great importance to Algebra University College, and this was the main reason that motivated teachers to participate. The topic of cloud-based solutions has been recognized as one of the most important issues in the development of the industry IT in general. All smart solutions for the present and the future depend on broader adoption of the cloud – there will be no smart cities or anything else smart unless we get more and more people to understand the importance and potential of the cloud. Algebra University College has therefore taken critical steps to raise awareness of the importance of the cloud at all levels: SME, private and public sectors. Algebra teachers feel that their expectations of the pilot project were met. They made new contacts with the business world and helped students develop quite sophisticated cloud-based solutions. The students, in turn, seemed pleased with this new experience.

The Croatian Employers' Association (CEA) was responsible for implementing Pilot 1 involving SMEs. As this solution proved to be successful, it was also used in the implementation of Pilot 2. The CEA promoted the project to its members, particularly in the SME sector. Introductory meetings were organized with SMEs and students to bring them together. When COVID -19 subsiding, F2F meetings were organized. The interest of the Ministry of Finance exceeded our expectations and SMEs from the following sectors were selected to implement Pilot 2: Education, Tourism, Medical and Insurance. According to the teachers, the SMEs that participated in the pilot needed help in moving to the cloud. They also needed better access to student employees, as they compete in the job market with very attractive large companies (and competition for highly qualified IT students is fierce). Algebra University College allowed MSP to meet the students in person. It showed students what projects and issues they would face if they chose a career in the SME sector. Feedback from the teachers showed that the SMEs involved in the pilot project were also very satisfied with the final results. Some of them will be able to immediately implement the solutions they worked on together into their business practices. Others used the DIHUB pilot as a learning opportunity - they learned about the possibilities that cloud-based solutions open up for their business, and also learned how to collaborate with students (they had no such experience before).

According to the teachers, Pilot 2 was a success. Student teams developed 6 prototypes for 6 different problems faced by SMEs that could be easily put into practice. Some students continued to work on the projects for their senior theses, making them even more challenging. In addition, the SMEs made contacts with the students and the students had the opportunity to contribute to the development of the SMEs. The

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most difficult part was matching the needs of the SMEs with the interests and knowledge level of the students. The very basic problems of SMEs are not interesting to students who had to solve much more complex problems during their studies. AUC therefore had to match the motivation level of the students with the actual projects of the SMEs. This took a lot of time and required negotiation skills on the part of the faculty. In the end, the most satisfying aspect is to see that the learning path of our students is much broader than expected, but also to see how confident they are in presenting their projects and solutions to the broader business community. One team managed to raise VC funding for their solution and start their own small business that will eventually bring their product to market. This made their mentors very proud. The teachers also suggested that it would be good if (in the future) there was an even greater opportunity to share good practices abroad.

4.2.3.Student feedback

In a survey addressed to students, they indicated that they were studying technical sciences. Only one student is studying arts. All also indicated that they could describe in detail or in general what cloud-based services are and how they can be used. After participating in the DIHUB pilot project, most of them are very interested for applying the cloud-based services in their field. They also pointed out that applying cloud-based services in their field can definitely be very useful, one of them pointed that they may be useful. Almost all of the students know exactly how cloud-based services can be applied in their field. Only one was thinking about it, but do not have a clear idea. All of the students found the DIHUB pilot project was very useful for acquiring a new set knowledge and skills, while the other half found it useful. Students also unanimously agreed that cloud-based services can increase business efficiency. Altogether also agreed that using cloud-based services can assure better organization of business processes. All of the participants indicated that their knowledge of applying cloud services had improved. Most of the students indicated that the educational materials used in the project were useful and of high quality, while the other indicated that they were too detailed. All of the students said that lecturers of the pilot managed to engage them for applying cloud services in their field of expertise all extent. Altogether are interested in cloud services and would like to participate in a learning programme related to it in the future. Almost all already developed an idea for the application of cloud-based services during the pilot study, that were unrelated to do with the case solving during the pilot study. One of the students recognize the value of applying cloud-based services but do not have an idea how to do it.

4.2.4.SME feedback

Under Pilot 2 in Croatia, 8 business cases were completed. The SMEs participating in the project were inspired by the students' ideas and were given the opportunity to deepen their knowledge about the benefits of cloud solutions for the development of their business. The SMEs also established good relationships with the teachers and students and indicated that the most important challenges were:

1. very tight schedules and a lot of regular work. This meant that establishing cooperation with a VET provider was an additional burden in terms of the organization of their permanent work. At the same time, they did not have the opportunity to hire an additional person to work with Algebra University College, and the VET provider was not able to deal with some issues on its own. It took a while for SMEs to figure out how to balance their regular work with collaborating with an educational institution.
2. low and medium level of existing knowledge in SMEs about cloud solutions. The VET provider had to spend a lot of time explaining to them all the possibilities that would open up through the use of cloud tools.

The SMEs involved in the project described the collaboration as very successful. Everyone was impressed by the level of the students' presentations. It is worth mentioning that one team of students received financial support for further work on their project. They were also satisfied with the organization of the cooperation.

SMEs indicated that the DIHUB project collaboration was a very useful learning experience for them. They learned about the structure of VET 's programs and how they can be adapted to the needs of SMEs, but also learned a lot about the latest technological trends in cloud computing. In addition, they increased their knowledge about business processes and their development using the latest technologies. All SMEs strongly recommend other entrepreneurs and startups to collaborate with students on various projects. They emphasized that others could also benefit from cooperation with universities, especially because not everyone can hire expensive experts available on the market and it is impossible to start a business successfully without really good and competent people. Thanks to a very strict organization of the work process, all project goals were achieved. The SMEs indicated that a very rigorous situation analysis was conducted before each business case was accepted. Then, under the guidance of their mentors, the students thoroughly investigated the main problem faced by the SMEs in each industry. Together with the SME managers, the students formulated goals or a problem they wanted to solve as part of their work. Only after both sides had agreed on the goals did they begin their work. This allowed both sides to accurately assess expectations and helped

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eliminate ambiguities and met the project objectives. Comments on the students' presentations were very positive. The SMEs were impressed with the students' presentation skills, but also with the maturity of their thinking, the ability to relate their solutions to the carefully identified problems, and their inquisitiveness. The students showed a great willingness to learn about the SME environment in question. They studied the industries in which SMEs operate to better understand the business challenges. They brought new perspectives, and even if not all of their suggestions and solutions can be implemented, they provided very fertile ground for the further development of SMEs. There were two proposals from SMEs:

1. After selecting the companies, a test should be offered to determine the level of knowledge of employees about cloud technologies. If the knowledge level is low, they should take a course on the basics of cloud benefits, as this will speed up communication and project work with students.
2. Educational institutions should be more proactive in reaching out to SMEs in their immediate area through their advisors or information services. It is not easy for an SME to figure out how to work with an educational institution and what channels to use. They point out that it would be useful for educational institutions to organize so-called "open days" for SMEs and start-ups.

4.3. Estonia

4.3.1. Introduction

In Estonia, Pilot 2 was conducted at the Tartu Vocational College. The pilot involved 4 teachers who worked together with a group of 15 students aged 15 to 25 at EQF 4 level to implement the project tasks.

4.3.2. Teacher feedback

As activities that activate and motivate students to participate in the project, educators indicated that DIHUB projects are also end-of-study projects, as well as mentoring and coaching support for students. According to the educators, the motivation for students to participate in the project was that they generally enjoy learning new technologies. They also pointed to the opportunity to gain new experience implementing a real project for a real customer and "doing something better for companies from all over Estonia." They also pointed out that even the name "cloud technology" sounds modern and promising and is an opportunity for students to gain new experience before entering the job market. Students worked in teams of 3 based on their skills. The educators arranged the teams so that there was at least one adult student in each of them. Project ideas emerged during the pilot and were suggested in part by the educators.

According to the educators, the most motivating thing for them was the fact that they could acquire new knowledge and skills related to the use of cloud technologies and the methodology of TOY. For some of them, the most motivating thing was the opportunity to gain new experience. During the project implementation, teachers used the following technical infrastructure: center virtual machines, customer infrastructure, cloud solutions, Microsoft365, Azure, Google Workspace, VMware vSphere, Proxmox.

When performing project tasks, students worked on the development of 5 different projects. One of them included a project that involved migrating some infrastructure services to the cloud for a construction company. In the implementation, the team transferred all infrastructure work (email, chat, calendars, files) from on-premises hosting to Microsoft 365. Another project was migrating the Learning information system from printouts and Excel spreadsheets to the SaaS platform and creating an infrastructure for teamwork using Google Workspace. In another project, the team created an IT system and an LMS for a private dance school. In another project, the students developed a Bacup system for an adult education company.

The SMEs that participated in Pilot 2 were small local businesses with 15 to 30 employees, but were among the largest in their area. These companies combined local technology with the cloud in their activities. In addition, one cloud services educator was using his own business to find customers who needed this type of service. Educators estimated that SME's motivation for participating in the project was to receive an integrated system for free. They also pointed out that the students kept presenting the results of the project to the SMEs at different stages of the project. They also agreed that all the projects were successful and that the SMEs were satisfied that the students could solve real business cases.

Half of the educators said that their expectations for Pilot 2 had been met. One mentioned that the project was more suitable for full-time students because they could spend more time on it. Another added that he would divide the content related to training and internships differently, pointing out that more time is needed for theoretical training and less time for practical activities. He also considered the significantly lower earnings he

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receives while teaching at the university as a demotivating factor compared to being an expert in the field of cloud technologies. Looking back, the biggest challenge for educators was motivating students to learn something more than what was in the curriculum, finding time to work on the project, finding companies willing to collaborate, and helping to develop project ideas. There is also information that educators – specialists in the field of cloud technologies – are forced to find motivation for lower-paying jobs.

4.3.3. Student feedback

In a survey addressed to students, they indicated that they were studying technical sciences. All also indicated that they could describe in general what cloud-based services are and how they can be used. After participating in the DIHUB pilot project, most of them are very interested for applying the cloud-based services in their field. They also pointed out that applying cloud-based services in their field can definitely be very useful. Most of the students know exactly how cloud-based services can be applied in their field. Half of the students found the DIHUB pilot project was very useful for acquiring a new set knowledge and skills, while the other half found it useful. Students also unanimously agreed that cloud-based services can increase business efficiency. 75% of them also agreed that using cloud-based services can assure better organization of business processes. Half of the participants indicated that their knowledge of applying cloud services had improved to a greatly, while the other half indicated that it had not improved significantly. Students had a very mixed opinion of the educational materials used in the project. 75% of the students said that lecturers of the pilot managed to engage them for applying cloud services in their field of expertise some or all extent. Half of the students are interested in cloud services and would like to participate in a learning program related to it in the future. Half of the students already developed an idea for the application of cloud-based services during the pilot study, that were unrelated to do with the case solving during the pilot study. Others are encouraged to deliberate about how cloud-based services can be applying in the future.

4.3.4. SME feedback

According to the small and medium enterprises in Estonia that participated in the project, they received many benefits. One of the companies mentioned that they have received new local servers. Currently, their resources are twice as big as before the project started. During the project implementation, SMEs switched from on-premise solutions to cloud solutions, which greatly improved work efficiency by enhancing existing resources with pre-built functions in cloud solutions. SME has been working with Tartu Vocational College for a long time and it has always been a very good cooperation, and the internship supervisor is always very helpful. The SMEs have also had a very good experience with this and future projects. They hope to collaborate on future projects, including the continuation of the DIHUB project. The biggest adversary in the implementation of the project was time, which is unfortunately limited. SME indicated that the project would be easier to coordinate if it were broken into shorter time periods. Finally, they indicated that the project was a great experience for both the company and the students. The companies gained "great new tools, services, servers, and configurations, and the students gained great experience."

4.4. Finland

4.4.1. Introduction

Two Finnish partners participated in the implementation of Pilot 2 - Haaga-Helia University of Applied Sciences and Business College Helsinki. A total of five educators and 42 students aged 20-55 (most aged 22-35) with EQF levels 4-6 participated in the pilot. Some of them had previous experience with similar initiatives, while others had no experience.

4.4.2. Teacher feedback

Motivation of the students by the teachers was mainly done by providing information about the DIHUB project and related courses, but also by introducing them to the DIHUB community and encouraging them to join. Thanks to the pilot project, students were able to connect with companies, which allowed them to have intern or find a job in these companies and became an additional motivating factor. One of the educators stated that the students were interested in "cloud technologies and artificial intelligence, so they were very happy to participate in the courses conducted by DIHUB and thus joined the DIHUB network." According to educators, the biggest motivation for students to participate in the project was the opportunity to research cloud services and learn more about technological solutions and how to use and manage them. Students were also motivated by the opportunity to interact with participating companies, educational institutions, and other entities to gain insight into cloud services and their use in practice and on a larger scale. Teachers also pointed out that students had the opportunity to gain knowledge and skills that are in demand in the job market. At Haaga-Helia College, students worked partly independently and partly in teams. The teams were formed on the basis of joint decisions preceded by appropriate discussion. In the case of Business College Helsinki, students realized their projects in teams. The teachers facilitated the formation of teams, and the project idea was given

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to the students by the company or the teacher. The following infrastructure was used to implement the projects: AWS (Amazon Web Services), Microsoft 365, Moodle, and IBM Cloud.

The following were created as part of the projects implemented by the students at the College of Haaga-Helia:

- → A course design that asked participants to create a problem-solving database to address course assignments and activities. The problem-solving database described problem situations and what information was needed to solve the problem and how to solve the problem. There were a total of 19 tasks or activities to report on.
- → Chatbot using IBM cloud. An AI project using the Google Colab environment.

As part of the project conducted by students from Business College Helsinki:

- → Microsoft 365 was implemented.
- → A solution for managing contacts and services in HR companies was developed, including the creation of chatbots.

Some students presented their projects to companies. Haaga-Helia University engaged two companies that provide IT services for a pilot project. One of them is in the field of cloud services, the other offers digital services in the field of hotel management. A representative from one of the companies gave two guest presentations. Business College Helsinki involved in the implementation of the project (through the individuals and students participating in the DIHUB project) small companies from different industries, employing 3 to 5 people. According to the teachers, the motivation of the SMEs to participate in the project included informing the students about employment opportunities and recruiting qualified workers, providing information about the company, and increasing brand awareness. One of the factors that affected the motivation of SMEs was the need to strictly adhere to the company's schedules, which created problems in conducting project groups.
The factors that motivated most of the educators to participate in the project were: interest in the subject, especially in the development of cloud services, as well as the opportunity for personal development and the possibility of establishing contacts and business collaboration. They indicated that they felt Pilot 2 was successful, primarily due to the fact that some students found employment shortly after completing the course and "students achieved distinctive results and many things were solved", despite obstacles encountered along the way. Educators also indicated that the pilot project met their expectations, primarily because they were able to obtain new information for course delivery and establish collaborations with businesses. This, in turn, provides a broader picture of the knowledge required and how to adapt it to the different needs of companies. One of the educators indicated that Pilot 2 was more challenging than Pilot 1. The educators also stated that the expectations of the companies that cooperated in the project implementation were met and the companies enthusiastically supported the students' and educators' efforts and companies were and still are willing to cooperate. However, the Business College Helsinki educators pointed out that in two cases the project did not have a clear goal or outcome to be achieved. These were more advanced projects that will continue to develop after the DIHUB project ends.

In retrospect, teachers said the biggest challenge was implementing the learning environment, the enormous amount of time required to develop and test the new technology throughout the course, and the limited time to achieve results. The greatest satisfaction was learning in an implemented functional learning environment and collaborating with businesses, as well as feeling that not only had the instructor learned, but also that the students had acquired appropriate new skills. In addition, one of the most satisfying factors was that the students were very motivated and noticed during the project that they were developing both their technical skills and very important soft skills. It is also worth mentioning that there is a Drone Hobby Center in Hagga-Helia Uniwercity, and with K&C they managed to find suitable partners whose activities are very similar to those of Centum. The educators noted that both they and their partners gained a lot of new knowledge during the implementation of the projects and are looking forward to the results of the reforestation project in Helsinki.

4.4.3.Student feedback

In a survey addressed to students, they indicated that they were studying technical sciences. All also indicated that they could describe in general or in detail what cloud-based services are and how they can be used. After participating in the DIHUB pilot project, most of them are interested for applying the cloud-based services in their field, half of them are very interested. Half of them also pointed out that applying cloud-based services can definitely be very useful in their field, but the other half said that they may be useful or they are not sure if cloud-based services would be useful in their field. Only 25% of students know exactly how cloud-based services can be applied in their field, the others were thinking about it, but they do not have a clear idea. Almost all of the students found the DIHUB pilot project was useful ore very useful for acquiring a new set knowledge

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and skills. Students also unanimously agreed that cloud-based services can increase business efficiency. 75% of them also agreed that using cloud-based services can assure better organization of business processes. Half of the participants indicated that their knowledge of applying cloud services had improved to a greatly, while the other half indicated that it had not improved significantly. Half of the students found the educational materials useful and of high quality. For the rest, they were useful, but too detailed. All of the students said that lecturers of the pilot managed to engage them for applying cloud services in their field of expertise some or all extent. Just 25% of the students are interested in cloud services and would like to participate in a learning programme related to it in the future. The others are interested but not sure if they would like to participate in the learning programme related to it in the future. One of the students is interested cloud-based services, but do not have intention to participate in the learning programme in the future. None of the students developed an idea for the application of cloud-based services during the pilot study, that were unrelated to do with the case solving during the pilot study. Almost all recognize the value of applying cloud-based services but do not have an idea how to do it. One student was encouraged to deliberate about ways of applying cloud-based services in the future.

4.4.4. SME feedback

As part of the project tasks, Business College Helsinki started a collaboration with Kwork Innovations, where two business cases were conducted, and with Olander, where one business case was conducted.
The companies stated the main benefits of the joint project were:

1. New ideas, a new focus on the development of interaction robot software. Mapping and insight into use cases in the school environment. Requirements and ideas for robot control panel and tool design.
2. The most important communication needs from the point of view of job seekers were identified, the related security challenges were identified, and a framework for improving the efficiency of chat communication and the chatbot was obtained.
3. Visibility, functional and modern websites that serve the business in the best possible way. Exactly what has been sought since the beginning of the project.

For one of the companies, the challenge was too much choice in the tools available, which made the students' work more difficult. At the same time, it was a natural result of the need to analyze the situation and come up with different possible solutions. The second company said that the biggest challenge was to develop a compact, functional and transparent website. Both companies agreed that the collaboration was very good. In particular, they pointed out that:

1. the leading role of the teachers was important and good.
2. students were able to present their case well.
3. the meetings were well planned, always from the perspective of both the company and those involved in the project, which guaranteed a good result.

The companies agreed to collaborate in the continuation of this or that project. One of the companies stated that it learned a lot of good things during the implementation of the project, not only about modern technologies, but also about following a certain vision and paying attention to "different ideas and things you might not have thought of as an entrepreneur." Both entrepreneurs would also recommend a development project with an educational institution related to cloud services to other entrepreneurs. They also indicated that the goals set in the project were not only met, but exceeded in both cases. Finally, they added that the students were very enthusiastic, hardworking, and willing to work. Communication was top notch and the team spirit was amazing.

4.5. Portugal

4.5.1. Introduction

In Portugal, the off-the-job training component of the initial DIHUB Path has been mainly provided with the support of the DIHUB partner Haaga Helia University of Applied Sciences. Haaga Helia provided this opportunity already for the 1st round of pilots in Portugal since October 2020, with a total of 19 participants in the training courses and very positive feedback both from participants in the training and teachers. The activities associated with Pilot 1 in Portugal (and in the other consortium countries) are described in a report requested by the WP5 leader. However, the first pilot round has also contribute to train tutors in a partner organization (Instituto Superior de Engenharia do Porto) aiming to prepare then to be first line of support in the on-the-job training component of the pilots (with companies' participation).
To report the outcomes of the 2nd Pilot of DIHUB, the WP5 leader distributed two questionnaires among partners to be completed respectively by students and teachers participating in the pilot. However, due to the

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specificities of the pilot implementation in Portugal, the present document has been developed to provide complementary information. Thus, after this introduction, there is a summary of the activities implemented in Portugal regarding Pilot 2, followed by a brief comment to the survey for students and more detailed feedback regarding the questions included in the survey for teachers.

4.5.2. Summary of activities implemented

To successfully organise the 2nd pilot of DIHUB, the Portuguese partners took into consideration the **outcomes and lessons learned of the 1st Pilot**, namely the importance of informing students in advance about the activities' calendar and the difficulty in engaging participants in the on-the-job training in companies, especially due to three factors:

1. the education institutions themselves already provide internships, apprenticeships and other initiatives to foster interaction between students and companies, some of them providing a grant or other kind of financial compensation to students.
2. students in these fields (ICT, AI, Mechanical Engineering, etc.) are very demanded by the labour market, so it is difficult to engage them in the 100 days programme proposed by DIHUB, especially when most of them are already working in the last year of their graduate studies.
3. COVID-19 pandemic crisis has accelerated remote working and most students aimed to work from their homes, instead of engaging significantly in activities in companies' facilities required to develop important components of companies' challenges.

Thus, the Portuguese partners of DIHUB started early in 2021 to make all the arrangements for Pilot 2, namely:

1. Identify possibilities for Portuguese students to participate in the courses provided by the partner Haaga Helia;
2. Contact teachers/educators/professors of two Polytechnic Schools (Instituto Politécnico do Porto through its management, technology and engineering schools) and Escola Superior de Tecnologia e Gestão de Águeda (included in the University of Aveiro) to present the project and engage them and their students in the pilot, especially those enrolled in EQF 5 programs;
3. Contact several SME (as well as non-profit organisations) aiming at hosting students, jointly develop with them and professors several challenges to be solved during the on-the-job training component of DIHUB, as well as the recognition process to be part of their actual studies path (and achieve ECTS credits);
4. Organise information and awareness-raising sessions with students to present DIHUB opportunities and invite them to enrol in the 2nd pilot.

Next, we describe various actions performed by INOVA+ and TICE for the organisation of the 2nd pilot and the respective outcomes. Evidence of these actions are available (e.g., sent e-mails, recording of sessions, etc.).

4.5.3. Promotion and contacts among education providers and students

A. <u>Teachers/ students from ISEP (Instituto Superior de Engenharia do Porto)</u>

Besides several contacts, meetings, and e-mails exchanges with 4 Professors from ISEP (Polytechnic Institute of Engineering) who had already collaborated in the 1st Pilot, the main initiatives organised to engage students from this institution were as follows:

- **23rd June 2021**: Information/awareness-raising session organised by DIHUB partners with students from the Master of Computer Engineering. 13 participants registered in the session; there were 12 participants. Representatives from companies interested in hosting students have also participated in this session and presented themselves and their challenges to students.
- **June 2021**: Follow up e-mail with information about the Pilot, including training offer and practical challenges proposed by companies.
- **August 2021**: e-mail information for students of Pilot 1 and students participating in the awareness-raising session of June, inviting them to register in one or more of the courses offered by Haaga Helia to DIHUB students (in August and October 2021).

Besides the above-mentioned initiatives directly organised by the DIHUB Portuguese partners, the teachers of ISEP also promoted the offer of DIHUB among their students and in the online platform Moodle of ISEP.
Besides the promotion among students, there were also several meetings with the teachers from ISEP, to discuss and organise the practical part of the pilot with companies. More concretely, we explored the possibility of conciliating the DIHUB path with the academic path of students, namely with their masters' projects or with apprenticeships.

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B. Teachers from ESTGF (Escola Superior de Tecnologia e Gestão de Felgueiras)

DIHUB Portuguese partners contacted other education providers whose training offer includes or is related to cloud-based technologies and/or artificial intelligence, to expand the potential scope of impact of the project. In this context, it is also relevant to note, as explained before, that students from these fields are highly demanded in the Portuguese labour market. Thus, despite the high quality of the DIHUB path, in Portugal, it occurs that students are invited from an early stage to collaborate with companies and other organisations, often with financial rewards (grants or salaries), which made DIHUB's offer less attractive in comparison. Therefore, we tried to engage other education providers outside large cities (note that ISEP is located in Porto, the 2nd largest city in Portugal), as it is the case of the Higher Schools in Felgueiras (item B in this chapter) and Águeda (item C in this chapter), in the expectation that students from less central areas of Portugal would adhere to the initiative. We have also considered a small compensation for students able to successfully complete the full DIHUB path, sponsored by INOVA+.

Thus, in August 2021, we contacted the representatives of the ESTGF (Higher School of Technology and Management from Felgueiras) to engage their teachers and students in the second pilot.

C. Teachers/students from ESTGA

In September 2021, contacts were initiated with the Higher School of Technology and Management of Águeda (ESTGA), which has relevant training and education offer with purposeful connection to the DIHUB offer. This Polytechnic School is part of the University of Aveiro and is inserted in significantly industrial region near Aveiro, providing several EQF 5 and 6 programs related with the most relevant sectorial needs in the area. This school is already providing most of their training programs using problem-based learning/challenge-based learning approaches, with a long tradition of companies' engagement in their activities. There were meetings with teachers and representatives from the school and the relevant courses, to organise the promotion and engagement of students in the DIHUB path.

The main initiatives organised to engage students were as follows:

- **September 2021**: e-mail information for teachers and students about the DIHUB project, opportunities for students and invitation to an awareness-raising session in early October. To be noted that this information was sent not only to students and teachers at the school ESTGA but also to other two polytechnic schools belonging to the University of Aveiro: ESAN (Escola Superior Aveiro Norte) and ISCA (Escola Superior de Contabilidade e Administração).
- **7th October 2021**: Information/awareness-raising session organised by DIHUB partners with students from various courses of the three above-mentioned education institutions. There were 15 participants in the session. Representatives from companies interested in hosting students have also participated in this session and presented themselves and their challenges to students.
- **October 2021**: Follow up e-mail with information about the Pilot, including training offer and practical challenges proposed by companies. Among other information, this e-mail included an Expression of interest for potential participants in the DIHUB path to complete to provide more details about their profile and expectations for the practical part of the Pilot. 11 students completed the Expression of Interest and received additional information about how to engage in DIHUB Path. It is relevant to mention that the School year has started on October 7th.
- **January 2022**: Additional contacts with ESTGA teachers to promote the last Haaga Helia course in the frame of the DIHUB project (starting in February 2022) among Portuguese students. Information about DIHUB was sent per e-mail and through the directors of the relevant courses and a total of 12 students showed interest in DIHUB and in knowing more information. An information/awareness-raising session was organised on the 26th January 2022 but the session didn't take place due to a lack of participation from students. Additional information was sent per e-mail to students and teachers after the date of the session, giving them the possibility to Express Interest and be engaged in the DIHUB path.

4.5.4. Training offers available

Portuguese students were given the opportunity to participate in the courses made available by the DIHUB partner Haaga Helia University of Applied Sciences as part of the DIHUB path that were entirely held online and in English. In each course, there was an average of 8-10 places available for Portuguese students.

The courses offered were as follows:

AWS Cloud operations (from 23.08.2021 to 17.12.2021)

- **Target:** students already enrolled in previous AWS Academy Cloud Foundations course

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Microsoft Azure Cloud Fundamentals (from 25.10.2021 to 17.12.2021)
- **Target:** students initiating the DIHUB path

Advanced AI (from 25.10.2021 to 17.12.2021)
- **Target:** students who have completed the course Basics of AI or elsewhere acquired the same knowledge and skills

Microsoft Azure Cloud Fundamentals (from 07.02.2022 to 20.05.2022)
- **Target:** students initiating the DIHUB path

4.5.5.Contacts with SMEs and cloud-based/AI challenges proposed to students

To allow students to put into practice the cloud-related competences acquired in training under the DIHUB Path, DIHUB Portuguese partners approached the organisations that had completed the survey about the knowledge and use of cloud-based services and technologies. Among the 25 organisations who responded to the survey (mostly SMEs), 8 of them agreed to be contacted by DIHUB to explore a challenge/opportunity related to cloud services and/or AI and host one or more DIHUB students to address this challenge in the DIHUB path. Companies were individually contacted by e-mail, by phone or by videoconferencing to define concrete work proposals for the students. Some companies had more than one challenge and could host/work with more than one student, so in total there were around 12 challenges proposed to students.
We were very surprised by the interest from SMEs. Although we knew at the beginning that there was a gap in the market for workers in this sector, in practice we were not aware of the great needs of SMEs. Based on this information, we can predict that this interest will continue to grow in the future, which will give us the opportunity to carry out similar projects.

4.5.6.Main results

We undertook a variety of different activities to recruit and engage students and interacted with several educational institutions and SMEs. Despite the initial interest of students, only a few of them managed to complete the courses we proposed. Below are detail of students participation in DIHUB courses/DIHUB pathway:

1. Participation in August 2021 course:

Participation in AWS Cloud operations: There were 3 registered students from Portugal, but only 2 of them concluded the course (Tiago Dias and Tiago Fonseca). It should be noted that July and August are holiday periods in Portugal and most universities are closed or with low activity, so it was difficult to reach out students who wonted in a course that starts in August. However, we managed to involve the above-mentioned, who additionally completed the course, which is a great success for us. In addition, early July is usually exams period which made engagement difficult.

2. Participation in courses October 2021:
   - Microsoft Azure Cloud Fundamentals course, 4 students interested in attending the course, 2 from ESTGA, 1 from ESMAD, 1 from ISEP. Unfortunately, none of them completed the course for various reasons.
   - Advanced AI course, 5 students interested in attending the course, 2 from ISEP, 2 from ESTGA and one from ESMAD. Of these, the 2 students from ISEP attended the course. The other 3 eventually eventually dropped out of the course.
   -
3. Participation in course February 2022:

11 students showed interest in participating in the DIHUB pathway, unfortunately they did not enrol in the Microsoft Azure Cloud Basics course. As an additional attractiveness factor, this course included a free attempt for participants to do the certification exam by Microsoft.

Although interest in the DIHUB offering was high, several factors independent of the organisers resulted in not all courses being completed by students. In the future, care should be taken to schedule courses and advertise them early. You might also be tempted to include students from departments unrelated to the courses. The main reasons that can help explain the low participation of Portuguese students in the DIHUB pathway are the following:

- Difficulty in conciliating the DIHUB path with the school/academic pathway: Students interested to participate in the DIHUB pathway Often combine their education with participation in financially supported VET courses. hey also sometimes found it difficult to balance the DIHUB pathway with projects, exams, papers, and other assignments that students are bound to as part of their studies. DIHUB partners worked with faculty to explore the possibility of integrating part of the DIHUB pathway

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with internships, apprenticeships, or a thesis in the workplace, but these activities are often scheduled months in advance, so it was difficult to modify them to coincide with the DIHUB Part of the school calendar changed on short period of time due to restrictive measures connected to COVID-19, which made planning and adjusting project activities unstable and difficul.

- Labor market characteristics: Portuguese ITC students are highly sought after in the labor market. The educational institutions themselves already offer internships, apprenticeships, and other initiatives to integrate students into the workforce, and these activities are included in the curricula
- In addition to the above reasons, some students also had other personal motivations (e.g. need to find a job, lack of time, struggling with pandemic effects on their businesses) that made it difficult for them to engage in the DIHUB pathway.
-

Overall, the main reason for low student participation was the Covid 19 pandemic, which prevented attendance at live meetings, kept changing the school calendar, and affected many people associated with the project. It should also be noted that future DIHUB projects have a great chance of success due to their current dropout.

4.5.7. Brief comment to the student feedback

Students who have completed Pilot 2 rate it very positively. They especially appreciate the opportunity to solve real problems in SMEs. They state that both the educational materials and the project they developed have increased their knowledge and skills in cloud-based services. They also indicated that they are interested in participating in similar projects.

4.5.8. Comments to the teacher feedback

In their survey, teachers indicated that activities to activate students to participate in the DIHUB pilot program consisted mainly of disseminating information and promotional materials among students, raising awareness of the project's opportunities during class time, holding organized information and awareness events through DIHUB partners, and offering support to students who showed interest in the DIHUB pathway. The age of the students who participated in the program ranged from 22to 25 years old, and they were at EQF level 4 or 5. Unfortunately only two students participated in Pilot 2 (at least five wanted to participate but could not for various reasons). These students worked in a team and focused on the idea they proposed. Their main motivation was related to the educational component, i.e., the opportunity to receive quality training on topics that are very important to current and future jobs. The technical infrastructure provided by Haaga-Helia was used in their project.

5-7 teachers from ESTGA and ISEP were involved in the planning and initiation of the pilot program, and one teacher was present throughout the pilot program. The teachers who participated in the project were aware that the knowledge and skills taught in DIHUB are very important in the labour market, and were therefore aware of their importance for the students. Participation in the pilot was an opportunity for them to get in touch with other project activities, including the webinars for educators organized by DIHUB. Pilot 2 of the DIHUB project has met the expectations of the teachers, because despite the low interest of the students, they have noticed how much interest there is in this type of service among SMEs. This shows the direction in which universities should develop educational services and what they should focus on.

SMEs were involved mainly through the contacts originally established by DIHUB to conduct a survey on the knowledge and use of cloud-based services and technologies. Of the 25 companies that responded to the survey (mostly SMEs), half were from the consulting and ICT sectors, and about 96% were already cloud-enabled. 8 of them agreed to contact DIHUB to explore a challenge/opportunity in cloud services and/or artificial intelligence and to host one or more DIHUB students to address the challenge the DIHUB way. Companies were contacted individually via email, phone, and video conference to identify specific student challenges. Some companies had more than one challenge and could work with more than one student. Based on this, 12 challenges were created and proposed to students. The challenges were further developed in collaboration with professors to allow for alignment with educational pathways. The participating SMEs are aware of the need to implement digital transformation processes and are aware of the importance of artificial intelligence and cloud-based solutions as a key factor for their competitiveness. This knowledge was the factor that motivated the SMEs to participate in the project. The needs of SMEs in implementing cloud services proved to be enormous, and students were not able to meet them all.

Teachers pointed out that the pilot project was successful in part because of the high level of interest from them and the SMEs, and somewhat less so because of the students' interest. They also emphasized that the most difficult aspect was student involvement and the fact that companies were quite aggressive in working with educational partners.

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5. Usability of the developed training programmes

Following the DACUM analysis undertaken in WP3, project partners developed training programmes to cover all identified cloud-related skills. The following matrix identifies those training programmes and clearly demonstrates that in the course of the project, partners were able to develop training content that, taken together, successfully rounds up all cloud-related skills. The matrix shows how the DIHUB consortium together provides various educational programmes, in which DIHUB skills, described in DACUM in more detail, are delivered on three different EQF levels (EQF 4, 6 and 7), with a specific number of teaching hours (numbers in the matrix denote the number of teaching hours per DIHUB skill topic).

We believe this proves the high usability of our training programmes. At the same time, it manifests the imbalance, as the national node from Bulgaria, due to the non-existence of a VET provider, was not able to develop any content. Plus, the national node from Portugal, also due to the non-existence of a VET provider as a consortium partner, developed only a small portion of the content. This would be the most important recommendation for the continuation of the project activities: to find a strong VET provider in these two countries, so their students could benefit better from the project outputes.

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DIHUB Project partner	TART			BRCCI		BCH		INP	AUC				HHU		INP	AUC			HHU
EDU programmes / DIHUB skills mapping matrix	IT Support Specialist	Network Specialist	IT System Specialist	Cloud strategist&monetization expert	Cloud migration expert	Service Desk Specialist	Security Operations Center Specialist	Training units of the National Qualifications Catalogue	Computer Engineering	System Engineering	Digital Marketing	Multimedia	Business Information Technology Software development	Business Information Technology ICT infrastructures and cloud services	SWITCH (Software development postgraduation)	Computer Engineering	System Engineering	Digital Marketing	Information Systems Management
	EQF4								EQF6							EQF7			
DIHUB Skill#1 Virtualization	52	78	78			45	45			120				405					15
DIHUB Skill#2 Database management			78			10	10		80	80		60	270						
DIHUB Skill#3 Serverless architecture	52	52	52			45	45					20		135			30		15
DIHUB Skill#4 Security	26	26	26			25	75		85	205		60		270		120	205		270
DIHUB Skill#5 Cloud deployment (multicloud)		26	26									25	270				60		15
DIHUB Skill#6 Hybrid cloud			26														30		15
DIHUB Skill#7 DevOps		26	78											270	150	120	120		
DIHUB Skill#8 Application migration strategies	26					25	10			135		120							15
DIHUB Skill#9 Programming	130	130	130			30	20		480	225	120	315	405	405		180	45	60	
DIHUB Skill#10 AI and ML													270	270		180			270
DIHUB Skill#11 Automation	39	39	52			50	25			60							60	60	
DIHUB Skill#12 Adaptability	13								60							60	60		

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DIHUB Project partner	TART			BRCCI		BCH		INP	AUC				HHU		INP	AUC			HHU
EDU programmes / DIHUB skills mapping matrix	IT Support Specialist	Network Specialist	IT System Specialist	Cloud strategist&monetization expert	Cloud migration expert	Service Desk Specialist	Security Operations Center Specialist	Training units of the National Qualifications Catalogue	Computer Engineering	System Engineering	Digital Marketing	Multimedia	Business Information Technology Software development	Business Information Technology ICT infrastructures and cloud services	SWITCH (Software development postgraduation)	Computer Engineering	System Engineering	Digital Marketing	Information Systems Management
	EQF4								EQF6							EQF7			
DIHUB Skill#13 Performance testing	13	13	13			10	10										60		
DIHUB Skill#14 Change management	13	13	13			10	10		135	135	105	90	15	15					
DIHUB Skill#15 Scalability	13	13	13			10	10		60	60									15
DIHUB Skill#16 Migration alternatives	13	13	13			30	30		45		60								15
DIHUB Skill#17 Cloud TCO	13	13	13			15	15					20					60	20	15
DIHUB Skill#18 Cost control and cost factors			13			15	15		30	30	30	30					30	30	15
DIHUB Skill#19 CAPEX vs OPEX																	30		15
DIHUB Skill#20 Vendor selection	13	13	13			15	15		30	30		30					30	30	15
DIHUB Skill#21 Teamwork	52	26	52			75	75	75		60	60	45	135	135			30	30	270
DIHUB Skill#22 Ethics	13	13	13			32	32					30	54	54			30	30	10
DIHUB Skill#23 Communication	26		26	8	4	50	50	75				30	135	135			60	60	270
DIHUB Skill#24 Presentation	13	26	13	4	4	30	30	50				20	81	81			20	20	270

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6. Conclusions related to the developed training programmes

The implementation of Pilot 1 and 2 under the DIHUB WP4 project took place during the unfavorable epidemiological situation related to the Covid 19 epidemic. However, this did not prevent it from being successful. Pilots were conducted with all partners, and despite the limitations faced by participants, it was very well received. It was a great experience for students and professors as well as SMEs. Here is a list of the benefits most frequently cited by participants:

1. students:
   → acquiring and deepening knowledge about cloud technologies;
   → possibility to apply the acquired knowledge in practice;
   → making business contacts;
   → development of soft skills;
   → learning to team work.

2. professors:
   → deepening knowledge of cloud technologies;
   → making or deepening business contacts;
   → developing team management skills.

3. SMEs:
   → incorporating modern technologies into daily operations;
   → increasing competitive advantage.

Although project participants indicated that participation in the project required a lot of work and communication was not always easy (due to the epidemiological situation, some meetings had to be held online), they appreciated the opportunity to participate in the pilot. Special attention should be paid here to students from Bulgaria and Portugal. In these two national nodes, this type of teaching does not exist, and the Haaga-Helia lectures were an important motivator for participation in the project, expanding one's knowledge and developing new skills. The educators from these two countries also deserve attention because they showed great commitment and passion. They supported the students every step of the way and were a motivating factor not only before but also during Pilot 2, resulting in exceptional student projects that will be known to all residents of the Bulgarian capital.

However, it was not without problems. The Covid situation proved to be a serious obstacle, especially for the Portuguese partners who had difficulties recruiting students due to the blockade. Another problem in running the programme in this country was the lack of professorsand experts in the field of cloud technologies. They also stated that they did not consider Pilot 2 to be completely successful. Despite adequate planning, support, and guidance at the consortium level and numerous activities related to project implementation, there was not enough response from students interested in participating in the project. They also pointed out that the dates of some activities coincided with the dates of vacations or exams during the study period, so students could not fully participate in Pilot 2. The Bulgarian and Estonian partners also pointed out the problem of time constraints and the need to adapt to students' schedules.

Despite the challenges faced by the students from all partner countries, they successfully delivered their cases and new cloud solutions to companies in the SME sector. The students themselves were very positive about the pilots. They should pay attention to a few facts in particular:

1. the teaching materials proved to be effective as they focused mainly on cloud-based technologies and addressed the students' needs. During Pilot 2, most countries recorded an improvement in the quality of the teaching materials following the changes introduced on the basis of Pilot 1.
2. the DIHUB project gave the partners the opportunity to further improve their educational programs and adapt them to the needs of the labour market.
3. based on the survey results, it is fair to say that the project was the most successful and benefited all three parties in Bulgaria.
4. the vast majority of the students stated that Pilot 2 carried out within the DIHUB project was very useful in acquiring new knowledge and skills. They also indicated that they acquired new, practical knowledge or enhanced their existing knowledge related to the use of cloud solutions in their field.

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5. the lecturers involved in the implementation of Pilot 2 succeeded in arousing the students' interest in the implementation of cloud services in their field. This proves the great commitment of the researchers in the implementation of the pilots.
6. most of the students indicate that they are very satisfied with the opportunity to participate in the project. In particular, the Bulgarian students showed great commitment to the implementation of the tasks, and for many of them the project became an inspiration for the development of such solutions in the future.
7. all companies and institutions involved in the project evaluated its results very positively. They paid special attention to the involvement of students and educators.
8. the companies involved in the project emphasized that the projects carried out within the DIHUB project had a positive impact on their daily work and contributed to increasing their competitive advantage.

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7. Future trends

Convenience and the use of cloud services are the key reasons for their adoption by businesses and for forming cloud computing trends 2022. Manufacturers of cloud-based services are anticipated to stay on top of the market to see the future of cloud computing a long-term forecast. Based on Gartner cloud adoption, developing technologies like AI and edge servers are driving cloud spending growth.

Cloud computing services are now being used in the post-pandemic workplace, and many companies are seeking new methods to make use of the cloud's advantages, which is the future of cloud computing 2030. Some of the key drivers supporting the expansion of this technology include the continuously evolving needs of organisations, rising customer demands, the massive quantity of data, and the rush to automate fundamental business activities, all contributing to the future of cloud computing 2025.

The future of cloud computing in 2030 is that by 2030, the cloud computing market may have grown fivefold. As per the latest study, the worldwide cloud computing services market might be worth $1,620,597 million by the end of the decade. Based on a 2019 estimate of $325,689 million, this corresponds to approximately 16 percent compounded annual growth.

The future of cloud computing 2030 promises success in the following areas:

- Understanding of important business processes and data operations.
- Measuring actual return on investment and value for money.
- Risk management for suppliers.
- Solving challenges for security and integrity.

The future of cloud computing 2030 assures that the market must be equitable for companies to profit, as in the future of cloud computing 2025. This expansion must be done so that it is environmentally friendly and uses current computer systems to minimize loss. Anyone with surplus computational resources may make money by investing in the marketplace for the future of cloud computing 2025. At the same time, companies would benefit from a lower-cost service by setting trends and deciding the future of cloud computing 2030.

Cloud computing has no alternative. It is therefore paramount that all segments of education, HEIs and VETs together, make their best efforts in providing high-quality training programmes for development of cloud-related skills – both in the segment of formal education, as well as in the segment of life-long learning.

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8. Annexes

8.1. DIHUB – Survey for teachers

1. Name of the educational institution, where you teach:
2. Location (city, country) of the educational institution, where you teach:
3. Please describe activities you undertook to activate students to get involved in the DIHUB pilot.
4. In your opinion, what was the motivation of students to take part in the pilot?
5. Please describe the profiles of students taking part in the pilot (age, EQF level, level of experience with similar initiatives).
6. How many students took part in the pilot?
7. Did the students in the pilot work on individual or team projects? If they worked on team projects, please describe the process of team creation. Did they come up with the idea outside of the pilot, or was the project idea born in the process of piloting?
8. How many teachers took part in the pilot?
9. Please describe your motivation as a teacher to take part in the pilot.
10. Please describe the profile of teachers who took part in the pilot (areas of expertise, level of previous experience with similar initiatives).
11. Which technical infrastructure was used for delivering the first pilot's results?
12. Please shortly describe at least 2 student projects from the pilot.
13. How did you involve SMEs in the pilot? Please describe the profile of SMEs taking part in the pilot.
14. In your opinion, what was the motivation of SMEs to take part in the pilot?
15. Did students pitch their projects to SMEs?
16. Do you consider your second pilot to have been successful? Please explain.
17. As a teacher, have your expectations from the pilot been met?
18. As far as you know, what was the feedback from SMEs? Have their expectations from the pilot been met?
19. In retrospect, what would you say was the most challenging, and what the most rewarding aspect of the second pilot?

8.2. DIHUB – Second pilot – Survey for students

1. Name of the educational institution, where you teach:

2. Location (city, country) of the educational institution, where you teach:

3. Mark the scientific or artistic area to which your study belongs:
   - natural sciences
   - technical sciences
   - (bio)medicine
   - biotechnical sciences
   - social sciences
   - humanities
   - arts
   - interdisciplinary studies

4. At what level are you familiar with the cloud-based services after participating in the DIHUB pilot?
   - I can describe in detail what cloud-based services are and how they can be used
   - I can describe in general what cloud-based services are and how they can be used
   - I am only familiar with the term
   - I am not familiar with it at all

5. Assess your interest for applying the cloud-based services in your field of expertise after participating in the DIHUB pilot:
   1 (not interested at all) 2 3 4 5 6 (very interested in)

6. In your opinion, would it be useful to apply the cloud-based services in your field of expertise?
   - it would definitely be very useful
   - it may be useful
   - I am not sure if it would be useful
   - I do not think it would be useful

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I do not know

7. Assess your knowledge of applying cloud-based services in your field of expertise?
   I know exactly how it could be applied
   I was thinking about it, but I do not have a clear idea
   I think it could be applied but I would have to think it through
   I do not have any idea

8. In your opinion, how useful was the DIHUB pilot for acquiring a new set of knowledge and skills?
   1 (not useful at all) 2 3 4 5 6 (very useful)

9. Mark the extent to which you agree with the following statements.
   Cloud-based services can increase business efficiency.
   1 (strongly disagree) 2 3 4 5 6 (strongly agree)
   Application of the cloud-based services can assure better organisation of the business process.
   1 (strongly disagree) 2 3 4 5 6 (strongly agree)

10. Assess how much your knowledge of applying cloud-based services has improved after participating in the DIHUB pilot:
    it has greatly improved
    it has slightly improved
    it has stagnated

11. In your opinion, educational materials which were used in the DIHUB pilot were:
    useful and of a high quality
    useful but too detailed
    useful but could be more detailed
    not very useful

12. Did the lecturer(s) of the pilot manage to engage you regarding the applying cloud-based services in your field of expertise?
    yes, absolutely
    yes, partially
    no
    I am not sure

13. After participating in the DIHUB pilot:
    I am interested in cloud-based services and would like to participate in the learning programme related to it in the future
    I am interested in cloud-based services, but I am not sure if I would like to participate in the learning programme related to it in the future
    I am interested in cloud-based services, but I do not have intention to participate in the learning programme related to it in the future
    I am not interested in cloud-based services

14. Mark the statement which describes your attitude toward applying cloud-based services most accurately.
    Already during the pilot, I developed an idea on how to apply cloud-based services unrelated to the case we were solving during the pilot.
    I am encouraged to deliberate about ways of applying cloud-based services in the future.
    I recognize the value of applying cloud-based services but do not have an idea how to do it.
    I do not recognize the value of applying cloud-based services at all.

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8.3. DIHUB – Second pilot – Survey for SME

1. What benefits did the company get from the joint development project?
2. How would you describe the success of the cooperation with the educational institution?
3. As an entrepreneur, did you learn something from the process and be willing to start the project again?
4. Would you recommend to other entrepreneurs a development project with an educational institution related to cloud services, whatever they might be?
5. Were the project objectives met for the company?
6. Comments on the students' work during the project?

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8.4. Memo for ESCO committee regarding cloud jobs/skills mapping

Digital Innovation Hub for cloud-based services
Project Nº.: 612656-EPP-1-2019-1-FI-EPPKA2-SSA-P
https://dihubcloud.eu/
DIHUB consortium members

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

To:
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Cc:
Mrs. Laura Visan, laura.visan@esco-support.eu
Mr. Emilio Castrillejo, emilio.castrillejo@ec.europa.eu

Subject: Cloud related technologies jobs/skill mapping

Dear ESCO Team,

As part of Erasmus+ project named Digital Innovation Hub for cloud-based services[1] (project Nº.: 612656-EPP-1-2019-1-FI-EPPKA2-SSA-P) our international consortia studied cloud-based services, related jobs and impact of cloud technologies for labour and educational market in Europe.

Our works include two comprehensive materials which we believe could be interesting for skill-job mappings that are to be derived on top of ESCO. Attached to this memo, we are providing two documents/project outcomes:

- DACUM analysis for cloud-based services including ESCO v1.0 mappings, recognized cloud jobs descriptions and recommendations for education for future cloud professionals;
- DIHUB recommended curriculum updated to ESCO v1.1 including EDU path, learning outcomes and module description guidelines to be used by variety of institutions and stakeholders on their mission to improve EU's expertise and services in cloud.

Analysing development of ESCO classification and especially focusing on how ESCO can be used to define and map different emerging fields, we strongly believe that our contribution can be valuable for future grouping of ESCO skills into cloud related group similar to other initiatives currently in process.

The DIHUB consortium set up a European-wide cluster of interconnected nodes using the latest cloud computing technologies for innovations development, education and for generation of new start-ups. We recognized ESCO to be valuable tool for easy and interoperable dissemination of EDU programs providing recognized foundation for professionals looking to improve their skills, expertise and/or to acquire credentials in their professional path.

Looking forward to hearing from you, kind regards,

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[1] https://dihubcloud.eu/

DIHUB

www.dihubcloud.eu

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