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Erasmus+ Programme
of the European Union

SEnDIng

D4.3

INTERNET OF THINGS VET PROGRAMME CERTIFICATION

Editor(s):	Georgia Griva, Paraschos Kambageorgiou, Foteini Tzaridou, Nektarios Dimitrakopoulos
Responsible Organisation(s):	UNICERT S.A.

Document Version-Status:	SEnDINg_DLV4.3-final
Submission date:	M37
Dissemination level:	Public

Deliverable factsheet

Project Number:	591848-EPP-1-2017-1-EL-EPPKA2-SSA
Project Acronym:	SEnDIng
Project Title:	Sector Skills Alliance for the design and delivery of innovative VET programmes to Data Science and Internet of Things professionals

Title of Deliverable:	Internet of Things VET Programme Certification
Work package:	WP4 "Implementation of skills certification mechanism"
Task:	4.3 Design of Internet of Things VET program certification scheme
Document identifier:	SEnDINg_DLV4.3-final
Editor(s):	Georgia Griva, Paraschos Kambageorgiou, Foteini Tzaridou, Nektarios Dimitrakopoulos
Reviewer(s):	Vasileios Gkamas (UPATRAS), Maria Rigou (UPATRAS)
Approved by:	Maria Rigou (UPATRAS), All partners

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Delivery Slip

	Name	Partner	Date
From	Georgia Griva, Paraschos Kambageorgiou, Foteini Tzaridou, Nektarios Dimitrakopoulos	UNICERT S.A.	01/12/2020
Reviewed by	Vasileios Gkamas, Maria Rigou	UPATRAS	03/12/2020
Approved by	Maria Rigou	UPATRAS	04/12/2020

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 programme 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 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 programmes, while recommendations will be outlined for validation, certification & accreditation of provided VET programmes.

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.

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1 Introduction

The scope of the deliverable is to present the certification scheme of the Internet of Things VET program developed by SEnDIng. The structure of the deliverable is as follows:

- Section 2 describes the approach and methodology followed for the development of the Internet of Things certification.
- Section 3 describes the examination system developed by UNICERT S.A.
- Section 4 describes the SEnDIng Internet of Things certification procedure.
- Section 5 contains the terms of the code of conduct of the certified persons.
- Section 6 contains the terms of use of the certificate.
- Section 7 contains all the Annexes of this deliverables.

1.1 Scope and objectives

The main goal of this deliverable is to design the certification scheme for the Internet of Things VET program which will be piloted during the project. The intention of the Certification Scheme is to create a functional and scalable framework designed to certify the knowledge, skills and competences provided by the Internet of Things VET program. It covers the requirements for the following five (5) areas:

- Certification scheme categories
- Elements of a certification scheme
- Process requirements
- Development and review of the certification scheme
- Obligations of the participants-Code of Conduct

While working on the topic of Internet of Things certification, the European Qualifications Framework (EQF) recommendation and its main reference level descriptors were taken into consideration:

- ***knowledge*** (the outcome of the assimilation of information through learning. Knowledge is the body of facts, principles, theories and practices that are related to a field of work or study),
- ***skills*** (the ability to apply knowledge to complete tasks and solve problems),
- ***competences*** (the ability to use knowledge or skills in work or study situations)

In order to achieve the main goal, the team had to accomplish the following objectives:

- ***Clarity of the expected impact*** on candidates in terms of knowledge, skills and competences,

- ***Design of a reliable and valid assessment procedure*** able to capture the essence of the knowledge, skills and competences held by an individual,
- ***Aligned with the educational modules***, the examination syllabus and consequently with the examination questions, so that they can complement each other and provide maximum value for the IoT professionals.
- Development of an ***unbiased and reliable examination system***;
- Maintain certification ***examination quality*** for every examination session.

1.2 Audience of the document

The current deliverable serves as a roadmap of the Internet of Things certification mechanism, detailing the steps and the actions taken during the implementation of the certification process.

Thus, the deliverable is addressed to:

a) the *SEnDIng project partners* who shall implement the pilot trainings,

b) the *ICT professionals* who will participate in the training and certification activities of the project,

c) *HEIs, VET providers and certification bodies* that could provide the certification process of other or similar training courses.

The direct beneficiaries of this deliverable include ICT professionals and more specific IoT professionals who work at the ICT sector and other sectors where the IoT is applied (e.g., banking, assurance, energy). Another category of the project's direct beneficiaries, and respectively of this deliverable, are the enterprises that employ ICT professionals who will participate in the provided VET programs, as their employees will be provided with skills and competences that meet their needs together with labour market's needs.

1.3 Definitions

The definitions of the main terms used in this deliverable are the following:

Closed format or closed-ended questions: Multiple choice questions, where respondents are restricted to choose among any of the given multiple-choice answers are known as closed format or closed-ended questions. There is no fixed limit as to how many multiple choices should be given to the respondents.

Multiple answer questions: Multiple answer questions allow respondents to choose more than one answer. This type of question may be used when more than one answer is correct; respondents can select all of the correct answers.

Open format questions or open-ended questions: Open format questions or open-ended questions give your audience an opportunity to express their opinions in a free-

flowing manner. These questions do not have predetermined set of responses and the respondent is free to answer whatever he/she feels right.

Hot spot images: In a Hot Spot question, users indicate the answer by clicking a specific area of an image. A Hot Spot refers to a pre-defined range of pixel coordinates within an image that when clicked indicates a correct answer.

Validation: validation means a process of confirmation by an authorised body that an individual has acquired learning outcomes measured against a relevant standard and consists of the following four distinct phases: a) identification through dialogue of particular experiences of an individual, b) documentation to make visible the individual's experiences, c) a formal assessment of these experiences and d) certification of the results of the assessment which may lead to a partial or full qualification[1].

Certification: Certification is the process of formally validating knowledge, know-how and/or skills and competences acquired by an individual, following a standard assessment procedure. Certificates or diplomas are issued by accredited awarding bodies[2].

Certificate: In the context of Erasmus+, a document issued to a person having completed a learning activity in the field of education, training and youth, where relevant. Such document certifies the attendance and where applicable, the learning outcomes of the participant in the activity[3].

Syllabus: (a plan showing) the subjects or books to be studied in a particular course, especially a course that leads to an exam.

Knowledge: the outcome of the assimilation of information through learning. Knowledge is the body of facts, principles, theories and practices that is related to a field of work or study. In the context of the European Qualifications Framework, knowledge is described as theoretical and/or factual[4].

Skills: the ability to apply knowledge and use know-how to complete tasks and solve problems. In the context of the European Qualifications Framework, skills are described as cognitive (involving the use of logical, intuitive and creative thinking) or practical (involving manual dexterity and the use of methods, materials, tools and instruments).

Competence: means the proven ability to use knowledge, skills and personal, social and/or methodological abilities, in work or study situations and in professional and personal development. In the context of the European Qualifications Framework, competence is described in terms of responsibility and autonomy.

Certification scheme for persons: Competence and other requirements, related to

[1] Official Journal of the European Union, Council Recommendation of 20 December 2012 on the validation of non-formal and informal learning (2012/C 398/01)

[2] Cedefop (2014). Terminology of European education and training policy: a selection of 130 terms. 2nd ed. Luxembourg: Publications Office

[3] https://ec.europa.eu/programmes/erasmus-plus/programme-guide/annexes/annex-iii_en

[4] EC, Recommendation of the European Parliament and of the Council of 23 April 2008 on the establishment of the European Qualifications Framework for lifelong learning

specific categories of professionals and specialized persons, for whom the same procedures, standards and regulations apply[5].

Code of Conduct: A code of conduct is a statement of expected behaviours of the certified person. It can contain a description of professional, ethical or behavioural norms.

1.4 Dependencies with other WPs and deliverables

The current deliverable constitutes the "***final phase***" in the educational value chain of the VET programs. In the chain of implementation of the SEnDIng Internet of Things VET program, this deliverable is directly connected with the deliverables: "D2.2 Reference model of skills, e-competences and qualifications needs of DS and IoT Engineers", "D2.3 Vocational curricula educational modules for Data Science and Internet of Things VET program", "D2.4 Training methodology" and "D2.5 Training monitoring and assessment methodology".

Moreover, this deliverable complies with the requirements of "D6.1: Quality Assurance Plan" and "D6.4: Impact evaluation methodology".

[5] Guidance for the development and recognition of certification schemes for persons conformity with ELOT EN ISO/IEC 17024 Requirements

2 Approach and methodology

2.1 Definition of the labour market's need for knowledge, skills, and competences certification

According to a research conducted by *CEDEFOP* in December 2016[6] Information and communications technology (ICT) professionals conduct research, plan, design, write, test, provide advice and improve information technology systems, hardware, software and related concepts for specific applications. From 2005 to 2015, employment for ICT professionals grew by one third. From 2015 to 2025, about 10% growth is expected, translating into some 400.000 new jobs. Such growth may increase already heavy pressure on supply of ICT professionals. They are a shortage occupation in twenty-four EU Member States and a surplus in just one EU country. The five key skills required for ICT professionals are advanced ICT skills, problem solving, moderate ICT skills, learning and **Job-specific skills.** ICT professionals are a high-skilled occupation: in 2015, seven out of 10 people held high qualifications and about one quarter of them hold medium-level qualifications. ICT is a general-purpose technology, and so changes and disruptions in the economy can have significant influence on the future Skill demands for these professionals.

Overall, increased demand for highly-skilled ICT professionals is expected. However, developments in technology and value chains will likely shift the balance from technical ICT skills to sector-specific knowledge and soft skills such as management and planning. Additionally, ICT technical skills services are increasingly outsourced to non-EU, cheaper markets. Likewise, the growth of the Internet of Things will drive demand for skills and occupations related to architecture and design, knowledge of and skills in handling diversified systems, and understanding of standardisation and interoperability between connected (and to-be-connected) systems. Technical knowledge of IoT networks, and skills for managing the multiple network configurations that are part of IoT networks, are also expected to be in demand.

2.1.1 Target group of the certification scheme

Taking into account the project's requirements, the scheme structure will be based on "D2.2: Reference model of skills, e-competences and qualifications needs of Data Scientists and IoT Engineers", as well as "D2.3: Vocational curricula/educational modules for Data Science and Internet of Things VET program". The knowledge areas that will be covered by the certification are addressed to:

- Learners wishing to demonstrate an understanding of the fundamental knowledge, terminology and activities of IoT. The objective is focused on an understanding of

[6] https://skillspanorama.cedefop.europa.eu/en/analytical_highlights/ict-professionals-skills-opportunities-and-challenges

the overall knowledge areas. The purpose is to certify that a candidate has gained knowledge of the IoT terminology and basic concepts.

- Experienced IoT professionals who would like to prove/improve their proficiency. The purpose is to certify that a candidate has experience with IoT technologies.

2.1.2 Existing research on skills, competences and qualifications required by IoT professionals

The state-of-art in the domain of Internet of Things is similar to the Data Science domain - interdisciplinarity as a main characteristic. Only few VET programs (mainly at beginner's level) are provided by big vendors such as CISCO and BOCSH, universities provide Bachelor programs titled in general as Computer Science/Computer Engineering with specialization in Internet of Things and Master programs titled as Internet of Things. The main difficulties in designing a curriculum on Internet of Things and the challenges in designing education/ training programs in IoT technology are two: (a) there is no consensus among researchers on which scientific domains should be covered in a qualification program on Internet of Things and at what proficiency level and (b) there is no widely accepted skills framework or attempt for taxonomization of the core competences needed by Internet of Things engineers..

2.2 Description of the IoT certification scheme

The components of the certification are the following:

- Definition of the skills and knowledge that the certification scheme covers
- Syllabus
  - Syllabus content (topics to be covered by the certification) aligned with every certification examination module.
  - The percentage of questions from each certification examination module, that will appear on the examinations.
- Examination conditions
  - Prerequisites
  - Conditions and recommendations before and after the examination
  - Duration of the certification examination process
- Type of the certification examination
  - Definition of the number of questions and format (i.e., Multiple choice, True/false, Matching, gap filling, case study questions, etc);
  - Examination format (i.e., web-based or paper based, etc);
- Grading method
  - Definition of the number of correct answers and their grading depending on the different weights or difficulty of the question.
- Passing score
  - Definition of the passing rate

- Delivery
  - Designate the examination centres where the certification examination will be held and the certificate format (i.e., template, hardcopy or e-certificate etc).

2.2.1 The structure of the syllabus of the IoT VET program

The IoT VET program includes 6 IoT related educational modules and 1 educational module for transversal skills. These modules are:

1. **Introduction to IoT (IoT-EM1).** This educational module consists an introduction to the IoT concept and its applications. It aims to make the learners familiar with the IoT technology and present the different roles involved in an IoT project and the common IoT application development tools and methods.
2. **Architectural Design and Applications in IoT (IoT-EM2).** This module introduces the key aspects of the IoT system architecture (IoT edge devices, gateways) with emphasis on server-side infrastructure solutions (cloud computing service models, deployment models and public cloud providers). Furthermore, this module presents the non-functional requirements that should be considered when designing IoT applications, followed by a detailed presentation of the major IoT application domains. Moreover, selected IoT applications are presented along with their characteristics and are classified based on their goal. The learners will then be familiar with the software architectural styles in IoT applications (client-server, peer-to-peer, publish-subscribe, etc.) and how they relate to the predefined IoT application classes. The last sections of the module provide analysis of the considerations for designing IoT applications and present a reference architecture for an IoT Application. Finally, the learners are being guided on how to develop IoT applications in a public cloud provider infrastructure.
3. **IoT Communication Technologies (IoT-EM3).** This educational module introduces the plethora of communication protocols and standards that are used for signaling and data exchange in IoT systems in a comprehensive and visual way. 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 IoT protocol stack is presented and explained. Moreover, the comparison of IoT communication technologies aims at presenting guidelines for the learners to be able to select the right protocol for different applications. Learners complete quizzes and projects to apply their newly acquired skills and knowledge.
4. **IoT Security and Privacy (IoT-EM4).** The IoT may be the most unsecure network encounter so far. Things are now connected to each other forming their own network in a user's private life and is also connected to the highly unsecure network, the Internet. The IoT is now part of our everyday routine. IoT applications include smart cities, transport, and many more in which in certain cases the user cannot

directly control. A computer owner can control the level of security in his/her computer by adapting security measures, not downloading certain applications, using security software etc. A citizen in a Smart City cannot control the security measures employed in the IoT and thus cannot control his/her privacy level. The same applies in every application in which the user may use and has access to the user's privacy. The current module introduces the risks of using IoT and possible measures to create a more secure environment. It aims to create a sense of awareness to the learner of the possible security breaches and how to avoid them by adapting security measures whenever possible.

5. **IoT Devices (IoT-EM5)**. This educational module introduces the "Things" in the Internet of Things. More specifically, it is concerned about the different IoT devices (sensors, actuators, peripherals), their electronics, as well as, different microcontrollers and how they can interact with the environment. The module focuses on how to select and interface common sensors and actuators to support real life IoT applications.
6. **IoT Business Value (IoT-EM6).** This module includes an introduction of IoT in the business world clarifying why companies need to understand IoT business. The aim of this educational module is to get to know the advantages of involving IoT into the business world. The learners will initially see in theory how a company can be transformed with the use of IoT by an overview of the IoT technologies already used in the specific area. Then, the learners can study the different IoT business model types, the different challenges that arise in this area of a business and the landscape of IoT Business. Finally, the learners will with the help of some case studies of successful companies that already have IoT strategies, get to know how all this information will be in practice. Learners will complete quizzes with questions based on their newly acquired skills and knowledge.
7. **Transversal Skills (TS):** As part of SEnDIng vocational training, we have 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.

2.2.2 Description of the IoT knowledge, skills, and competences to be certified

The knowledge, skills, and competences that are certified by the SEnDIng IoT certification are the following:

1. Internet of Things

Knowledge

- Describe the value that IoT delivers in different business domains
- Explain the business processes related to IoT in specific domains
- Understand IoT architectures and the related network and communication protocols
- Recognize different types of sensors, actuators, displays and related embedded electronics
- Design the application level (e.g. use protocols that support different IoT applications) of IoT in the context of big data, cloud technologies and data science
- Formulate requirements about IoT information security

Skills

- Analyse, argue and describe the business value of a particular IoT system
- Design an IoT system that includes sensors, controllers, actuators and displays, connected to a cloud platform through internet connection
- Develop and deploy workflows and dashboards for an IoT system that includes sensors, controllers, actuators and displays, connected to a cloud platform through internet connection
- Develop working code for an IoT system that includes sensors, controllers, actuators and displays, connected to a cloud platform through internet connection
- Apply IoT information security concepts

Competences

- Exercise self-management within the guidelines of work or study contexts that are usually predictable, but still are a subject to change;
- Supervise the routine work of others, taking some responsibility for the evaluation and improvement of work or study activities;

2. Transversal Skills

- Communication skills
- Adaptable to change
- Teamwork
- Ability to present in front of colleagues and clients
- Goal-oriented
- Thinking outside the box
- Agile mindset

2.3 Certification criteria and prerequisites

The table below presents the prerequisites for participation in the pilot IoT training programme.

Diplomas	Work experience in the field of ICT (in years)			
	0	>=1	>=2	>=3
General Upper Secondary Education				✓
Vocational Upper Secondary School or Post-Secondary Education (both in ICT fields)				✓
Bachelor in the field of ICT from a Higher Educational Institute		✓		
Bachelor in the field of engineering (other than ICT), physical sciences, life sciences, mathematics, financials and business administration from a Higher Educational Institute			✓	
Post-graduate degree (MSc and/or Phd) in the field of ICT from a Higher Educational Institute	✓			
Post-graduate degree (MSc and/or Phd) in the field of engineering (other than ICT), physical sciences, life sciences, mathematics, financials and business administration from a Higher Educational Institute		✓		

Table 1: Prerequisites for participation in the pilot Internet of Things training program

The level of knowledge is evidenced by the diplomas demonstrated in the aforementioned table, while that of the work experience by tax or insurance data, accompanied by an appropriate employer's declaration or an employer's recommendation letter mentioning the participant's relevant job description and the period of the assignment. These documents will be asked during the applicants' expression of interest for participation in the pilot programme.

Only those who will have successfully completed the three phases of the training programme (online Internet of Things courses, transversal skills training and work-based learning) will be eligible to participate in the final exams leading to certification.

Other potential prerequisites to take into consideration are the following:

1. Age: As for the age criterion we think that probably it is not necessary (i.e., more than 18 years old), since the professionals normally are older (at least the ones with the work experience that we demand).
2. Physical ability: A prerequisite for their physical abilities (i.e., without disabilities), probably it is not necessary. If all partners agree, we could request from the participants a declaration where they will certify that "the specific needs of the participant do not interfere in the training and work-based learning of the program or the assessment procedure during the certification examination process".

2.4 Specifications of the assessment method

2.4.1 Types of the examination questions

The IoT certification exam lasts forty-five (45) minutes and is composed of twenty-eight (28) questions, which are distinguished based on their degree of difficulty in easy (50%), moderate (25%) and difficult (25%). All questions are of "closed type". For example:

- select one correct answer out of many given answers (selection of a correct choice by many)
- select the correct answers (at least two) from the given answers (selection of many correct answers out of many questions)
- filling the answer or filling in the missing text of a sentence (filling in the blanks),
- selection of the right part or parts of an image (hot spot themes) etc.

One candidate succeeds at the exams if he/she answers correct at least 70% of the questions.

2.4.2 Degree of difficulty and assessment

For each close-ended question the difficulty level will be determined upon the sum of four (4) assessment parameters.

Assessment parameters

- Number of corresponding syllabus elements: 1, 2, ≥3
- Degree of critical thinking that is required: 1: less, 2: medium, 3: more
- Degree of popularity/commonality of used terms: 1: more, 2: medium, 3: less
- Theoretical/Practical nature of the question: 1: Theoretical, 2: Practical

Difficulty level of each question

- Easy: 4-5
- Moderate: 6-7
- Hard: ≥8

Scoring

For each correct answer, the participant will be automatically awarded by the certification examination platform one (1) point and for each wrong a zero (0) point. There is no negative score.

2.4.3 Total number of questions per examination

Each test will be comprised of 28 close-ended questions with the proper dispersion. The distribution of questions among the educational units is depicted at the following table. For each educational module five (5) questions will be randomly selected from a question pool.

Allocation of questions in an examination test		EDUCATIONAL MODULES/TRAINING UNITS																
		IoT-EM2			IoT-EM3			IoT-EM4			IoT-EM5			IoT-EM6			Transversal skills (TS)	Total
		I	C	A	I	C	A	I	C	A	I	C	A	I	C	A		
Degree of difficulty	Easy	1	2			2	1	1		1		1	1	1		1	2	14
	Moderate		1		1				2				1		1		1	7
	Difficult			1		1			1		1					2	1	7
Total		**1**	**3**	**1**	**1**	**3**	**1**	**1**	**3**	**1**	**1**	**1**	**2**	**1**	**1**	**3**	**4**	**28**

Table 2: Allocation of the close-ended questions in an examination test

2.4.4 Questions' pool for the IoT VET programme

The total number of close-ended questions must be at least 168 (i.e., 6 times the total number of the questions of one examination test, to ensure objectivity, transparency and randomness of the test produced for each participant), as indicated in the following table. Annex 1 gives the question pool for the IoT certification exams.

Allocation of questions of the questions pool		EDUCATIONAL MODULES/TRAINING UNITS																Total
		IoT-EM2			IoT-EM3			IoT-EM4			IoT-EM5			IoT-EM6			Transversal skills (TS)	
		I	C	A	I	C	A	I	C	A	I	C	A	I	C	A		
Degree of difficulty	Easy	4	7	4	4	7	4	4	6	4	4	6	4	4	6	4	12	84
	Moderate	2	4	2	2	3	2	2	3	2	2	3	2	2	3	2	6	42
	Difficult	2	4	2	2	3	2	2	3	2	2	3	2	2	3	2	6	42
Total		**8**	**15**	**8**	**8**	**13**	**8**	**8**	**12**	**8**	**8**	**12**	**8**	**8**	**12**	**8**	**24**	**168**

Table 3: Allocation of close-ended questions to be included in the pool

3 Examination system developed by UNICERT

This section presents the examination system developed by UNICERT and approved by the Hellenic Accreditation System. The **e-CERTify** online proctoring system developed by UNICERT provides a unique option to those who wish to certify their knowledge and skills through remote examinations. e-CERTify is an integrated system designed to implement distance monitoring of exams for persons certification. The relevant process takes place in an easy-to-use, but completely safe environment both for UNICERT and the candidate, ensuring the exam's reliability and transparency at the same time.

With online proctoring, the exam is carried out remotely at the candidate's workspace with the use of his own personal computer, which should have internet access and video and sound equipment (i.e., web-camera, microphone, speakers).

3.1 Technical requirements for participation in the certification exams

The technical requirements for participation in the certification exams supported by the e-CERTify online proctoring system are the following:

- General Requirements
  - An Internet connection – broadband wired or wireless (3G or 4G/ LTE)
  - Speakers and a microphone – built-in or USB plug-in or wireless Bluetooth (headsets are not allowed)
  - A webcam or HD webcam - built-in or USB plug-in
  - An Email Account
- Supported Operating Systems
  - Windows 7 or higher. For devices running Windows 10, they must run Windows 10 Home, Pro, or Enterprise. Safe Mode is not supported.
  - MacOS 10.7 or higher
- Supported Browsers
  - Windows: IE 11+, Edge 12+, Firefox 27+, Chrome 30+
  - Mac: Safari 7+, Firefox 27+, Chrome 30+
  - Linux: Firefox 27+, Chrome 30+
- Processor and RAM requirements
  - Processor: Single Core 1Ghz or Higher (Minimum) or Dual Core 2Ghz or Higher Intel i3/i5/i7 or AMD equivalent (Recommended)
  - RAM: 4 GB
- Internet connection
  - 1000kbps (up/down) for high quality video
  - 1.2 Mbps (up/down) for 720p HD video
  - Receiving 1080p HD video requires 1.8 Mbps (up/down)
  - Sending 1080p HD video requires 1.8 Mbps (up/down)

3.2 Required actions before the exam date

e-CERTify special Browser Installation

Before you take the exam, you need to install a special Browser. This includes 2 steps:

Step 1: Install Mozilla Firefox

if you haven't already, by visiting the following link:

https://www.mozilla.org/el/firefox/new/

Step2: Install e-Certify special Browser

Prior to the exam date, an email will be sent to you, including:

a) A link for downloading and installing a special Browser;

b) An attached file of settings specific for the exam.

Install the Browser (a), and then double click the attached file (b), so that the exam settings take effect.

Checks to be done before the exam

➢ A valid Government issued Identification Document should be available, such as a national ID card, passport, driving license, military card or social security card (including a photograph and date of birth in English characters);

➢ Virtualization software such as VMware or Virtual Box must be disabled. For exam security reasons, the e-CERTify special Browser cannot run through any virtualization software;

➢ You can rotate your webcam 360 degrees;

➢ You are the only person in the room throughout the exam session;

➢ There is no background noise in the room;

➢ There is adequate light in the room, but no direct light towards the web camera;

➢ Thera are no papers, books or notes on the desk;

➢ Your computer sound settings are set to Speakers and Microphone since headsets are not allowed during the examination;

➢ Mobile phones should be set to silent and not deactivated, so that contact is feasible in case of technical issues.

Note: *The exact Date and Time of the Exam has been communicated and agreed with the candidate.*

3.3 Required actions during the exam date

Check-In

Step 1: Link for online Conferencing and Credentials

On the Exam date and 30 minutes before the time of the Exam, an email will be sent to you, including:

a) A link for online Conferencing

b) The Exam Credentials (i.e., candidate ID and Password)

Follow the link, save and run the online Conferencing application.

Step 2: Log in to the online Conferencing application

By running the online Conferencing application, you are also logging in a waiting room.

Step 3: Candidate Verification

The invigilator needs to verify your ID before you begin the exam. With the use of the Conferencing application and the webcam, the invigilator verifies the ID of the Candidate.

Step 4: Check of Video and Audio settings

➢ Your computer sound settings are set to Speakers and Microphone since headsets are not allowed during the examination.

Step 5: Check of the Candidate's workspace

➢ You are the only person in the room throughout the exam session;

➢ There is no background noise in the room;

➢ There is adequate light in the room, but no direct light towards the web camera;

➢ Thera are no papers, books or notes on the desk.

Step 6: Waiting the other Candidates

Please, wait until all others in your exams session are checked-in.

Exam Period

Step 1: Run the e-CERTify special Browser

By running the previously installed special Browser, you are invited to sign in the Exams platform. Now it's the time to use the Exam Credentials you have received (i.e. candidate ID and Password).

Note: From now on and until the end of the Exam, your computer is locked down. No application can run except the Exam, and no keyboard shortcuts and keys are available except those the Exam Administrator allows for the appropriate running of the Exam.

Step 2: Take the Exam

During the Exam:

- The invigilator monitors your movements
- The invigilator can see the candidates, but the candidate cannot see him/her
- Both candidates and the invigilator are muted
- Requests from the candidates to the invigilator are communicated through chatting
- If necessary, the invigilator makes appropriate announcements
- The 2nd warning from the invigilator to the candidate cancels the exams for the specific candidate.

Check-Out

- When you have completed your exam, click End Exam.
- Your answers are automatically submitted, and no changes can be made.
- The invigilator confirms the end of the Exam and that the Exam session has successfully completed.

Additional Information

- One (1) invigilator monitors six (6) Candidates
- In case that the Candidate does not sit for the exam for some reason (e.g., sickness), the exam is cancelled for the specific Candidate
- The candidate is not allowed to take any breaks during the Exam
- Technical problems on behalf of UNICERT cause the cancellation of the Exam. While technical failure on behalf of the Candidate cancels the Exam for the specific Candidate

Anti-Cheating Issues

During the check-In process, Candidates are required to provide documentary proof of identity. The invigilator takes a few minutes for the verification, after which the Candidate is required to physically scan/turn the camera around the entire room so that the invigilator is able to examine the room for possible sources of information. Books, notepads, various digital devices, notes on the wall, papers, pens, and other items — including a second computer monitor — are not allowed in the testing environment.

The webcam technology makes it possible for the invigilator to keep watch on both the Exam taker and her/ his workspace during the Exam. The invigilator monitors the candidate continuously throughout the whole Exam process and can ask the Candidate for an additional camera scanning in case of any suspicious activity comes to mind. The invigilators are well trained and experienced to detect any hints of malpractice related to Candidate's eye movement and body language. In case that something suspicious is detected, the Candidate is warned once. In case of a second warning, the Candidate is disqualified and the Exam is terminated for him/her.

3.4 Human Resources requirements

UNICERT S.A. ensures that Certification Examiners are suitably qualified and have received the necessary training to enable them to carry out the supervision of the certification examinations (including tele-examinations) in accordance with the requirements of UNICERT S.A. The examiners sign a relevant form of acceptance of conditions for compliance with the standards of supervision, confidentiality and impartiality required by UNICERT S.A. At the start of cooperation with each new supervisor, an update (Quality Protocol-22) is provided for:

- the Quality Management System implemented by UNICERT S.A.,
- the certification examination procedures followed,
- all other procedures relating to his employment, and
- Possibility to attend a supervision as a trainee in order to follow the process closely, before undertaking a supervision on his own.

4 SEnDIng IoT certification procedure

4.1 Certification steps

The SEnDIng IoT certification procedure includes the participation in one examination and in case of failure, participation in two (2) reassessments. Upon completion of the certification exams (examination and retest), a list of participants in the certification exams will be issued, which will record the results of the examinations. For those who have succeeded in the exams, a decision will be taken to issue their certificates. In detail, the certification path consists of the following steps:

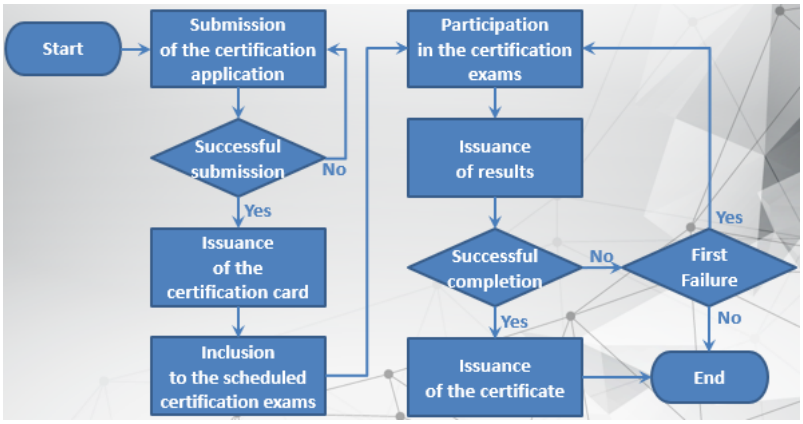

Figure 1: SEnDIng certification steps

Step 1. Submission of the certification application and the necessary supporting documents for each candidate.

Step 2. Verification of the Application for Certification and its supporting documents for each candidate.

Step 3. If the application is approved, issuance of the Skills Card for each candidate, otherwise resubmission of the correct application and/or supporting documents (repeating steps 1 and 2).

Step 4. Inclusion of the candidates to the scheduled certification exams.

Step 5. Participation of candidates in the certification exams.

Step 6. Immediate issuance of results at the end of the examination process. For those who did not successfully complete part of the modules of the certification exams or the whole examination there can be two (2) repetitions of steps 4 to 6.

Step 7. Issuance of a decision to grant certificates to those who have successfully passed the certification exams.

4.2 Submission of the certification application

Those interested to participate in SEnDIng certification exams have to fill in the online form https://unicert.gr/european-project-en/?lang=en with the following data:

- Personal Data
  - First Name, Last Name, Father's name, Mother's name
  - Identity number (dentification card (ID) / Passport / Other)
  - Gender (Male/Female)
  - Full address (Street / Number / Area / P.C / City)
  - Landline Number
  - Mobile phone number
  - E-mail address
  - Country
  - Occupation
- Special needs
- Supporting documents
  - Photocopy of ID document
  - Photocopy of graduation certificate from an educational institution (at least of Compulsory Education)
- Preferrable date for participation in exams

4.3 Verification of the certification application and its supporting documents

The review of the application focuses on:

- Check of the completion of the mandatory fields.
- Identification of application details and documents / supporting documents submitted.
- Existence of a handwritten signature.
- Existence of other evidence (what is required by the certification).
- Check for previous entries in the examinations.
- Check for earlier misuse of the certificate by the applicant; in this case, the application is considered rejected.
- Acceptance of the terms of personal data management.
- Applicant's agreement on the terms of Certification.

4.4 Certification Exams Schedule

The candidates will be informed for the date of conduct of the certification examinations carried out at least 15 days prior to the completion of the certification. The information will be communicated to the applicants with reference to:

- The examination centre info (email, contact phone number, contact person);
- The date and exact time of conduct of the examination;
- Information for persons with disabilities;
- Anything else considered necessary.

4.5 Participation of candidates in the certification exams

As we have mentioned at Section 2, the examination process will last 45 minutes and will consist of 28 closed-ended type questions, which will be distinguished by the degree of difficulty in easy (50%), moderate (25%) and difficult (25%). The examinees will be able to:

- choose one answer that they consider correct from a series of possible answers (multiple choice)
- select from the given answers (at least two) that are correct (multiple choice)

A candidate succeeds at the examination if he/she answers correctly at least 70% of questions (20 correct answers out of the total 28). In this case and after the necessary checks, the corresponding certificate is also issued. During the period of each examination, candidates must meet the requirements of their subjects, having as well the chance to check their responses and make possible corrections before confirming completion. In case of retaking the exam due to failure in a certification subject, the examination platform will ensure that the same set of exam questions is not displayed.

4.5.1 Steps during the examination process

The test will be conducted on a digital exam platform specially designed for the certification/examination tasks of the project and according to the quality assurance procedures of UNICERT S.A. Moreover, the online proctoring system of UNICERT presented at Section 3 will be used:

The steps taken are the following:

1. Start the exam application.
2. Enter the exam code to the corresponding field.
3. Introduce the unique Unicert Supervisor Code and the Supervisor from the Registry of Auditors-Supervisors-Auditors-Inspectors-Experts of EOPEPEP, on each computer.

Then the details of an examiner who is invited to come to the computer screen are displayed. This action is repeated on each computer for each supervised exam period.

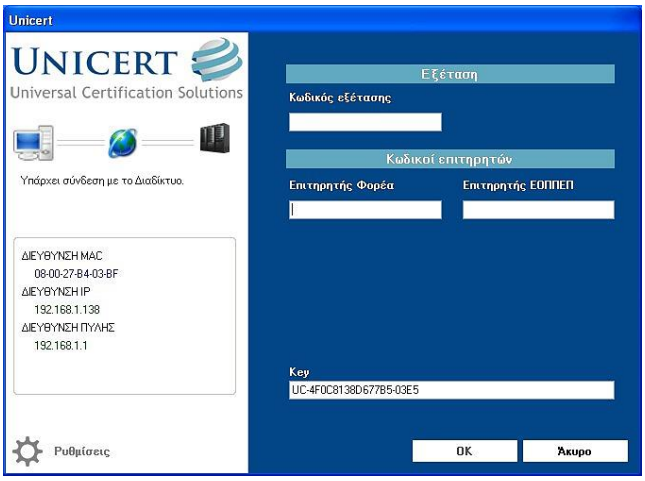

Figure 2: Certification exams platform for SEnDIng project (1/2)

4. Give to the candidates their username and password in order to enter the corresponding field.

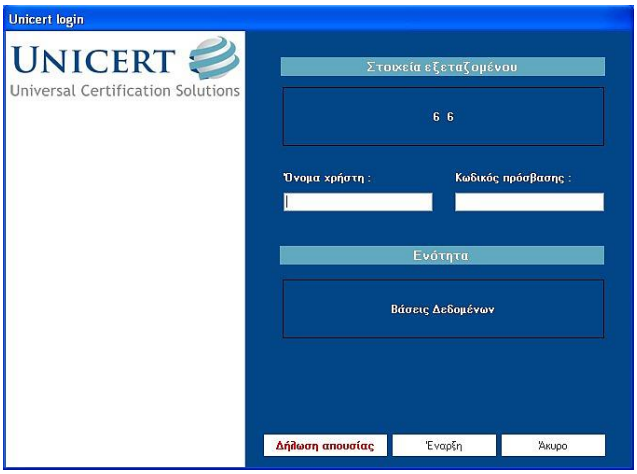

Figure 3: Certification exams platform for SEnDIng project (2/2)

5. In case of an absence of a candidate the supervisor enters his code in order to confirm the absence. If the test does not start and the start time has elapsed, the absence is automatically declared in the system.

   NOTE: A prerequisite for starting the exam is to have an Internet connection to download the exam questions.

6. The exam form appears at the bottom of the screen at the beginning of the test. Depending on the question, the application is properly adjusted. When the examiners are confident that they have responded correctly to what the text to speech is asking for, they select the Confirm button. If they want to think about it and answer it at the end, pressing the Previous and Next buttons they are redirected to other unanswered

questions. With the Reload button, the exam question returns to its original format without any action taken. Also, it is possible to increase or decrease the font size of the text, contrasting the text and background colours and the "pin" of the screen.

7. If the test is not responding, recovery is performed, and the test data is not lost. The examiner terminates the examination process (Inspector.exe) from the Task Manager and reopens the application. The test returns to where it was when the Confirm button was last pressed.
8. Quit Exit: If all the questions are answered, a successful result message is displayed. If there are unanswered queries, a table with the corresponding queries appears and there is the possibility of returning to the test. If the candidate wishes, he/she may terminate the exam at any time by clicking the end button, even if there are unanswered questions.

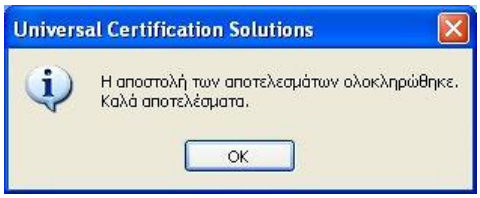

Figure 4: Successful submission of answers

NOTE: If an error is reported while the results are being sent, a check is made on the Internet connection. If the problem is restored, by pressing OK the results are successfully sent. If it is not restored, it is important to type the exam code and the supervisors' code and then save the encrypted file to the user's selection folder (desktop is recommended). Then, through the "Settings" and the tab "Examination System", in the "Send Results" field, the user selects the "From file" choice and he/she searches the encrypted file that has been saved. Another option is to send it with a code, always in consultation with the responsible of the examinations.

1. As soon as the results are successfully sent, the second examination session may start by repeating the procedure with steps 1-4.
2. At the end of all the examination periods/sessions, the following actions take place:
    a. Verification that all candidates have simultaneously stopped the examination process by announcing the end of the exams.
    b. Optional completion of the applicant satisfaction survey questionnaire, which is anonymous.
    c. The Supervisors shall confirm that all the examinations have been taken.
    d. Completion of the Certification Examination Report by the supervisors.

4.6 Assessment of the results

The assessment of the results/performance of the candidates will be performed automatically by the on-line examination system/platform. At the end of each examination test there will be possible to receive from the central test server encrypted electronic files with the results of the evaluation carried out over the Internet.

4.7 Delivery of a certificate

This task requires the successful participation in the certification exams, according to the defined success threshold (70%). The partner that is responsible for the certification tasks will issue the certificates in digital and/or hard copy (following the agreed template as cited in the Annexes of the current deliverable) and send them by mail to the successful candidates.

5 Code of conduct of the certified persons

5.1 Participants' obligations

In order to participate in the certification examination, the participants have certain obligations until the end of the examination process. These obligations are included in the term code of conduct which has been carefully set as a series of commonly followed rules. More specifically:

- Connected to the examination system: at least thirty (30) minutes before the beginning of the certification exam. After the beginning of the examination the entry of candidates in the examination system will not be allowed.
- Necessary documents for the participation of each candidate in the examination:
    - The certification card and
    - The original identification document and a copy of it, which was submitted with the certification application.
- Items allowed in the surround space: thermos / bottle of water or soda.
- Items forbidden in the examination procedure:
    - Any type of electronic storage media (ie, removable USB drives) and
    - Any type of external image capture devices / audio / video (ie, cameras). It should be noted that, upon approval by the supervisors of this examination, any type of telecommunication devices is not allowed (ie, mobile phones) in the examination space.
- Smoking is strictly forbidden during the examination. The temporary exit for smoking is forbidden for all candidates during the examination. It should be noted that before the start or between the examination of two modules.

During the conduct of the Certification Examination

- The behaviour of the candidate during the conduct of the examination should be determined by the known rules of discipline and respectful behaviour. Candidates must comply directly to any suggestions or recommendations of the supervisors. Failing to comply with the above, can even lead to their exclusion from the examination, which is considered unsuccessful and scored with zero (0).
- Activating and using the telecommunication devices during the examination (i.e., mobile phones) is prohibited, if they are not taken away by their supervisors, for as long as the examination lasts.
- Any attempt or actions/methods of copying answers and generally preventing the proper conduct of the examinations or alteration of their results, is prohibited and people responsible will be disqualified, their examination will be considered unsuccessful and scored with zero (0).

- During the examination candidates are not allowed to exit the examination system, without the approval of the supervisors.
- Candidates are not allowed to remain in the examination system after completing their examination.

5.2 Participants' rights

Each person, a candidate for certification, has the following rights:

- Submission of the certification application online via UNICERT S.A. website.
- Ability to conduct a "simulation test" prior to examination in any designated Center of the ERASMUS+ project partnership in order to familiarize yourself with the examination procedure.
- Complete control of his/her answers to the syllabus that there are going to be examined.
- Object to any matter related to the examination procedure.
- Use of the certificate issued by the organization after the successful completion of its certification, anywhere in the Private and/or Public Sector, without violation of the conditions accompanying it.

5.3 Participation instructions

Individuals who wish to participate in certification exams should:

1. Contact the UNICERT S.A. in order to obtain a Certification Card.
2. Submit the Certification Application Form which can be found in the following link. Moreover, a scanned copy of a valid form of identification and any additional supporting documentation are required to publish the Certification Card. This card is been received by the candidates. It contains personal information, certification category, the tested modules, their performances at the exams, as well as instructions for use.
3. Be on time to login to the examination system, presenting the certification card and the original form of identification, which they had displayed. Note that in case of failure, the candidates are retested with the same card, following the steps 3 and 4.
4. Receive their Certificate within a maximum period of ten (10) working days after their successful participation in the certification exams.

Valid form of identification means:

- For Greek citizens: identity card or a temporary certificate of the competent authority, passport, driving license, personal insurance booklet.
- For citizens of the European Union: identity card, passport.

- For citizens of countries outside the European Union: visas, residence permit, work permit.

6 Terms of use of the certificate

1. The **Certificate of the VET program Internet of Things**, may be used as official proof of certified knowledge and skills only for the modules described herein, according to Certification Scheme Regulation (CSR) and its Appendix (CSR-APDX2D) that corresponds to the modules.
2. The holder of this certificate may declare and display possession of said certificate only for the modules described herein.
3. The holder of this certificate may not use it in any misleading or otherwise improper manner.
4. The holder of this certificate may not state anything with regard to this particular certification that may be construed as misleading or otherwise improper.
5. The holder of this certificate must immediately inform the partnership of the ERASMUS+ project SEnDIng of matters that can affect his/her capability to continue to fulfil the certification requirements.
6. The holder of this certificate must cease any usage or mention of said certificate immediately upon its revocation or withdrawal regardless of reason.
7. The holder of this certificate must return all documents relevant to the certificate being revoked or withdrawn, including the certificate itself, to the partnership of the ERASMUS+ project SEnDIng immediately.

7 References

[1] Official Journal of the European Union, Council Recommendation of 20 December 2012 on the validation of non-formal and informal learning (2012/C 398/01)

[2] Cedefop (2014), Terminology of European education and training policy: a selection of 130 terms. 2nd ed. Luxembourg: Publications Office.

[3] ERASMUS+ Programme Guide, Annex III Glossary of terms, (https://ec.europa.eu/programmes/erasmus-plus/programme-guide/annexes/annex-iii_en)

[4] EC, Recommendation of the European Parliament and of the Council of 23 April 2008 on the establishment of the European Qualifications Framework for lifelong learning

[5] Hellenic Accreditation System, Guidance for the development and recognition of certification schemes for persons conformity with ELOT EN ISO/IEC 17024 Requirements

[6] CEDEFOP, ICT professionals: skills opportunities and challenges, https://skillspanorama.cedefop.europa.eu/en/analytical_highlights/ict-professionals-skills-opportunities-and-challenges, December 2016

8 Annexes

The Annexes attached to the deliverable are the following:

- Annex 1: Template of SEnDIng Internet of Things certification
- Annex 2: User manual for online proctoring system
- Annex 3: Certification Procedures Frequently Asked Questions

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Annex 1

Template of SEnDIng Internet of Things certification

UNICERT
Universal Certification Solutions

SEnDIng
Sector Skills Alliance for the Design and Delivery of Innovative VET Programmes to Data Science and Internet of Things Professionals
Erasmus+ KA2, 2017-3184/001-001

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

UNICERT SKILLS
CERTIFICATION OF KNOWLEDGE & SKILLS

This is to certify that:

Name Surname:

Father's name/Mother's name:

Date _____

Has succeeded in the examinations for the following modules:

Internet of Things (IoT)

(certification scheme in the frame of the ERASMUS+ project Sector Skills Alliance for the design and delivery of innovative VET programmes to Data Science and Internet of Things professionals-SEnDIng 591848-EPP-1-2017-1-EL-EPPKA2-SSA)

_____

N. Noulas
Legal representative of UNICERT S.A.

ΠΑΝΕΠΙΣΤΗΜΙΟ ΠΑΤΡΩΝ UNIVERSITY OF PATRAS · ΕΤΥ · OLYMPIC Training & Consulting · BASSCOM Bulgarian Association of Software Companies · ESIcenter Eastern Europe · Πανεπιστήμιο Κύπρου University of Cyprus · universal learning systems · yadiwo · mixanografiki · CODE RUNNERS · Nemetschek BULGARIA · UNICERT Universal Certification Solutions

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Annex 2

User manual for online proctoring system

SEnDIng Project

UNICERT Teleproctoring Exams

INSTRUCTIONS to Examiners

1.General Requirements

- ✓ Desktop or Laptop (Windows XP or later)
- ✓ Internet connection
- ✓ Camera & Microphone & Speakers
- ✓ E-mail

2. Installation of required programs

In order to complete the test, you need to install a specific test program (UNICERT Exams Client) as well as a video conferencing program (Zoom Meetings), before the scheduled date of the examination.

Download & Install UNICERT Exams Client & Zoom Meetings

- ✓ UNICERT Exams Client
  - Version for Windows XP or later (download here)
  - If needed, download the .netFramework 4 by clicking here
  - For Windows XP, Service Pack 3 has to be installed.
- ✓ Zoom Meetings (download here).

Before the test, make sure that your microphone and speaker are working in any zoom meeting.

3. Exam preparation

- ❖ Make sure that you have an identification document available, such as Identity card, Passport or Driver's License
- ❖ The camera can be rotated 360 degrees.
- ❖ There are no other persons in the area during the examination.
- ❖ There is no background noise.
- ❖ There are no papers, books, notes.
- ❖ There is sufficient lighting that does not disturb the camera.
- ❖ Speakers are allowed, but headphones are not.
- ❖ Mobile phones are muted, not switched off.

4. Before the examination

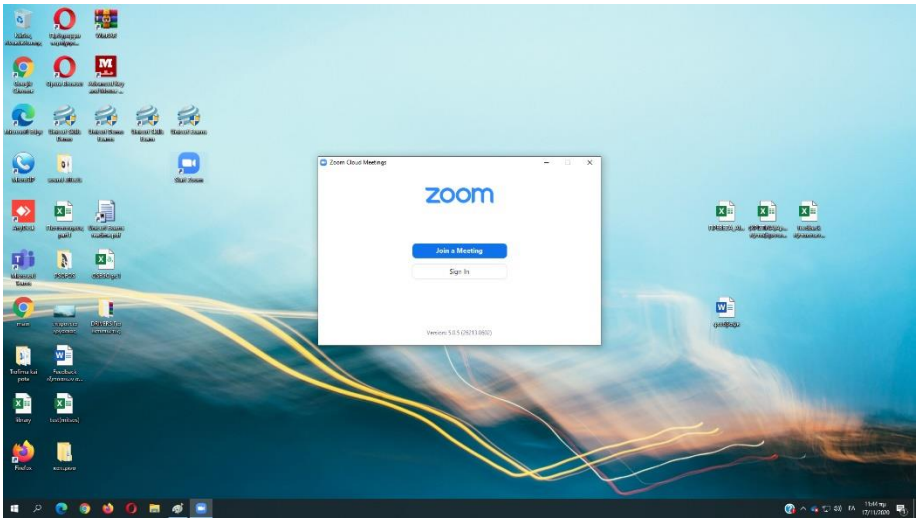
Two (2) days before the examination, you will receive an e-mail that includes:

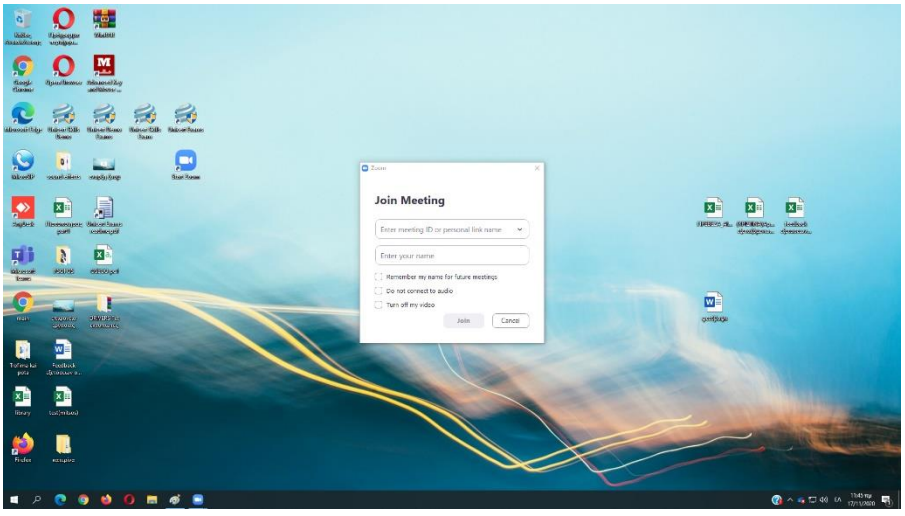
- ✓ Link and Meeting ID for Teleproctoring written exams.
- ✓ Exam Codes (candidate ID and Password). Write down the codes, they will be needed in the next step.
- ✓ Dates and hours of written exams, respectively.

5. Check-In

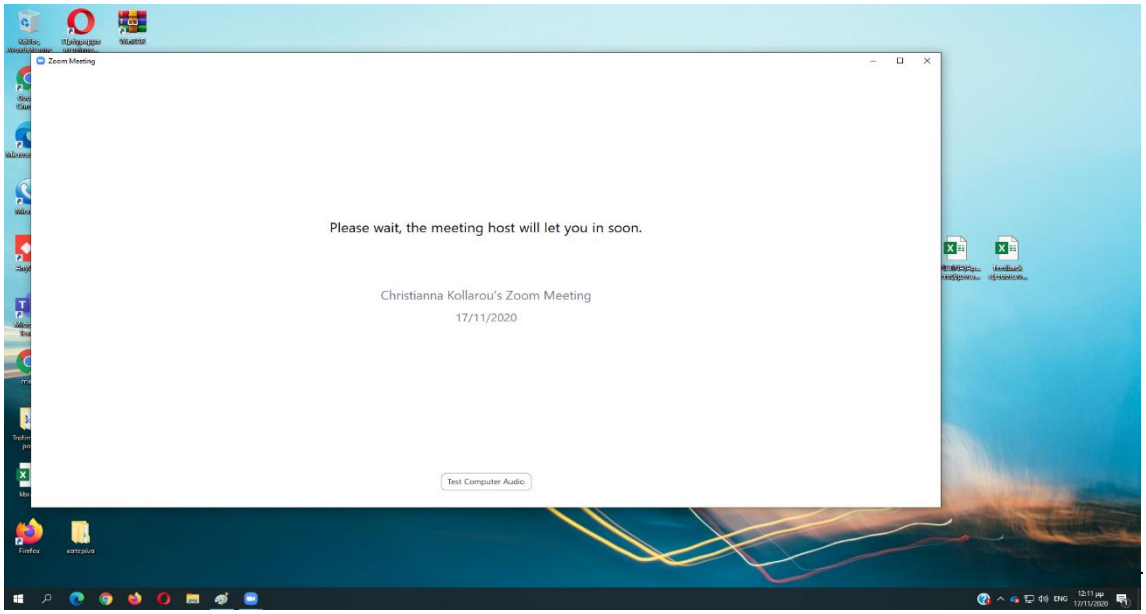
Starting the Zoom meeting

At least 30 minutes before the scheduled test time, start the Teleproctoring session. On the Zoom window, select "Join a Zoom meeting", enter the ID meeting that was sent to you via email, your name and surname, as stated in the ID document.





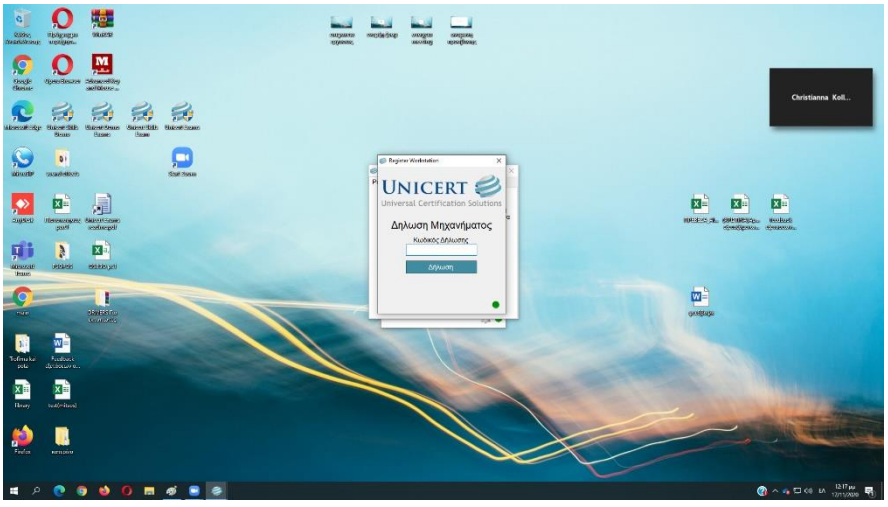
When launching the Videoconferencing application, you enter a "waiting room" and wait until the certified proctor admits you.



Once you enter the Video Conference room, the following procedures are performed:

- ✓ Picture and sound settings are checked.
- ✓ Using the camera, the certified proctor verifies your identity.
- ✓ Check of your space.
- ✓ Wait for all candidates to be admitted.

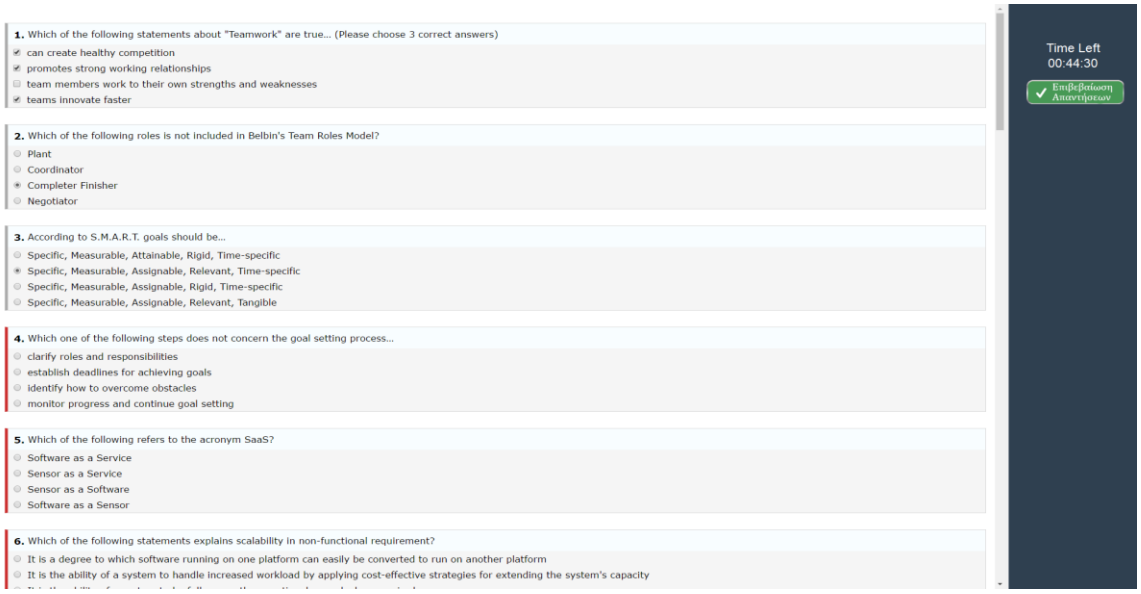
At the same time, you start the exam program, which will ask you to register your computer on the first window, in order to begin with the examination. The specific declaration code will be given by the proctor, after validating the details of all participants.



6. Examination

Enter the credentials you have been given in the email you received. From this point until the end of the exam, your computer is "locked", only the exam application and the teleproctoring application are running.

During the examination, each unanswered question has a distinctive red line. If there are still unanswered questions in the submission, a pop-up dialog box will point this information to the candidate.



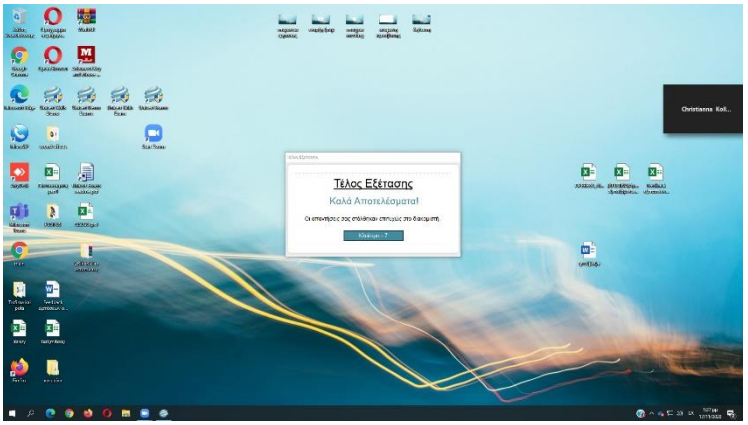
During the examination:

- The certified proctor monitors your movements. He sees you but you don't see him.
- The proctor as well as the candidates are muted.
- When needed the proctor makes relevant announcements.
- Should the proctor warn the same candidate twice, his examination is cancelled.

7. Check-Out

When you have finished the exam, click on the relevant button to declare the end. Replies are submitted automatically and no changes can be made.

The Supervisor confirms the end of the Examination and the successful completion of the procedure.



Best of luck!

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Annex 3

Certification Procedures Frequently Asked Questions

Certification Procedures Frequently Asked Questions

Q1. When the final exams will take place?

The final exams will take place in two rounds. The first round will be on November 2020 and the second round on December 2020. The specific dates of the exams will be defined in consultation with those expressing interest to participate in the exams.

Q2. How many chances I have in order to pass the final exams?

There are 2 chances to pass the final exams. In the case that you will fail to pass the exams during the first round (on November) or the second round (on December), there will be a resit round on late December.

Q3. How the final exams will be delivered?

Due to the COVID-19 outbreak, the final exams will be delivered online with eProctoring using your own personal computer.

Q4. Which are the requirements of the online exam?

The minimum requirements of the online exam are the following:

- Photo ID (A valid Government issued ID that includes a photograph and date of birth in English characters, such as a National ID card, Passport, driving license or social security card.)
- A quiet room with sufficient light and a clean desk. No other persons are allowed to be present in the room.
- External or integrated Web camera able to rotate 360^{o}
- Desktop or laptop with Internet connectivity (at least 512/512 kbps for uploading /downloading)
- Speakers and microphone

Q5. Which is the duration of the exam?

The duration of the exam is 45 minutes.

Q6. Which topics will cover the exams?

For those attending the Data Science training, it will cover the following modules

- 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
- TS: Transversal Skills

For those attending the IoT training, it will cover the following modules

- 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
- TS: Transversal Skills

Q7. Which will be the format of the exam?

The format of the exam is the following

- It will be delivered in English.
- It contains 28 multiple choice questions.
- All the questions should be answered.
- Wrong answers will not have negative impact at your score.
- The distribution of the questions among the various modules is the following

For those attending the Data Science training

Difficulty of question	DS-EM2	DS-EM3	DS-EM4	DS-EM5	DS-EM6	Transversal Skills
Easy	3	3	2	2	2	2
Moderate	1	1	2	1	1	1
Difficult	1	1	1	1	2	1
Total	**5**	**5**	**5**	**4**	**5**	**4**

For those attending the IoT training

Difficulty	IoT-EM2	IoT -EM3	IoT -EM4	IoT -EM5	IoT -EM6	Transversal Skills
Easy	3	3	2	2	2	2
Moderate	1	1	2	1	1	1
Difficult	1	1	1	1	2	1
Total	**5**	**5**	**5**	**4**	**5**	**4**

Q8. Which is the score that I should achieve in order to pass the final exams.

The minimum score that you should achieve in order to pass the final exams is 70% (20 correct answers out to 28)