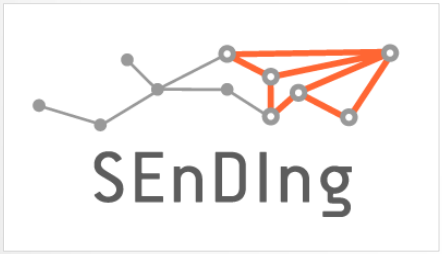

Co-funded by the
Erasmus+ Programme
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SEnDIng

D1.4

FINAL PROJECT REPORT

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Project Title:	Sector Skills Alliance for the design and delivery of innovative VET programmes to Data Science and Internet of Things professionals

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Delivery Slip

	Name	Partner	Date
From	Vasileios Gkamas	UPATRAS	26/01/2021
Reviewed by	Maria Rigou	UPATRAS	28/01/2021
Approved by	Maria Rigou, All partners	UPATRAS	29/01/2021

PROJECT SUMMARY

SEnDIng project aims to address the skills' gap of Data Scientists and Internet of Things engineers that has been identified at the ICT and other sectors (e.g. banking and energy) at which Data Science and Internet of Things have broad applications. To achieve this goal, SEnDIng will develop and deliver to the two aforementioned ICT-related occupational profiles two learning outcome-oriented modular VET programmes using innovative teaching and training delivery methodologies.

Each VET program will be provided to employed ICT professionals into three phases that include: (a) 100 hours of on-line asynchronous training, (b) 20 hours of face-to-face training[1] and (c) 4 months of work-based learning. A certification mechanism will be designed and used for the certification of the skills provided to the trainees of the two vocational programs, while recommendations will be outlined for validation, certification & accreditation of provided VET programs.

Furthermore, SEnDIng will define a reference model for the vocational skills, e-competences and qualifications of the targeted occupational profiles that will be compliant with the European eCompetence Framework (eCF) and the ESCO IT occupations, ensuring transparency, comparability and transferability between European countries.

Various dissemination activities will be performed – including the organization of one workshop at Greece, Bulgaria and Cyprus and one additional conference at Greece at the last month of the project – in order to effectively disseminate project's activities and outcomes to the target groups and all stakeholders. Finally, a set of exploitation tools will be developed, giving guides to stakeholders and especially companies and VET providers, on how they can exploit project's results.

[1] Due to COVID-19 restrictions this training has been delivered online.

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1 Introduction

1.1 Scope of the deliverable

This deliverable consists the final report of SEnDIng project. It is a public document that aims to provide to the reader a 360º view of the project. The report presents:

- The project objectives for addressing the currents needs of the ICT sector
- The project progress through its lifetime
- The main outputs produced
- The main deviations occurred from the project work-plan

1.2 The SEnDIng project

SEnDIng is a 3-year Sector Skills Alliance Erasmus+ project run during the period November 2017 – January 2021. The project consortium consists of 12 partners coming from 4 European countries (Greece, Cyprus, Bulgaria and Ireland): two Higher Education Institutions (HEIs), two Vocational Education and Training (VET) providers, five IT SMEs, two Associations of IT companies and professionals and one Certification Body.

The main administrative information of the project is presented below:

- **Program**: Erasmus+ KA2: Cooperation for innovation and the exchange of good practices - Sector Skills Alliances
- **Call ID**: EACEA-04-2017
- **Lot**: Lot 2, SSA for Design and Delivery of VET
- **Project Number**: 591848-EPP-1-2017-1-EL-EPPKA2-SSA
- **Grant Agreement Number**: 2017-3184/001-001
- **Project Coordinator**: University of Patras, Greece
- **Duration**: 38 months
- **Number of Partners**: 12
- **Maximum EU grant**: 982.537 €
- **Start Date**: 1st December 2017
- **End Date**: 31st January 2021

All the public deliverables produced during the project are available at SEnDIng website and Erasmus+ dissemination platform.

Figure 1: The SEnDIng consortium

2 ICT sector needs and project objectives

2.1 ICT sector needs

Data Science and Internet of Things (IoT) have been recognized as among key drivers regarding the skills required by IT professionals. Although they are in their early stages of realization, at the same time they bare the potential to bring enormous benefits to enterprises and organizations and likewise to disrupt existing business models and processes. In addition, their value for the EU economy is huge. According to the European Data Market Monitoring Tool, the value of the Data Economy, exceeded the threshold of €400 Billion in 2019 for the EU27 plus the United Kingdom, with a growth of 7.6% over the previous year. Moreover, IoT with a value of €120 billion will solely contribute to an increase of 7 points of European GDP by 2025, through productivity improvement and value distributed to end customers.

However, one of the main barriers preventing the full exploitation of Data Science and IoT potential, is the skills gap observed at both domains. According to the latest estimates, the number of data professionals in the EU27 plus the UK reached €76 million in 2019 (3.6% of the total workforce), but there is still an imbalance between the demand and the supply of data skills in Europe. The data skills gap is forecast to continue as demand will continue to outpace supply. In the IoT domain, the skills demand has also been extremely high during the last years, with the total installed base of IoT devices projected to amount to 75.44 billion worldwide by 2025. A survey conducted in 2017 showed that 76% of enterprises need IoT specialists with more advanced skills and 80% did not have the skills needed to keep their IoT infrastructure working as it is. Moreover, according to another report published in 2017, 33% of enterprises declared that there is a major skills gap in IoT readiness. The skills gap together with the continuous evolution of Data Science and IoT technologies and their application at many economic sectors (i.e., ICT, financial, energy) make the skills required by IT professionals increasingly sophisticated, and the need to be constantly updated imperative.

2.2 Project objectives

In the aforementioned landscape, the SEnDIng project addresses the skills gap at the Data Science and IoT domains, by providing IT professionals with technical knowledge and skills together with transversal skills and competences that are relevant to the needs of the labour market, are transferable and are recognized among European countries. The main project objectives achieved are the following:

- Design 2 VET programs for Data Science and IoT that are based on multi-disciplinary and learning-outcomes oriented curricula and combine technical knowledge and skills with transversal skills and competences.
- Design 2 reference models of knowledge, skills and competences for Data Scientists and IoT professionals in accordance with well-known European frameworks, such as the e-Competence Framework (e-CF) and the European Skills, Competences, Qualifications and Occupations (ESCO).
- Pilot the VET programs in three phases (online Data Science/IoT training, online transversal skills training and work-based learning) and certify the learning outcomes obtained.
- Disseminate the project results to target groups and engage them with the project to maximize its potential impact.
- Take actions towards the sustainability of project outputs and their exploitation by relevant stakeholders.

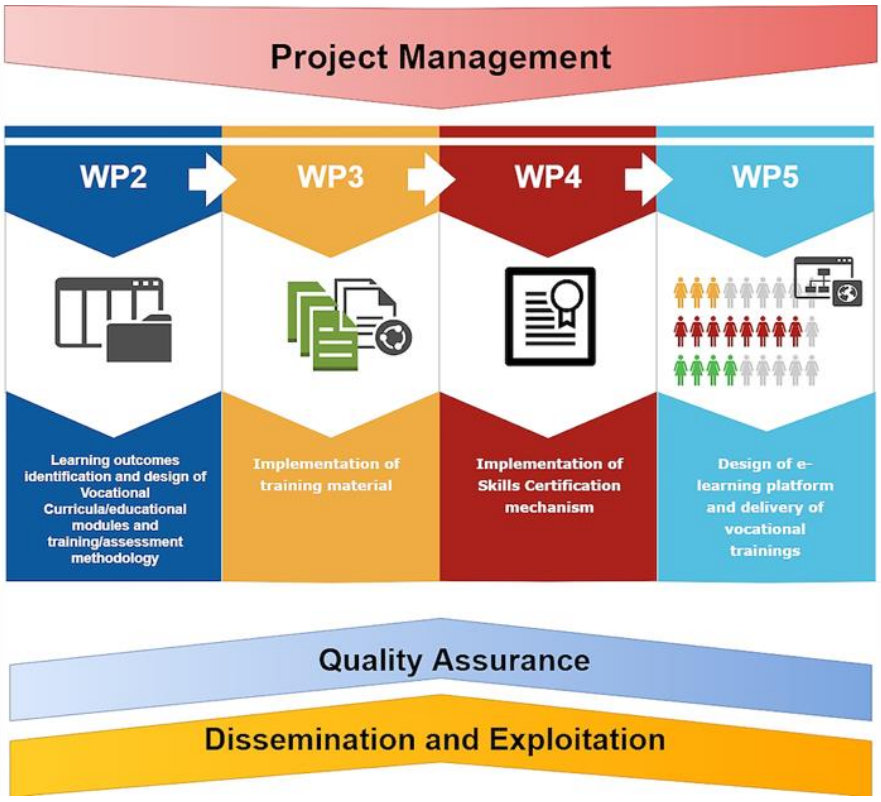

Figure 2: Work-plan of SEnDIng project

The project work-plan is divided into the following seven (7) work packages:

- WP1: Project management and coordination
- WP2: Learning outcomes identification and design of vocational curricula/educational modules and training/ assessment methodology
- WP3: Implementation of training material
- WP4: Implementation of skills certification mechanism
- WP5: Design of e-learning platform and delivery of vocational trainings
- WP6: Quality assurance and evaluation of project
- WP7: Dissemination and Exploitation

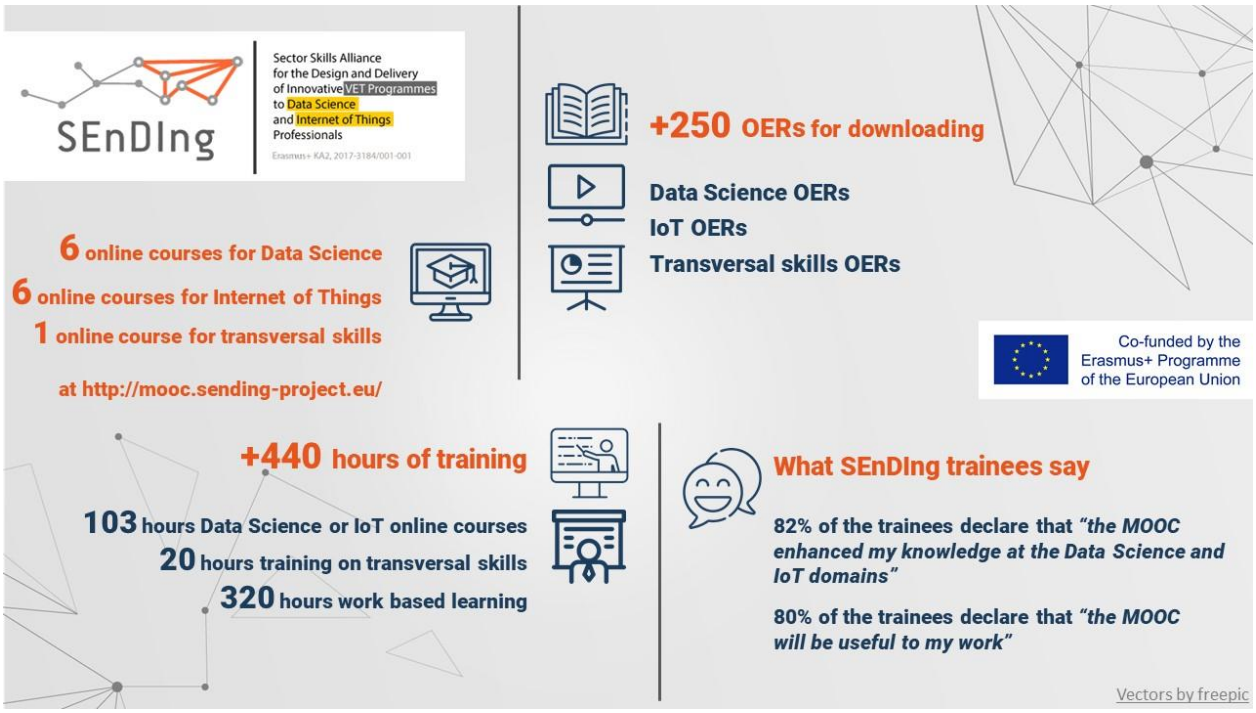

Figure 3: SEnDIng in numbers

3 Project progress and main challenges faced

The project has been implemented with the following stages.

STAGE I. Definition of Data Science and IoT training needs, mapping to learning outcomes and design of VET program.

WP2: Learning outcomes identification and design of vocational curricula/educational modules and training/ assessment methodology.

The first step was to define the training needs in consultation with the main beneficiaries, namely IT companies, SMEs and professionals aiming to ensure that the VET programs (Data Science and IoT) meet their needs and contribute to the elimination of skills gap at the Data Science and IoT domains. We conducted interviews with leading international experts in Data Science and IoT (7 stakeholders involved in the interviews) and a survey among companies delivering Data Science and/or IoT projects (collecting 43 responses for the IoT survey and 36 responses for the Data Science survey) in order to validate the learning outcomes of the VET programs.

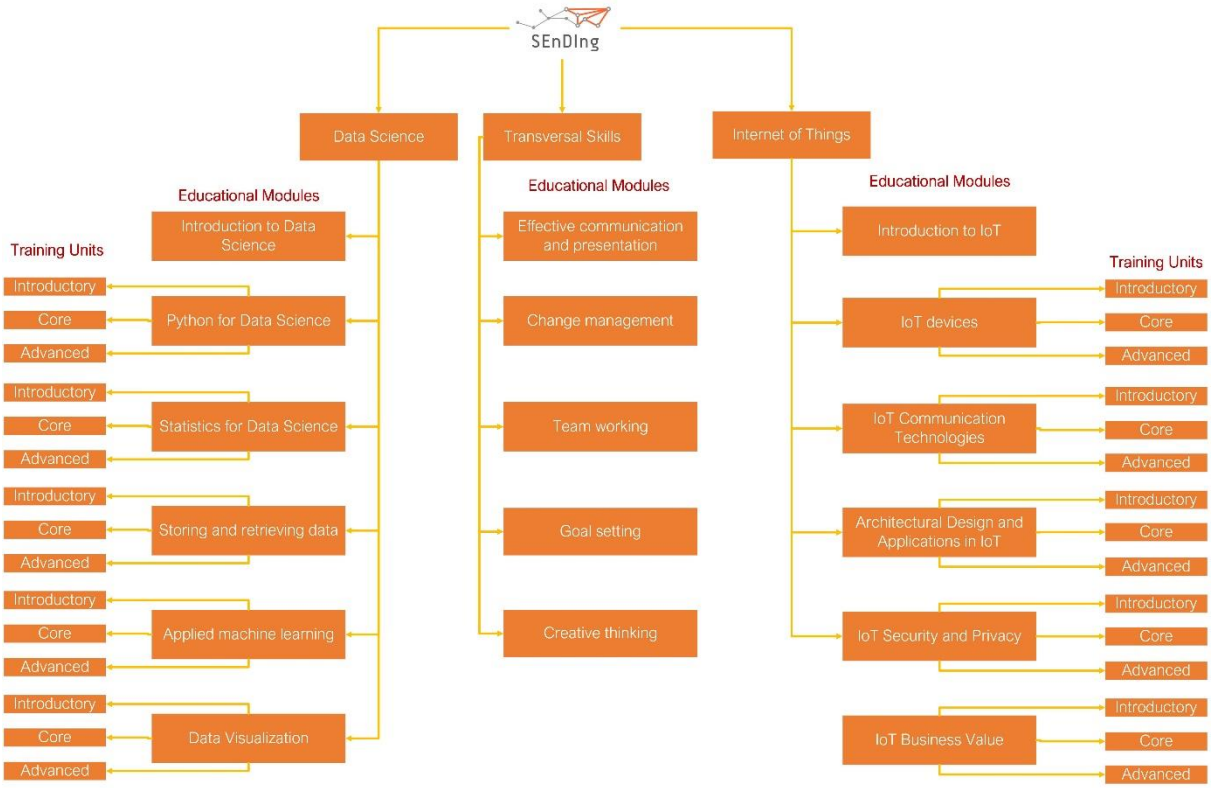

Figure 4: The SEnDIng curricula for Data Science, IoT and transversal skills

As a next step, we designed the vocational curricula for Data Science, IoT and transversal skills, as well as the training methodology and the methodology for monitoring the training and for the assessment of the learners. Structuring the training framework in a modular way and implemented through different methods (online training and work-based learning) was key to support the exploitation of project results and their transferability at different contexts (i.e., higher education). Taking into account the eCF framework and ESCO classification, we defined also two reference models of knowledge, skills and competences, one for Data Scientists and one for IoT professionals. The aim was to support the recognition of the VET programs' learning outcomes among the European ICT industry.

The main issues faced during this phase are the following:

- Definition of occupational profiles and learning outcomes. The definition of occupational profiles, especially that of the IoT engineer, and the mapping of the learning outcomes derived from the surveys among stakeholders, with the learning outcomes defined in the European e-Competence Framework and ESCO was a key challenge.
- Defining the vocational curricula and their educational modules was also a challenge due to the complexity of the Data Science and IoT domains and applications, and the different views between the academic and industrial partners of SEnDIng consortium.

STAGE II. Develop the training material and the MOOC platform

WP3: Implementation of training material & WP5: Design of e-learning platform and delivery of vocational trainings

At the next step we designed the training material for the Data Science and IoT online training, as well as transversal skills training. We have chosen to develop the training material in the form of Open Educational Resources that could be easily reused, adapted and extended by any interested. We put special emphasis on the development of training material in the form of short videos (e.g., 5-15 minutes), which are more attractive compared to conventional learning resources (i.e., texts). These videos were complemented by supportive presentations and texts. We also designed a set of projects for the work-based learning phase of the SEnDIng VET program.

Moreover, at this stage we defined the technical and operational specifications of the eLearning platform for the delivery of the Data Science and IoT online courses. We surveyed and tested different solutions both open source and commercial. Based on this survey, we exploited the Open edX MOOC platform to host the self-paced online courses giving to learners the flexibility to adapt the online training at their own schedule.

No major issues have been raised at this stage of the project.

STAGE III. Design the skills certification scheme of the VET programs

WP4: Implementation of skills certification mechanism

At this phase, we initially studied the national qualifications frameworks and the ECVET landscape in Bulgaria, Greece and Cyprus, as well as the accreditation methodology of VET programs in the aforementioned countries. Moreover, we designed the ECVET qualifications and units of the Data Science and IoT VET programs, as well as the certification schemes for the learning outcomes of the Data Science and IoT VET programs.

The main issues faced are:

- Identification of credit units of the VET program. Due to the absence of a credit VET system in Greece and the partial use of credits in some qualifications in Bulgaria and Cyprus in non-formal lifelong learning VET programmes, we adopted the logic of the ECVET credit system, according to which 1 ECVET credit point is accumulated for every 25 hours of training.

STAGE IV. Evaluate the effectiveness of SEnDIng approach: SEnDIng pilot trainings

WP5: Design of e-learning platform and delivery of vocational trainings

During this phase we published an open call inviting companies to participate in the 2 VET programs (Data Science and IoT). The pilots have run in three phases:

(a) 103 hours of online asynchronous courses at Data Science or IoT based on the VET program,

(b) 20 hours of online synchronous courses for building transversal skills (although the initial plan was to deliver this training through face-to-face sessions) and

(c) 320 hours of work-based learning.

The main issues faced are:

- Deliver online the transversal skills training. Although the initial plan was to deliver the transversal skills training through face-to-face sessions, the COVID-19 restrictions forced us to reschedule this training and move to online sessions. The main challenge was to keep the motivation of the trainees and promote collaborative learning and the continuous interaction between the trainer and the trainees using various training techniques (e.g., role play, working in teams, teambuilding).

- Running work-based learning. Running the work-based learning was a key challenge faced at this phase due to the different expertise of the participating companies and moreover, due to their different culture as a consequence of different national contexts. For this reason, we run an online training for the in-company mentors who had the responsibility for guiding their trainees, while we have also provided a handbook describing all the details and methods for monitoring the work-based learning and assessing the trainees. An additional challenge has been raised due to COVID-19 given that work-based learning was adapted at the internal policies of each company with regards to the remote or on-site work of their employees.

Moreover, from the initial stage of the project and in parallel with the implementation of the aforementioned WPs, we designed the quality assurance plan of the project, the risk register and the evaluation plan for assessing the project outputs and their impact to key stakeholders (WP6). Finally, the dissemination and exploitation activities of the project (WP7) guarantee its effective promotion and communication with the defined target groups.

4 Outputs of SEnDIng project

This section presents the main outputs produced by the SEnDIng project.

- **Learning outcomes of VET programs for Data Science and IoT**

  This output defines the learning outcomes for the Data Science and IoT vocational trainings that have been piloted during the project. The learning outcomes provide clear requirements about what learners should know and be able to implement in practice at the end of the training cycle. The learning outcomes are compliant with good practices in both the pedagogical theory applicable in VET and the technical domains of IoT and Data Science. We performed a desktop research on existing Data Science and IoT studies, curricula and courses in order to formulate the first draft version of the learning outcomes. Then, the learning outcomes were discussed among project partners and key experts in the respective fields and finally they were validated in an online survey among stakeholders.

  For more information, please refer to the following deliverable:

  D2.1: Learning Outcomes in terms of knowledge skills and competences

- **Reference models of skills, e-competences and qualifications needs of Data Scientists and IoT Engineers.**

  This output defines 2 reference schemes of skills, e-competences and qualification needs for the Data Science and IoT domains. As main inputs we used the learning outcomes for the Data Science and Internet of Things vocational trainings from the one hand, and the structure of the European e-Competence Framework (including the results of CEN Workshop on ICT Skills as European ICT Professional Role Profiles) and the ESCO IT occupations from the other. In the reference models, we aligned the learning outcomes with the definitions provided in the EU reference models. Thus, using the multidisciplinary features of the Data Science and Internet of Things domains, we created a wide basis for the understanding of the skills and competences that could be adapted for different contexts and organizations. In addition, the standardization of a common language on ICT competences in e-CF and the common reference terminology in ESCO, ensure the transparency, comparability and transferability of the reference models between European countries.

  For more information, please refer to the following deliverable:

  D2.2: Reference model of skills, e-competences and qualifications needs of Data Scientists and IoT Engineers

- **Vocational curricula for Data Science, IoT and transversal skills**

  We developed the curricula of the Data Science, IoT and transversal skills VET programs. The main characteristics of the curricula are the following:

  (a) *Multi-disciplinar*. The educational modules (courses) developed cover both technical knowledge and skills at Data Science and IoT domains, as well as transversal skills and competences. The transversal skills aim to build upon academic and experiential learning and to prepare the IT professionals for engaging within the business environment in a creative way, communicating effectively with the internal and external environment of a business and acting in a collaborative way.

  (b) *Modular*. Each curriculum is separated in educational modules. The modules have been designed by selecting and ordering the types of learning activities that trainees undertake to achieve the learning outcomes. Each module is further divided in training units at three levels of proficiency:

  - Introductory (I): The module is introduced and its most important aspects are given.
  - Core (C): All core aspects, principles and methods of the module are covered in sufficient detail as necessary to apply the knowledge and skills on the job. The learner becomes able to discuss matters with other stakeholders and acquire more knowledge when necessary.
  - Advanced (A): Advanced aspects of the module are covered in sufficient detail as necessary to apply the knowledge and skills on the job.

  This permits the learners to create their own learning paths according to their needs. As the learning outcomes aimed by the transversal skills training are horizontal, the transversal skills educational modules are not split into the three training units (Introductory, Core and Advanced).

  (c) *Learning outcomes-oriented*. Based on the definition of the VET program's learning outcomes, the learning outcomes of the learning units of each module have been defined.

  For more information, please refer to the following deliverable:

  D2.3: Vocational curricula/educational modules for Data Science and Internet of Things VET program

- **Training methodology for the delivery of the vocational trainings.**

  We designed a training methodology for the delivery of SEnDIng vocational trainings. This methodology provides to trainers and VET providers guidelines, suggestions and tools that are suitable for the delivery of the three phases of the vocational training: a) online training for Data Science and IoT, b) transversal skills training and c) work-based learning. Furthermore, it guides the companies on the implementation of work-based learning procedures in order to guarantee the up-skilling of their employees. The outcome of this process is the provision of a practical yet theoretical grounded corpus of guidelines regarding ICT professionals' training in Data science and IoT which expands from the narrow limits of a constructed learning pathway and takes the form of an effective participatory experience that will motivate learners and enhance their professionalism.

  For more information, please refer to the following deliverable:

  D2.4: Training methodology

- **Training monitoring and assessment methodology for the delivery of the vocational trainings**

  We designed the monitoring and assessment methodology for the delivery of SEnDIng vocational trainings. This methodology provides the guidelines and suggestions regarding the procedures, methods and tools suitable for monitoring and assessing the trainees through the three phases of the vocational training: a) online training for Data Science and IoT, b) transversal skills training and c) work-based learning. Through the monitoring and assessment processes all stakeholders involved in SEnDIng training know if the objectives of the training have been fulfilled and the intended learning outcomes have been achieved.

  For more information, please refer to the following deliverable:

  D2.5: Training monitoring and assessment methodology

- **Training material for Data Science**

  We developed training material for the following Data Science online courses:

  - DS-EM1: Introduction to Data Science
  - DS-EM2: Applied machine learning
  - DS-EM3: Python for Data Science
  - DS-EM4: Storing and retrieving data
  - DS-EM5: Statistics for Data Science

- DS-EM6: Data Visualization

The training material developed for each course is documents, presentations, videos, self-evaluation quizzes and projects. It is available for downloading in the form of Open Educational Resources.

For more information, please refer to the following deliverable:

D3.1: Training material for Data Science vocational trainings

- **Training material for Internet of Things**

We developed training material for the following Internet of Things online courses:

- IoT-EM1: Introduction to IoT
- IoT-EM2: Architectural Design and Applications in IoT
- IoT-EM3: IoT Communication Technologies
- IoT-EM4: IoT Security and Privacy
- IoT-EM5: IoT Devices
- IoT-EM6: IoT Business Value

The training material developed for each course is documents, presentations, videos, self-evaluation quizzes and projects. It is available for downloading in the form of Open Educational Resources.

For more information, please refer to the following deliverable:

D3.2: Training material for IoT vocational trainings

- **Training material for Transversal Skills**

We developed training material for the upskilling of ICT professionals at transversal skills. The aim of this training material is two-fold: (a) to help prospective learners to build their transversal skills that are developed upon academic and experiential learning and (b) to prepare them for engaging within the business environment in a creative way, communicating effectively with the internal and external environment of a business and acting in a collaborative way. The training material introduces learners to a portfolio of skills and competences required for effective communication and presentation, adaptation to changes, teamwork, goal-setting and thinking out of the box.

For more information, please refer to the following deliverable:

D3.3: Training material for transversal skills development

- **Recommendations for validation, certification & accreditation of provided VET programs**

  We surveyed the NQFs of Greece, Bulgaria and Cyprus, as well as the ECVET principles and applications, along with their degree of adoption in the aforementioned countries. Moreover, we have broken down based on the ECVET logic the two VET programs developed under SEnDIng, and we have allocated the appropriate credits per course, based on the identified learning outcomes and teaching methods.

  For more information, please refer to the following deliverable:

  D4.1: Recommendations for validation, certification & accreditation of provided VET programs

- **Data Science VET program certification**

  We developed the certification scheme for the Data Science VET program. This scheme describes the knowledge, skills and competences of the persons interested in being certified in the specific field, as well as the elements designating the design and development processes of the scheme, along with its implementation.

  For more information, please refer to the following deliverable:

  D4.2: Data Science VET program certification

- **Internet of Things VET program certification**

  We developed the certification scheme for the Internet of Things VET program. This scheme describes the knowledge, skills and competences of the persons interested in being certified in the specific field, as well as the elements designating the design and development processes of the scheme, along with its implementation.

  For more information, please refer to the following deliverable:

  D4.3: Internet of Things VET program certification

- **MOOCs for Data Science and IoT**

  We developed various online courses for Data Science and IoT. The access to online courses is open and free to anyone interested to build his/her knowledge and skills at the Data Science and IoT domains. More specific, we have developed the following Data Science online courses:

  - DS-EM1: Introduction to Data Science. In this course you will be introduced to Data Science and its applications. The aim of the course is to understand what the Data Science is, and the various activities that perform the different roles involved in Data Science projects. You will learn which the different phases of

solving a Data Science problem are, well-known tools and frameworks utilized, as well as Data Science applications at different domains.

- DS-EM2: Applied Machine Learning. In this course you will be introduced to the concept of Machine Learning and its applications in various domains. The aim of the course is to give you a comprehensive overview of Machine Learning and to assist you in understating what Machine Learning is, how Machine Learning algorithms work and how they could be utilized in solving real world problems. In addition, you will learn toolkits to design and formulate Machine Learning methods.
- DS-EM3: Python for Data Science. In this course you will be introduced to the concept of Machine Learning and its applications in various domains. The aim of the course is to give you a comprehensive overview of Machine Learning and to assist you in understating what Machine Learning is, how Machine Learning algorithms work and how they could be utilized in solving real world problems. In addition, you will learn toolkits to design and formulate Machine Learning methods. At the end of the course, you will be asked to complete quizzes to apply your newly acquired skills and knowledge.
- DS-EM4: Storing and Retrieving Data. In this course you will be introduced to the Hadoop ecosystem for storing and processing large volumes of data distributed across commodity servers. You will be equipped with the theoretical and practical background needed to perform Hadoop routine tasks and troubleshoot Hadoop clusters. Furthermore, the fundamentals of MapReduce και Spark Framework will be presented. Completing this course, you will be able to administrate and establish a secure Hadoop environment and work with the common Hadoop-related processing frameworks and modules.
- DS-EM5: Statistics for Data Science. This course consists an introduction to R programming language for solving Data Science problems. The aim of the course is to become familiar with R programming language and its libraries and packages for inferential statistical analysis, visualization and for implementing machine learning algorithms.
- DS-EM6: Data Visualization. In this course you will be introduced to Data Visualization and its applications in order to enhance visual communication. You will be equipped with the theoretical and practical tools needed to build effective and engaging data visualizations. Additionally, the role of the Data Scientist from a data presentation and communication perspective will be

defined. Completing this course, you will be able to design and develop visual stories with data, discover trends and patterns, and potentially communicate their findings to a non-technical or broader audience.

We have also developed the following IoT online courses:

- IoT-EM1: Introduction to IoT. This course consists an introduction to the IoT concept and its applications. It aims to make you familiar with the IoT technology and present the different roles involved in an IoT project. In addition, it presents common IoT application development tools and methods.
- IoT-EM2: Architectural Design and Applications in IoT. This course provides an introduction to the key aspects of an IoT system architecture with emphasis on cloud computing solutions (service models, deployment models, public cloud providers and services). Furthermore, it presents the non-functional requirements that should be taken into account when designing IoT applications, followed by the software architectural styles in IoT applications (client-server, peer-to-peer, publish-subscribe, etc.) and how they relate to the aforementioned quality attributes. Moreover, the course provides an overall recommended architecture for IoT solutions in terms of core and optional subsystems along with a discussion of cross-cutting concerns for IoT applications.
- IoT-EM3: IoT Communication Technologies. This course presents well-known communication protocols and standards used for signalling and data exchange in IoT systems. Special emphasis is given on the main characteristics, features and metrics of each protocol and standard. The relationship between the traditional TCP/IP protocol stack with the IoT protocol stack is presented and explained. Moreover, a comparison between different IoT communication technologies is done aiming to support you for selecting the right communication protocol for different IoT applications.
- IoT-EM4: IoT Security and Privacy. The course introduces the security challenges and risks faced in the IoT ecosystem, given that the IoT may is the most unsecure network encounter so far. In addition, it presents measures to create a more secure IoT environment and protect it from various threats. The course aims to create you a sense of awareness of the possible security breaches in IoT and how to avoid them by adapting appropriate security measures whenever possible.
- IoT-EM5: IoT Devices. This course introduces the "Things" in the Internet of Things. It deals with the different categories of IoT devices (sensors,

actuators, peripherals), their electronics, as well as, the different microcontrollers and how they can interact with the IoT environment. The course focuses on how to select and interface common sensors and actuators to support IoT applications.

- IoT-EM6: IoT Business Value. This course is an introduction to the IoT business value. You will initially see how a company can be transformed with the use of IoT, by presenting common IoT applications in various business domains. Then, the different IoT business model types and challenges that arise in an enterprise will be presented. Finally, various case studies of companies successfully adopted IoT based strategies will be presented.

The online courses are available at http://mooc.sending-project.eu/

- **Dissemination and promotional material**

We designed many dissemination and promotional material:

- 1 project tri-fold and 1 project flyer in English, Greek and Bulgarian
- 6 newsletters in English, Greek and Bulgarian
- Project videos in English
- 2 promotional flyers in English for the pilot trainings for IT professionals and companies
- 2 press releases in English

available at http://sending-project.eu/index.php/en/dissemination/other-public

- **Workshops and final conference**

We organized 2 national workshops in Greece and Bulgaria. The aim of the workshops was to present to the audience the SEnDIng project, its main outputs, as well as, exploitation perspectives for the main stakeholders (VET providers, IT professionals and enterprises). For more information, please visit:

http://sending-project.eu/index.php/en/dissemination/workshops

We also organized an online final conference. The aims of the conference were (a) to present the results of the project and how they can be exploited by relevant stakeholders, i.e., higher education institutes, VET providers, enterprises and professionals that are involved in Data Science and IoT projects and (b) to bring together the main stakeholders in order to present initiatives in the domain of education and training on Data Science and IoT and discuss the current and foreseen challenges and how they can be addressed. For more information, please visit:

http://sending-project.eu/index.php/en/dissemination/final-conference.

- **SEnDIng toolkits**

We designed 3 toolkits that provide the basic guidelines for the exploitation of project outputs by relevant stakeholders. These toolkits are available at the following links:

  - For ICT professionals
  - For enterprises
  - For VET providers

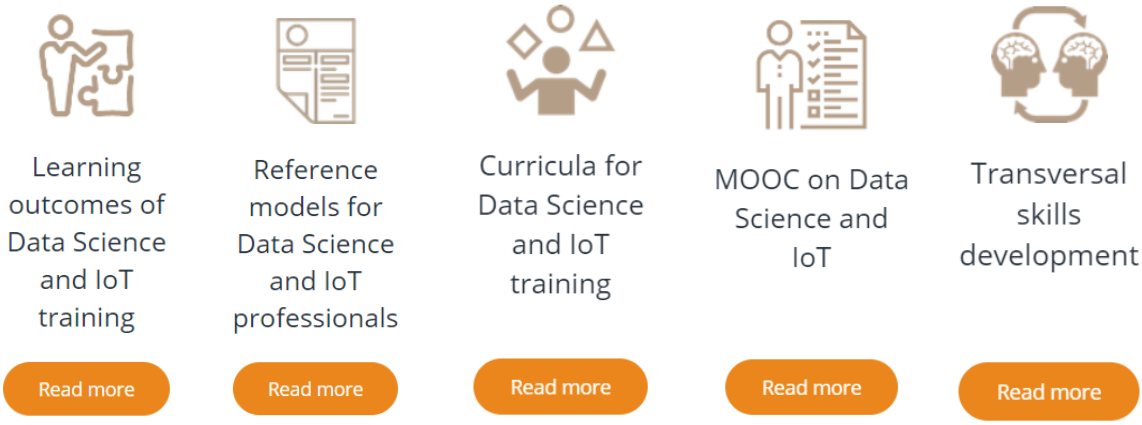

Figure 5: Main results of SEnDIng project

- **Publications**

During the project we made publications of project at the proceedings of international conferences:

1. Gkamas V., Rigou M., Bruce A., Patala T., *Upskilling IT Professionals: A MOOC for the Data Science and IoT domains*, 24th Pan-Hellenic Conference on Informatics, Athens, 20-22 November 2020.
2. Kontodiakou P., Sotiropoulou A., Training of ICT professionals in soft skills: the case of SEnDIng, 24th Pan-Hellenic Conference on Informatics, Athens, 20-22 November 2020.
3. Ampatzidis, D. Oikonomou, P. Kitsos and M. Rigou, *A Smart Home Energy Management System Based on Internet-of-Things*, 2019 Panhellenic Conference on Electronics & Telecommunications (PACET), Volos, Greece, 8-9 November 2019.
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5 Deviations from the work plan

Although the project has as official starting date the 1st December 2017, the activities started with one month delay. The questions raised with the financial management of the project and especially the unit cost model, made hard to all partners to make from the first month their financial planning and recruit staff for the project. Furthermore, the heterogeneity of consortium partners (i.e., public organizations and private enterprises) made more complicated the application of all EC financial rules. This problem was bigger for the universities involved in the project (University of Patras and University of Cyprus), which as public organizations, have time consuming staff recruitment processes, which delayed the establishment of their project teams. Due to the aforementioned reasons, the delivery date of some deliverables scheduled for the first and second semester of the project was delayed, without having any negative impact to the implementation of consecutive deliverables and project activities and the smooth cooperation among the project partners.

Moreover, the COVID-19 restrictions forced us to reschedule some of the project activities that have been planned to be delivered through face-to-face sessions and finally resulted to an extension of project duration by 2 months (January 2021 instead of November 2020). More specific, the COVID-19 situation affected the implementation of the transversal skills training and work-based learning. The transversal skills training, which was initially planned as face-to-face had to be delivered online. This imposed delays on the delivery dates (reorganization and planning changes), which in turn delayed the start of the work-based learning phase (begun in July 2020). In addition, we had cases of trainees that started the training but at some point, before the start of the work-based learning got fired due to COVID-19 and had no company to 'host' them during this phase. We have decided to keep these people in the program and support them remotely.

Also, due to the pandemic and to the long period employees stopped working or worked remotely, companies go through a phase where they had other priorities (other than providing work-based training for their employees) and this in many cases resulted in employees not being able to allocate enough hours to SEnDIng-related projects during the work-based learning phase. Thus, we had a number of requests by companies for extension to the work-based learning phase and it has been extended till November 2020 (the initial plan was to be completed till the end of August 2020). Finally, the project final conference and the certifications exams have been delivered online due to the COVID-19 restrictions.