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SEnDIng

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TRAINING METHODOLOGY

Editor(s):	Sotiropoulou Aikaterini, Lampros Vasileios, Panagiotopoulou Akrivi
Responsible Organisation(s):	Olympic Training & Consulting Ltd
Document Version-Status:	SEnDIng_DLV2.4-final
Submission date:	M15
Dissemination level:	Public

SEnDIng

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

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:	Training Methodology
Work package:	WP2 “Learning outcomes identification and design of vocational curricula/educational modules and training/ assessment methodology”
Task:	2.4 Training methodology development
Document identifier:	SEnDIng_DLV2.4-final.docx
Editor(s):	Sotiropoulou Aikaterini, Lampros Vasileios, Panagiotopoulou Akrivi
Reviewer(s):	Vasileios Gkamas (UPATRAS), Paraschos Kambageorgiou (UNICERT)
Approved by:	Maria Rigou (UPATRAS), All partners

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	Name	Partner	Date
From	Catherine Sotiropoulou	OTC	15/02/2019
Reviewed by	Vasileios Gkamas, Paraschos Kambageorgiou	UPATRAS, UNICERT	22/02/2019
Approved by	Maria Rigou	UPATRAS	28/02/2019

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 online asynchronous training, (b) 20 hours of face-to-face training[1] and (c) 320 hours 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 the project's results.

[1] Initially the training on transversal skills was to be provided face to face. However, due to the COVID19 pandemic and the restrictions it brought, the 20h training on Soft skills had to be delivered online.

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1 Introduction

1.1 Scope

The purpose of this deliverable is to describe the training methodology of SEnDIng. The link between the form and content of training and its delivery, the so-called training methodology and techniques, constitutes one of the basic educational principles.

This document provides to trainers and VET providers the guidelines and suggestions regarding training methodology and tools suitable for the delivery of the three phases of SEnDIng VET programs a) on-line training, b) face to face training and c) work-based learning (WBL). Furthermore, companies will be consulted on the implementation of work-based learning procedures in order to guarantee the up-skilling of their employees.

In explaining how various methods can be combined into an effective constructivist approach, we also employ into the proposed methodology the principles of adult education as well as the principles of soft skills, ICT training and e-learning. 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 Internet of Things (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.

1.2 Audience of the document

The audience of the Training Methodology is a) the SEnDIng project partners who shall undertake the implementation of the project's training, b) the enterprises that employ ICT professionals which will participate in the WBL part of the provided VET programmes, c) other enterprises that employ ICT professionals, potential users of the SEnDIng training, d) HEIs and VET providers that could provide the full training scheme or implement parts of the training courses, e) trainers who could use the theoretical background and practical suggestions on how to design and deliver the SEnDIng courses in Data Science and IoT technologies.

The document serves as a source of the training methodology to be undertaken by the project participants in the piloting of SEnDIng training.

1.3 Limitations

The approved project proposal had foreseen that the 20h training on transversal skills was to be provided via face to face training. However, the COVID19 pandemic brought

limitations with regard the implementation of training due to the strict safety measures and social distancing that had to be taken in a worldwide scale.

For ethical and educational reasons, this guide entails details of both how the project had initially been planned and how it has been implemented, since its main goal is to constitute a product that will contribute significantly in the professional development of professionals in ICT sector, and other sectors as well. From this perspective, the elements that concern face to face training (methods, techniques, assessment and tools) are also included so as to be available for future use.

2 Content elements of the training

2.1 Target group of the training

The target group of SEnDIng training is ICT professionals and more specific Data Scientists and IoT engineers who work at the ICT sector and other sectors where the Data Science and IoT technologies are applied (e.g. banking, assurance and energy).

2.2 Structure of the training

The modular form of the curriculum allows the flexible implementation of the courses on the basis of the participants' needs. Each educational module is divided into training units at three levels of proficiency:

- **Introductory (I):** The educational module is introduced and its most important facts 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.

The order of the modules delivered depends on their content. It is suggested for the modules to be delivered progressively, with the transversal skills module being more flexible in the order of delivery.

Up-skilling needs can be met through a diversity of routes, depending on the participants' needs. For example, only one module or specific unit/level of proficiency from each module can be selected by the learner according to the competences, skills and knowledge he/she wants to acquire.

The curriculum is designed to be delivered as a blended learning course of e-learning, face to face training and work-based learning.

The recommended structure and duration of each module is presented in table 1 for the Data Science curriculum and in table 2 for the IoT curriculum.

For piloting purposes and participation in the certification exams provided during the implementation of SEnDIng project, the trainees have to complete the proposed face to face, e-learning and WBL training as depicted in the tables 1 for Data Science curriculum and 2 for IoT curriculum.

Table 1: Recommended modules of Data Science

Modules	**Duration**
Module 1: Introduction to Data Science (DS-EM1)	**3h**
Module 2: Applied machine learning (DS-EM2)	**20h**
Training units	
Applied machine learning – Introduction (DS-EM2-I)	2h
Applied machine learning - Core (DS-EM2-C)	10h
Applied machine learning – Advanced (DS-EM2-A)	8h
Module 3: Python for Data Science (DS-EM3)	**20h**
Training units	
Python for Data Science – Introduction (DS-EM3-I)	2h
Python for Data Science – Core (DS-EM3-C)	12h
Python for Data Science - Advanced (DS-EM3-A)	6h
Module 4: Storing and retrieving data (DS-EM4)	**20h**
Training units	
Storing and retrieving data – Introduction (DS-EM4-I)	4h
Storing and retrieving data - Core (DS-EM4-C)	10h
Storing and retrieving data – Advanced (DS-EM4-A)	6h
Module 5: Statistics for Data Science (DS-EM5)	**20h**
Training units	
Statistics for Data Science – Introduction (DS-EM5-I)	2h
Statistics for Data Science - Core (DS-EM5-C)	10h
Statistics for Data Science – Advanced (DS-EM5-A)	8h
Module 6: Data Visualization (DS-EM6)	**20h**
Training units	
Data Visualization – Introduction (DS-EM6-I)	2h

Data Visualization - Core (DS-EM6-C)	10h
Data Visualization – Advanced (DS-EM6-A)	8h
Total duration of e-learning	**103h**
Face to face training in transversal skills	**20h**
Work based learning	**320h**

Table 2: Recommended modules of Internet of Things

Modules	**Duration**
Module 1: Introduction to IoT (IoT-EM1)	**3h**
Module 2: Architectural Design and Applications in IoT (IoT-EM2)	**20h**
Training units	
Architectural Design and Applications in IoT – Introduction (IoT-EM2-I)	4h
Architectural Design and Applications in IoT - Core (IoT-EM2-C)	8h
Architectural Design and Applications in IoT – Advanced (IoT-EM2-A)	8h
Module 3: IoT Communication Technologies (IoT-EM3)	**20h**
Training units	
IoT Communication technologies – Introduction (IoT -EM3-I)	2h
IoT Communication technologies – Core (IoT -EM3-C)	8h
IoT Communication technologies – Advanced (IoT-EM3-A)	10h
Module 4: IoT Security and Privacy (IoT-EM4)	**20h**
Training units	
IoT Security and Privacy – Introduction (IoT-EM4-I)	2h
IoT Security and Privacy - Core (IoT-EM4-C)	8h
IoT Security and Privacy – Advanced (IoT-EM4-A)	10h
Module 5: IoT Devices (IoT-EM5)	
Training units	**20h**
IoT Devices – Introduction (IoT –EM5-I)	2h
IoT Devices – Core (IoT –EM5-C)	6h
IoT Devices – Advanced (IoT-EM5-A)	12h
Module 6: IoT Business Value (IoT-EM6)	**20h**
Training units	
IoT Business Value – Introduction (IoT-EM6-I)	2h
IoT Business Value - Core (IoT-EM6-C)	12h
IoT Business Value – Advanced (IoT-EM6-A)	6h
Total duration of e-learning	**103h**
Face to face training in transversal skills	**20h**
Work based learning	**320h**

3 Theoretical background of the recommended training methodology in SEnDIng

The theoretical background of the recommended training methodology in the frame of SEnDIng project is leaning on the following pillars:

- The constructivist approach
- The principles of adult education
- The principles of soft skills training
- The principles of ICT training
- The principles of e-learning
- The principles of work based learning

As a result, the proposed training methodology is based on both theoretical and empirical approaches that have been proven successful in adult education and training in the field of ICT.

3.1 The constructivist approach

The SEnDIng courses adopt the constructivist learning theory. In the constructivist paradigm, the learners are in the centre of the learning process and they are active creators and constructors of their own knowledge [1]. Active learning methods that give to trainees significant autonomy and control over the learning process are used. Learning outcomes follow a holistic, generalized concept of competence which is viewed from the perspective of the individuals and learners' personalities and capabilities.

The main implications of constructivism adopted in SEnDIng courses [1,2] are:

1. The trainees construct their own reality based on their previous experience and mental structures and beliefs.
2. Pre-existing conceptions and knowledge of learners are very important. Through training are explored, addressed and new knowledge is built on them.
3. The trainees reflect on their own experiences, assumptions and expectations, and develop critical thinking by analysing and assessing ideas and schemes in safe environments. By this way, they are able to reach a new understanding of things in their profession.
4. The learners assume responsibility for their own learning, by participating actively in the training process and exploring.
5. The trainers act as facilitators, helping trainees to construct knowledge rather than to reproduce a series of facts. Under this scope, problem-based learning, investigational work, situated learning, experimental learning, action learning

have a pivotal role. Discovery is facilitated by providing resources and effective use of questions.

6. The training in workplaces is very important since trainees can deal with real tasks within communities of practice and coaching by experts.
7. The trainees develop metacognitive skills. Becoming aware of the learning process they are able to analyse monitor and evaluate it. They need to know how to learn by developing effective learning strategies.
8. The collaborative learning is supported by encouraging group work and collaboration in constructing knowledge and not competition. Peer learning and the use of peers are supported. Trainers are encouraged to provide opportunities for more expert and less expert participants to learn from each other. Discussion and debates are promoted.
9. The trainees construct their own reality. Constructivism allows for multiple interpretations and expressions of learning. It is accepted and expected that each trainee will interpret information in different ways.
10. The assessment is performance oriented and does not claim absolute objectivity. It is mainly based on portfolios, projects, role-playing, case studies, self-evaluation etc.

3.2 Adult education principles

Adult education is based to a great extent on the assumptions and principles of the constructivist approach. In the development of the training methodology of SEnDIng the following adult education principles are applied [3,4,5,6,7]:

Principles	**Application**
Adults bring life experiences and knowledge to the learning environment. Experience is considered a resource of learning	– The experience and expertise of adults should be recognized. – Training should build on them and encourage the learners to actively participate in the creation of new experiences and share their experience and knowledge. – Learning activities should be created in a way that reinforces the use of past experience and knowledge.
Adults tend to prefer self-directed, autonomous learning	– Adult learners need control over the learning process. That gives and requires more responsibility and initiative of them. It also allows them to select, manage and evaluate their learning. – Learners should be involved in setting goals and making decisions.

	– The trainer should act as facilitator, coach and supporter, by finding ways to involve participants and investigating of what participants want to learn. – Opportunities should be provided to learners to direct their own learning. – Action-planning tools and templates to learners should be provided in order to help learners to develop and focus their self-directed efforts and facilitate learning.
Adults have preferences for the way in which they learn	– Acceptance that not all learners respond to a given teaching method or technique. – Providing a customized learning approach according to learners need and developing the appropriate learning strategy. – Use of a wide variety of methods corresponding to all learners' preferences in training delivery. – Make trainers aware of their own learning preferences.
Adults learn best through collaboration and reciprocity. An environment where people learn with others while sharing what they already know	– Low-risk environment for learning should be provided, capitalizing the different levels of knowledge and skills within the learning groups. – The learners' self-esteem should be strengthened through team-based learning on mutual trust and respect.
Adults are motivated to learn by a wide variety of factors	– Adults are motivated by a variety of factors such as personal aspirations, expectations, internal desire or interest, escape from a situation. – Adults need internal motivation for learning rather than external. – Learning should respond to their needs, interests and real-life problems, in other words, be meaningful and relevant. – Relevance is the key factor to motivation so it is important to inquire into the reasons why participants are interested in learning. – The learners should be invited to identify the link between learning and satisfaction of their personal needs.

	– A connection should be made between the learning content and the long term objectives of each learner, in work and life.
Adults learners are goal oriented, relevancy oriented and practical	– Learners should be asked to identify what they would like to learn. – Clear learning objectives should be established and it should be explained how they relate to training activities. – Learners should be engaged in identifying the challenges they face and the value of addressing these challenges. – Training must show relevance to the job or other interests. – Learning has to be applicable to adult work duties or other responsibilities and focus on practical skills, tools, methods. – Opportunities should be given to trainees to apply the knowledge to practical skills and use methods to solve problems.
Adult learners need to be respected and learn in an appropriate learning environment	– Respect, trust and acceptance are vital for successful adult training. – Learners need to feel safe in order to participate freely, take initiatives, experiment, and express themselves. – Mistakes have to be viewed and used as improvement aids and not as failures. – Creativity and an agreeable atmosphere are important, but they have to be balanced with cognitive achievements, stability, and clarity of purpose. – The wealth of knowledge and experiences the participants bring to training should be acknowledged. – Learners should be treated as equals. – The participants should be allowed to voice their opinions freely.
Adult prefer active learning	– The more actively engaged the learner is, the more learning takes place. – Different training methodology and techniques have greater rate of retention.
Adults want guidance	– Adults want information that will help them to improve their situation. – Adults do not want to be told what to do, but they want

	to choose options based on their needs.
Adults have different learning styles	– Every individual has his/her own learning style depending on the preferred perception channel - visual, auditory, or kinaesthetic. – Techniques appropriate for all types of learners should be used and combined in such a way that different perception channels are employed. – There are also different personal learning styles referring to order, analysis level, abstraction and type of information presented and processed, that may be influenced either by the individual's personality and cognitive characteristics or by the educational system, cultural factors and professional specialization. – The learning styles preferred by each group of trainees should be found, in order for the learning experience to be modified accordingly.

3.3 Soft skills training principles

Even though there is lack of consensus on how to define soft skills [21], there is a common understanding that soft skills are the interpersonal human and behavioural skills needed by someone in order to apply technical skills and knowledge in the workplace [22]. Five categories of soft skills constructs have been identified by academics [23] such as communication skills, problem-solving and thinking skills, leadership and team working skills, ethical and moral values, and self-management. The EQAVET working group [21] suggested another typology introducing three interrelated categories of soft skills: a) communication skills, including aspects like oral communication and conversation, b) interpersonal skills, namely the ability to work in teams, relate to people, manage/mediate conflicts, discussions, negotiations and bargaining, and c) problem solving.

Given that soft skills have been positively linked to a strong performance level of professionalism, it is essential for the SEnDIng project to follow the common principles of soft skills training given below, as they have been detected in a broad literature review in order for the training to be successful [8, 21, 23].

- The success of training in soft skills depends on the facilitation of experts, the contextual awareness, and the provision of support, real-world application, self-study and self-awareness.

- Soft skills are more experienced-based and need to be reinforced throughout a person's lifetime. Their development is a dynamic process that needs to be refreshed over time to reflect on career and education changes.
- Active participation of learners, employees and employers is a guarantee that an intervention for soft skills development is "fit for purpose".
- Not everybody learns soft skills in the same way; active learning (cooperative learning, problem-based learning), transformative learning, and making meaning of learners' experiences through reflection, are important.
- Soft skills are imparted in small groups and innovative material is needed. Training material needs to integrate a number of sources in order to achieve real and impactful results and external providers are needed to be brought.
- Since behavioural change happens over long periods of time, individual soft skills development interventions or courses are not enough. Such interventions require multidisciplinary teams to create complex real-life scenarios and simulations.
- Tools should be used interactively, there must be interaction between heterogeneous groups, and learners should act autonomously.

For more details with regard to the proposed methods and techniques on the online training on Soft Skills please see Appendix A- Trainers' Handbook on Transversal Skills online training

3.4 ICT skills training principles

The variety of areas covered in SEnDIng training implies that the teaching approach should follow the principles for teaching ICT skills [12] such as:

- Embedding and integrated: learning should be related to the purposes and needs of learners. The development and application of ICT skills should be integrated with other subjects, workplace activities and wider interests.
- Personalization: each learner should be offered an individual programme with opportunities for progression.
- Active learning: active learning methods should be used to maintain motivation by ensuring that skills are applied in real and relevant contexts.
- Collaborative learning: encouraging collaborative learning whenever possible.

3.5 On-line training principles

Online training such as e-learning has been developed to provide cost-effective and improved learning experiences beyond those available in classrooms. It is about the

delivery of all activities of education such as instructing, teaching and learning through various electronic media [10]. The appropriate instructional design, including the selection of appropriate theories and principles, is very important to the success of e-learning.

The theory of constructivism has been widely used in e-learning environments [9]. Elements of constructivism such as the design of learning activities (collaboration, cooperation, multiple perspectives, real-world examples, scaffolding, self-reflection, multiple representations of ideas, and social negotiation), the learning assessment (instructor assessment, collaborative assessment, and self-assessment), and the role of the instructor (coaching, guiding, mentoring, acknowledging, providing feedback, and assessing student learning) have been included in the development of e-learning models.

The following pedagogic principles [11] have been suggested to be followed for successful e-learning provision:

- Match to the curriculum: there must be clear objectives, relevance to content covered, appropriateness of students' activities.
- Inclusion: inclusive practices should be seen in terms of different types and range of achievement, physical disabilities, different social and ethnic groups and gender.
- Learner engagement: learners should be engaged and motivated, activities should have a worthwhile educational aim, not just to occupy the learners, be enjoyable, not to produce adverse emotional reactions, improving the learning atmosphere.
- Effective learning: promoting personalized learning, learner autonomy; encouraging metacognitive thinking and collaboration, providing authentic learning exhibiting multiple perspectives on a topic.
- Provision of formative and summative assessment for the purposes of improving and grade learners.
- Coherence, consistency and transparency: objectives, content, activities, and assessment should match to each other. It should be clear to the user what to expect.
- Ease of use: being open and accessible, intuitive and not requiring guidance on use, providing appropriate guidance to learners of teachers.

3.6 WBL definitions and principles

Work-based learning is one of the fundamental aspects of vocational training, since it is linked directly to the mission of vocational training and help learners to acquire

knowledge, skills and competences which are very important in working life [13]. Generally speaking, work-based learning is a form of experiential learning [14] and implies two characteristics, namely learning in a work context and learning through practice. It can be further understood as the model of learning through work, for work and at work [16]. It is often used in academic context as the educational strategy that combines traditional forms of education with work experiences, where theoretical and technical skills can be combined and applied. WBL is usually applied in school-based and vocational, educational and training programmes to develop basic work habits, occupational identity and specific occupational competences [14]. Through WBL the learners not only acquire specific skills and competences, but also enhance their ability to develop meta-competence and learning to learn skills [16].

The three main models of work-based learning are apprenticeships, on-the-job training periods in companies, as well as WBL integrated into a school-based programme.

Apprenticeships, known as "dual system" are often defined as "systematic long-term training alternative periods at the workplace and in an educational institution or training center" [13]. Learners spend a significant time in companies acquiring general and work-related knowledge and skills and often key competences [13].

The model of **on-the-job training** typically covers internships, work placements, traineeships or in-company training, which are incorporated as compulsory or optional elements of VET programmes leading to formal qualifications [13].

The third model is **WBL that is integrated into a school-based programme**, mainly through on-site labs, workshops, simulations or real business/industry project assignments. The aim of this model is to create real-life work environments, establish cooperation with companies and develop entrepreneurship competences [13].

Across Europe terminology and definition regarding WBL are still varying, and many countries combine the aforementioned three general models.

WBL benefits all parties involved. The following table summarizes these benefits, under the scope of providing WBL for the up-skilling of employees [13, 14, 15].

Learner	– Development of deep professional expertise – Build hard skills, soft skills, as well as other competences and behaviours – Development of carrier managements skills – Career improvements – Improve self-confidence, socialization and motivation – Fostering entrepreneurial skills

Employers	– Address skills gaps through tailor-made training – Improve productivity, innovation and performance – Positive effects on staff development – Enhanced corporate image – Staff retention and work satisfaction – Recruitment impact
VET	– Improved attractiveness of VET programmes – Better quality of VET programmes and learning outcomes – Enhancement of relevance and responsiveness of VET – Positive effect on teaching staff competences and development – Better cooperation between VET and businesses
Society	– Skilled labour force that corresponds better to the labour markets' needs – Cost-sharing of VET between the state and the employers – Contribution to innovation and creativity – Strengthening of social inclusion and improvement of equal opportunities – Increased employability

The following pedagogical and organizational options should be taken into account for successful work-based learning [14, 16]:

- There are many practices that may increase the extent to which work is learnt, such as: encouraging people to reflect on their experience; guidance provided by other workers and/or experts; mentoring; demonstration and practice; simulation; task rotation and task variety; project work; provision of problems to be solved.
- The extent to which employees–learners perceive their job to be meaningful, as well as the sense of progress and accomplishment within a WBL context, influences the learning process.
- The role of employers is crucial since they must devote some of the staff time to planning the learning process, assessment and review, supervision and training.
- The role of supervisors is crucial for the implementation of WBL. They should realize that developing the knowledge, skills and expertise of workers is part of their normal job tasks; and this role must be cultivated as part of the organizational culture. Mutual respect and a collaborative attitude are also crucial.

- Constructive feedback from supervisors, trainers, mentors, co-workers, and support are very important in the learning process.
- Supervisors or in-company trainers should be trained, in order to be able to help and interact with and manage the trainees under their supervision. They should have the required pedagogical and personal skills to support WBL.
- The complexity of the job influences the learning process and potential.
- The allocation of work is also important in stimulating learning; the learning process is affected by the way the tasks are allocated and work is organized. The opportunity to learn at work depends on the daily scheduling of normal work tasks and the production cycle. If such an opportunity is not offered, extra arrangements should be made between the enterprises and the training organizations.
- Encouraging progress and recognizing it stimulates the learning process. The working environment must also be organized in a way so as to encourage learners to take responsibilities and resolve problems by themselves.
- In small and medium-sized enterprises it is difficult to promote and improve the quality of WBL. In these cases the support or assistance of external expertise is valuable; such support could be coaching and training for in-company supervisors or the development of competency lists and learning guides. This expertise could be provided by VET practitioners.
- Practical methods of translating experience into learning could be a key challenge for improving the quality of WBL.

4 Recommended training methodology for face to face training

4.1 Recommended training methods and techniques

In accordance with the theoretical training methodology background presented before, the training methods and techniques recommended for the SEnDIng training courses are selected with respect to content and duration of the face to face training and the desired learning outcomes.

More specific, the training methods [1]:

1. Promote experiential, collaborative, active, transformational and self-directed learning.

2. Address all perception channels (visual, auditory and kinaesthetic) and cater for different learning styles, when used in combination.
3. Are differentiated according to the learning activity type: a) *Exploitation activities* reveal existing representations, experience and knowledge, provide reflection and critical thinking, and lead to the realization of training or reconstruction needs. b) *Presentation of information* provides new material for the construction of new schemes, knowledge, attitudes and skills in harmony with the desired learning outcomes. c) *Application in practice* leads to the acquisition and consolidation of new skills, competences and experiences.

The trainer, while determining the frequency and the extent to which each teaching technique will be used, has to take into account the unique characteristics of each learner group and the learning styles of the learners involved. Training techniques can be added or omitted according to the needs.

The training techniques per learning activity recommended for the module of soft (or transversal) skills are presented in the following table. The underlined ones are proposed for the purposes of SEnDIng training. Their use is not obligatory; it depends on the needs of the learners and the choices of the trainers:

Exploration	**Presentation of information**	**Application in practice**
Representation exercises Memory activation Questions Reflection Brainstorming Self-observation Group activities Group discussion Self-assessment theory/paper critiquing	Lecture Demonstration Use of multimedia Flipped learning Support with handbooks or other material Interview/lecture from expert Self-study Learning platform Group discussion	Brainstorming Role-play Simulation Exercises Case study Experimenting Working in teams Teambuilding and groups activities Presentation by learner Peer learning Workshops Moral dilemma exercises Self-assessment Reflection Individual coaching session Action plan Concept writing

5 Recommended training methodology for on-line ICT training

5.1 Recommended training methods and techniques

In accordance with the theoretical training methodology background presented before, the training methods and techniques recommended for the delivery of SEnDIng online training are the following:

- **Self-paced online training**. Self-paced online training has many advantages. It is highly flexible, which makes participation to the training easy. This is critical, as the main beneficiaries of SEnDIng training are ICT professionals who are likely to have strict work obligations, so flexibility is key for them. Furthermore, self-paced online training can also improve learning retention, as the learners often retain content better when they have time to absorb concepts between lessons. Additional benefits exist, after the completion of the course, as it continues to be a great reference tool when questions will arise during WBL or on the job.
- **Asynchronous online training** to promote learner autonomy. Asynchronous events are time-independent, so each learner is able to participate in the online training according to his/her program. A self-paced course is an example of asynchronous Learning because online learning can take place at any time.
- **Learner-centred content**. Learner-centred content presents many benefits. It provides self-reflection opportunities, as the learners want to know, how information relates to and benefits them directly, enables personalization and responds to individuals' needs. So, the online Open Educational Resources should be relevant and specific to learner's needs and responsibilities in professional life.
- **Personalization** to promote effective learning. Self-study courses should be customizable to reflect learner's interests and needs. In addition, learners should be able to build their own customized learning path, as when you allow your learners to choose what they want to learn, they feel valued.

6 Recommended training methodology for WBL

6.1 Forms of WBL adopted by SENDING

For the purposes of SEnDIng training the model of WBL that is going to be adopted is the "On the job training" (OJT) and more specifically in-company training or in other words learning at work, which means acquiring knowledge, skills and competences by doing a job and by reflecting on the experience.

OJT is the process of helping people to learn in planned ways at the workplace [17]; it is an approach of training based on regular work and aims at the development of skills, knowledge and competences that are needed in a specific job or work settings. OJT is tailored to the requirements of the workplace; it may be structured or unstructured [20].

In SEnDIng, structured OJT is going to be employed. Structured training implies the use of standardized training materials, processes, trained trainers and performance checklists [20], ensuring consistency and accountability. There is no one right way to implement a structured OJT but some characteristics should be reflected such as management support, trainers support process, checklists, OJT training materials, training of trainers and reporting [20].

The training activities which will result in learning through the model of OJT in the frame of SEnDIng will be planned and be both general and specific such as [17]:

- planned activities resulting in guiding what an employee-learner has to do and learn (e.g. special assignments and/or job rotation that increase general knowledge of certain operational areas),
- carefully structured approaches, such as using specific software to train learners and develop skilled workers.

Useful learning activities that might be carried out on the spot will also be exploited as good opportunities for learning.

OJT embodies many advantages for both trainees-employees and employers. Learning by executing work tasks in real workplace enables employees to develop specific professional expertise, transversal skills and improve their confidence in an easy way for them. For employers, OJT is a flexible cost-effective training method, that can be easily adjusted to the needs of their company and contribute to competitive advantages, improvement of quality, greater productivity, transfer of training, development of desired attitudes and rapid results.

6.2 Recommended training methods and techniques

The phases of the implementation of OJT in the frame of SEnDIng are [18, 19]:

a) Information and agreement between all the partners involved (enterprise, training provider and employee/trainee) regarding the detailed description of OJT, and preparation of the training. At this stage:
    - The training provider has to prepare a detailed task description; a checklist of the tasks that need to be trained; administration information such as lesson plans and schedule; adjustment of all the aforementioned in

collaboration with the enterprises. All this information will be enclosed into a training guide.

- The training provider has also to prepare a core OJT training material based on the learning outcomes.
- Each company involved will go through the aforementioned OJT plan and material and suggest any adaptations, inform the trainees-employees and the rest of the staff about the training, and assign a supervisor. The supervisors will be the ones responsible for the day to day implementation of OJT, and prepare the relevant climate as well as establish the priorities that will enable the smooth and effective implementation of OJT.
- Each company will select in-company trainers based on their professional and personal skills as well as their desire to train.

b) Implementation and evaluation of training. At this stage:

- The companies through the supervisors will involve the trainees according to the task description and break the procedure down into steps.
- The in-company trainers, based on the training guide tasks and training material, will implement the training, explaining to the employees-trainees what they are required to do and why, let them perform the required tasks autonomously, give them time to replicate tasks, observe carefully without interfering if it is not necessary, provide constructive feedback and guide them to adjust their performance. They will also adapt or provide additional training material if needed.
- Training providers of the consortium will provide support to the trainers and individual coaching.
- Each trainee has to comply with the training and evaluation rules and respect the tasks assigned, as well as to cooperate with the in-company trainer.
- The supervisors and in–company trainers have to perform the tasks assigned to them and report progress, as well as to communicate with the training organization.

There are many techniques [17] that have been proposed to be used in training at workplaces such as:

- **Basic techniques**: relatively simple techniques, such as giving feedback about performance, consultation, modelling, supervision, observation, learning by doing, demonstration.
- **Meta-techniques**: making use of the basic techniques and further involving one-to-one relationships between the trainer and the learner such as mentoring, coaching, counselling, peer training, job instruction training.
- **Organized activities** such as job rotation, quality circles, case studies.
- **Media-based techniques,** such as computer-assisted learning, e-learning, reading.
- **Other techniques,** such as action learning, briefings, consultants, delegation, find-out-yourself, meetings, unplanned opportunities.

The following techniques are proposed for the purposes of WBL in the frame of SEnDIng training courses:

Project

This behavioural technique focuses on problem analysis and solving and requires the active involvement of trainees. Trainees are given a description of a situation and are asked to come to decision or solve a problem. This can be done in small groups or individually. Trainers need to provide the ideal solution and be open to assess and discuss solutions proposed by trainees. This technique is particularly useful if the cases reflect real work situations and daily concerns. By this way, trainees can learn how to analyse and solve problems on an actual base. Moreover, the trainees learn the importance of accepting the opinions of others. Projects will be developed by the involved project partners and be adopted by in-company trainers, according to the companies and the trainees' needs.

Supervision

The main objective of supervision [18], as used in SEnDIng training courses, is to assist trainees in developing the professional skills and competences described by the learning outcomes. Trainees are guided in developing their competences, role awareness, and effective working methods, according to their developmental level. An essential element of supervision is to teach task and problem analysis. Through this process, trainees gain the necessary motivation, autonomy and self-awareness to successfully move to the next level of professional development. Supervision provided by SEnDIng will have the following characteristics: a) establishes clear performance objectives and promotes quality standards, b) focuses on problem-solving and monitoring performance objectives, c) enables trainees to continuously improve their own performance, d) provides feedback

and recommendations, e) motivates and empowers, f) encourages participatory decision making. Effective supervision leads to higher-quality services, enhanced productivity, as well as to employees with a wider range of skills and increased ability to function with autonomy. In SEnDIng, supervision can play a significant role in the professional development of trainees, not only in terms of technical skills but also in developing transversal skills. Supervision will be held both individually and in groups of trainees.

Coaching

Coaching focuses on the individual's needs and accomplishments providing encouraging feedback and suggestions to improve performance [19]. It is a collaborative solution-focused, results-orientated and systematic process in which the trainer facilitates the enhancement of work performance, self-directed learning and personal growth of the trainee [18]. According to a comparative review [18] coaching appears to be effective during formative education, encouraging motivation and developing skills related to reflection and critical thinking. Coaching will be used in SEnDIng to assist trainees to develop technical and transversal skills. Trainers will work directly with the trainees in individual sessions on regular basis. In line with the desired learning outcomes and according to the trainees' individual needs the trainers will agree with the trainees on a set of tangible and well-defined goals according to the acquisition of skills.

The in-company trainers will determine the frequency and the extent of OJT training techniques, taking into account the unique characteristics of each learner or learner group, the learning styles of the learners involved and the enterprises' needs. Training techniques can be added or omitted according to the needs. Trainers could also use more techniques, such as basic techniques, meta-techniques, organized activities, media-based techniques or other techniques.

There are also some additional elements that could strengthen the trainees' support [19]

- One-to-one feedback sessions
- Individual consultations
- Group discussions, managed on a regular basis
- Consultation in informal settings, e.g. lunch
- Coaching and mentoring in combination with self-managed learning

For more details with regard to the proposed methods and techniques on WBL please see Appendix B- Trainers' Handbook on WBL

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Appendix A

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

SEnDIng

Transversal Skills Training
Trainers' Handbook

Editor(s):	Sotiropoulou Aikaterini, Andrica Rozi, Panagiotopoulou Akrivi
Responsible Organisation(s):	Olympic Training & Consulting Ltd
Document Version-Status:	SEnDIng_DLV2.4 – Annex A
Submission date:	M28
Dissemination level:	Public

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

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:	Transversal Skills Training - Trainers' Handbook
Work package:	WP2 "Learning outcomes identification and design of vocational curricula/educational modules and training/ assessment methodology"
Task:	2.4 Training methodology development
Document identifier:	SEnDIng_DLV2.4 – Annex A
Editor(s):	Sotiropoulou Aikaterini, Andrica Rozi, Panagiotopoulou Akrivi
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	Sotiropoulou Aikaterini, Andrica Rozi, Panagiotopoulou Akrivi	Olympic Training & Consulting Ltd	16/03/2020
Reviewed by	Vasileios Gkamas, Maria Rigou	University of Patras	20/03/2020
Approved by	Maria Rigou	University of Patras	23/03/2020

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 program will be provided to employed ICT professionals into three phases that include: (a) 100 hours of online asynchronous training, (b) 20 hours of face-to-face training[1] and (c) 320 hours 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 the project's results.

[1] Initially the training on transversal skills was to be provided face to face. However, due to the COVID19 pandemic and the restrictions it brought, the 20h training on Soft skills had to be delivered online.

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1 Transversal skills online training

The target group of SEnDIng training is ICT professionals and more specific Data Scientists and IoT engineers who work at the ICT sector and other sectors where the Data Science and IoT technologies are applied (e.g. banking, assurance and energy).

1.1 Transversal skills educational modules

The transversal skills aims to build upon academic and experiential learning and to prepare the ICT 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. These educational modules will introduce a portfolio of skills and competencies required for effective communication and presentation, adaptation to changes, teamwork, goal-setting and thinking out of the box.

The transversal skills curriculum includes the following educational modules:

1. **Effective communication and presentation (TS-EM1)**
2. **Change management (TS-EM2)**
3. **Team working (TS-EM3)**
4. **Goal setting (TS-EM4)**
5. **Creative thinking (TS-EM5)**

The aforementioned modules are described at the following sections.

1.1.1 Effective communication and presentation (TS-EM1)

Objectives

Provide to the learners knowledge and skills for effective communication and presentation.

Learning outcomes

After the successful completion of this unit learners will (knowledge):

- know the principles of effective verbal and non-verbal communication
- have a comprehensive understanding of the principles of active listening
- be acquainted with the possible barriers to communication
- have a thorough knowledge about the principles of effective communication with clients and colleagues
- know possible techniques to adapt communication style depending on the scope of the message and feedback received
- have an overall knowledge about the principles of effective presentations

will be able to (skills):

- analyze the factors related to communication with colleagues and clients
- tailor their communication strategy according to the specificities of each encounter
- communicate with clarity and conviction
- encourage participation and interaction when presenting to colleagues or clients

and will (competences)

- adapt effectively to challenging situations in communication
- listen actively
- develop self-awareness in communication
- present technical information clearly, concisely and persuasively

Content

- Principles of effective communication
- Active listening
- Barriers to communication
- Principles of effective communication with clients
- Effective presentation

Learning methodologies

Face-to-face/Online training & work-based learning

Duration

4 hours for face to face / online training and 320 hours for work-based learning

Assessment

- Observation checklist
- Questionnaire
- Self-assessment

Pre-requisite

No pre-requisite knowledge or skills exist

1.1.2 Change management (TS-EU2)

Objectives

Provide to the learners knowledge and skills for change management.

Learning outcomes

After the successful completion of this unit learners will (knowledge):

- know what change is about and why it is inevitable in the business environment

- have a good understanding about the importance of developing resilience to change
- be acquainted with the process of transition through change
- have a general knowledge about change management processes

will be able to (skills):

- overcome resistance to change
- support their organization in implementing changes

and will (competences)

- develop a willingness to move from their comfort zone and accept changes in their working environment

Content

- Understanding changes
- Developing resilience
- Transition through change
- Change management

Learning methodologies

Face-to-face /Online training & work-based learning

Duration

4 hours for face to face / online training and 320 hours for work-based learning

Assessment

- Observation checklist
- Questionnaire
- Self-assessment

Pre-requisite

No pre-requisite knowledge or skills exist

1.1.3 Team working (TS-EM3)

Objectives

Provide to the learners knowledge and skills for effective team working.

Learning outcomes

After the successful completion of this unit learners will (knowledge):

- have a comprehensive understanding about the characteristics, principles and advantages of teamwork
- be familiar with the characteristics of a balanced team
- be aware of the roles and responsibilities of the members and leader of a team
- have a good understanding about techniques of setting team objectives
- have an overall knowledge about principles of developing an effective team
- have a basic understanding of team leadership
- know the principles of effective communication within teams

will be able to (skills):

- set a common vision and objectives within a team
- be active within a team and improving their teamwork
- motivate the other members of a team
- handle conflicts within a team

and will (competences)

- recognize different personality types within a team
- define individual and team expectations
- understand team dynamics
- improve team motivation
- promote the formation and development of teams in ICT environment

Content

- Formation and development of teams
- The role of teamwork
- Characteristics of effective teams
- Responsibilities and roles within teams
- Setting common goals
- Developing a team
- Team leadership
- Effective communication in teams

Learning methodologies

Face-to-face / Online training & work-based learning

Duration

4 hours for face to face/ online training and 320 hours for work-based learning

Assessment

- Observation checklist

- Questionnaire
- Self-assessment

Pre-requisite

No pre-requisite knowledge or skills exist

1.1.4 Goal setting (TS-EM4)

Objectives

Provide to the learners knowledge and skills for effective goal setting.

Learning outcomes

After the successful completion of this unit learners will (knowledge):

- have a good understanding of the meaning and importance of goal setting
- know the goal setting process
- know goal setting techniques and tools

will be able to (skills):

- identify what they want to achieve in their professional life
- initiate and run a goal-setting process
- use goal-setting tools and techniques

and will (competences)

- be competent in planning professional goals
- be able to look at their professional role and what services can provide to other people
- include other people from their work environment into their goal setting process

Content

- The benefits of goal setting
- Overcoming obstacles in goal setting
- Effective goal setting

Learning methodologies

Face-to-face /Online training & work-based learning

Duration

4 hours for face to face/ online training and 320 hours for work-based learning

Assessment

- Observation checklist
- Questionnaire

- Self-assessment

Pre-requisite

No pre-requisite knowledge or skills exist

1.1.5 Creative thinking (TS-EM5)

Objectives

Provide to the learners knowledge and skills for creative thinking.

Learning outcomes

After the successful completion of this unit learners will (knowledge):

- understand different forms and definitions of creativity
- be acquainted with the phases of creative problem-solving procedures
- be familiar with tools of creative thinking
- have a general understanding about the characteristics of a creative environment
- understand the concept of agile thinking

will be able to (skills):

- gather information about a problem
- identify and analyze problems
- use techniques in order to generate ideas
- manage a creative thinking process
- organize ideas and select the best solutions
- use agile thinking in order to provide valuable solutions

and will (competences)

- be curious about why things are and trying to understand the dynamics of a situation
- see problems in a more positive way
- develop ideas into valuable solutions to the problems
- use creative thinking methodologies in order to support their clients
- think out of the box when they are trying to provide a solution

Content

- Creative behaviour
- Methods and techniques of creative thinking
- Agile thinking
- Characteristics of a creative environment

Learning methodologies

Face-to-face/ Online training & work-based learning

Duration

4 hours for face to face/ online training and 320 hours for work-based learning

Assessment

- Observation checklist
- Questionnaire
- Self-assessment

Pre-requisite

No pre-requisite knowledge or skills exist

2 Theoretical background of the recommended training methodology in SEnDIng

The theoretical background of the recommended training methodology in the frame of SEnDIng project training in transversal skills is leaning on the following pillars:

- The constructivist approach
- The principles of adult education
- The principles of soft skills training

As a result, the proposed training methodology is based on both theoretical and empirical approaches that have been proven successful in adult education and training.

2.1 The constructivist approach

The SEnDIng courses adopt the constructivist learning theory. In the constructivist paradigm, the learners are in the centre of the learning process and they are active creators and constructors of their own knowledge [1]. Active learning methods that give to trainees significant autonomy and control over the learning process are used. Learning outcomes follow a holistic, generalized concept of competence which is viewed from the perspective of the individuals and learners' personalities and capabilities.

The main implications of constructivism adopted in SEnDIng courses [1,2] are:

1. The trainees construct their own reality based on their previous experience and mental structures and beliefs.
2. Pre-existing conceptions and knowledge of learners are very important. Through training are explored, addressed and new knowledge is built on them.
3. The trainees reflect on their own experiences, assumptions and expectations, and develop critical thinking by analysing and assessing ideas and schemes in safe environments. By this way, they are able to reach a new understanding of things in their profession.
4. The learners assume responsibility for their own learning, by participating actively in the training process and exploring.
5. The trainers act as facilitators, helping trainees to construct knowledge rather than to reproduce a series of facts. Under this scope, problem-based learning, investigational work, situated learning, experimental learning, action learning have a pivotal role. Discovery is facilitated by providing resources and effective use of questions.
6. The training in workplaces is very important since trainees can deal with real tasks within communities of practice and coaching by experts.

7. The trainees develop metacognitive skills. Becoming aware of the learning process they are able to analyse monitor and evaluate it. They need to know how to learn by developing effective learning strategies.
8. The collaborative learning is supported by encouraging group work and collaboration in constructing knowledge and not competition. Peer learning and the use of peers are supported. Trainers are encouraged to provide opportunities for more expert and less expert participants to learn from each other. Discussion and debates are promoted.
9. The trainees construct their own reality. Constructivism allows for multiple interpretations and expressions of learning. It is accepted and expected that each trainee will interpret information in different ways.
10. The assessment is performance oriented and does not claim absolute objectivity. It is mainly based on portfolios, projects, role-playing, case studies, self-evaluation etc.

2.2 Adult education principles

Adult education is based to a great extent on the assumptions and principles of the constructivist approach. In the development of the training methodology of SEnDIng the following adult education principles are applied [3,4,5,6,7]:

Principles	**Application**
Adults bring life experiences and knowledge to the learning environment. Experience is considered a resource of learning	– The experience and expertise of adults should be recognized. – Training should build on them and encourage the learners to actively participate in the creation of new experiences and share their experience and knowledge. – Learning activities should be created in a way that reinforces the use of past experience and knowledge.
Adults tend to prefer self-directed, autonomous learning	– Adult learners need control over the learning process. That gives and requires more responsibility and initiative of them. It also allows them to select, manage and evaluate their learning. – Learners should be involved in setting goals and making decisions. – The trainer should act as facilitator, coach and supporter, by finding ways to involve participants and investigating of what participants want to learn. – Opportunities should be provided to learners to direct

	their own learning. – Action-planning tools and templates to learners should be provided in order to help learners to develop and focus their self-directed efforts and facilitate learning.
Adults have preferences for the way in which they learn	– Acceptance that not all learners respond to a given teaching method or technique. – Providing a customized learning approach according to learners need and developing the appropriate learning strategy. – Use of a wide variety of methods corresponding to all learners' preferences in training delivery. – Make trainers aware of their own learning preferences.
Adults learn best through collaboration and reciprocity. An environment where people learn with others while sharing what they already know	– Low-risk environment for learning should be provided, capitalizing the different levels of knowledge and skills within the learning groups. – The learners' self-esteem should be strengthened through team-based learning on mutual trust and respect.
Adults are motivated to learn by a wide variety of factors	– Adults are motivated by a variety of factors such as personal aspirations, expectations, internal desire or interest, escape from a situation. – Adults need internal motivation for learning rather than external. – Learning should respond to their needs, interests and real-life problems, in other words, be meaningful and relevant. – Relevance is the key factor to motivation so it is important to inquire into the reasons why participants are interested in learning. – The learners should be invited to identify the link between learning and satisfaction of their personal needs. – A connection should be made between the learning content and the long term objectives of each learner, in work and life.
Adults learners are goal	– Learners should be asked to identify what they would

oriented, relevancy oriented and practical	like to learn. – Clear learning objectives should be established and it should be explained how they relate to training activities. – Learners should be engaged in identifying the challenges they face and the value of addressing these challenges. – Training must show relevance to the job or other interests. – Learning has to be applicable to adult work duties or other responsibilities and focus on practical skills, tools, methods. – Opportunities should be given to trainees to apply the knowledge to practical skills and use methods to solve problems.
Adult learners need to be respected and learn in an appropriate learning environment	– Respect, trust and acceptance are vital for successful adult training. – Learners need to feel safe in order to participate freely, take initiatives, experiment, and express themselves. – Mistakes have to be viewed and used as improvement aids and not as failures. – Creativity and an agreeable atmosphere are important, but they have to be balanced with cognitive achievements, stability, and clarity of purpose. – The wealth of knowledge and experiences the participants bring to training should be acknowledged. – Learners should be treated as equals. – The participants should be allowed to voice their opinions freely.
Adult prefer active learning	– The more actively engaged the learner is, the more learning takes place. – Different training methodology and techniques have greater rate of retention.
Adults want guidance	– Adults want information that will help them to improve their situation. – Adults do not want to be told what to do, but they want to choose options based on their needs.
Adults have different learning styles	– Every individual has his/her own learning style depending on the preferred perception channel - visual, auditory, or kinaesthetic.

	– Techniques appropriate for all types of learners should be used and combined in such a way that different perception channels are employed. – There are also different personal learning styles referring to order, analysis level, abstraction and type of information presented and processed, that may be influenced either by the individual's personality and cognitive characteristics or by the educational system, cultural factors and professional specialization. – The learning styles preferred by each group of trainees should be found, in order for the learning experience to be modified accordingly.

2.3 Soft skills training principles

Even though there is lack of consensus on how to define soft skills [9], there is a common understanding that soft skills are the interpersonal human and behavioural skills needed by someone in order to apply technical skills and knowledge in the workplace [10]. Five categories of soft skills constructs have been identified by academics [11] such as communication skills, problem-solving and thinking skills, leadership and team working skills, ethical and moral values, and self-management. The EQAVET working group [9] suggested another typology introducing three interrelated categories of soft skills: a) communication skills, including aspects like oral communication and conversation, b) interpersonal skills, namely the ability to work in teams, relate to people, manage/mediate conflicts, discussions, negotiations and bargaining, and c) problem solving.

Given that soft skills have been positively linked to a strong performance level of professionalism, it is essential for the SEnDIng project to follow the common principles of soft skills training given below, as they have been detected in a broad literature review in order for the training to be successful [8, 9, 11].

- The success of training in soft skills depends on the facilitation of experts, the contextual awareness, and the provision of support, real-world application, self-study and self-awareness.
- Soft skills are more experienced-based and need to be reinforced throughout a person's lifetime. Their development is a dynamic process that needs to be refreshed over time to reflect on career and education changes.
- Active participation of learners, employees and employers is a guarantee that an intervention for soft skills development is "fit for purpose".

- Not everybody learns soft skills in the same way; active learning (cooperative learning, problem-based learning), transformative learning, and making meaning of learners' experiences through reflection, are important.
- Soft skills are imparted in small groups and innovative material is needed. Training material needs to integrate a number of sources in order to achieve real and impactful results and external providers are needed to be brought.
- Since behavioural change happens over long periods of time, individual soft skills development interventions or courses are not enough. Such interventions require multidisciplinary teams to create complex real-life scenarios and simulations.
- Tools should be used interactively, there must be interaction between heterogeneous groups, and learners should act autonomously.

3 Recommended training methodology for transversal skills online training

3.1 Recommended training methods and techniques

In accordance with the theoretical training methodology background presented before, the training methods and techniques recommended for the SEnDIng training courses are selected with respect to content and duration of the transversal skills online training and the desired learning outcomes.

More specific, the training methods [1]:

1. Promote experiential, collaborative, active, transformational and self-directed learning.
2. Address all perception channels (visual, auditory and kinaesthetic) and cater for different learning styles, when used in combination.
3. Are differentiated according to the learning activity type: a) *Exploitation activities* reveal existing representations, experience and knowledge, provide reflection and critical thinking, and lead to the realization of training or reconstruction needs. b) *Presentation of information* provides new material for the construction of new schemes, knowledge, attitudes and skills in harmony with the desired learning outcomes. c) *Application in practice* leads to the acquisition and consolidation of new skills, competences and experiences.

The trainer, while determining the frequency and the extent to which each teaching technique will be used, has to take into account the unique characteristics of each learner group and the learning styles of the learners involved. Training techniques can be added or omitted according to the needs.

The training techniques per learning activity recommended for the module of soft (or transversal) skills are presented in the following table. The underlined ones are proposed for the purposes of SEnDIng training. Their use is not obligatory; it depends on the needs of the learners and the choices of the trainers:

Exploration	**Presentation of information**	**Application in practice**
Representation exercises	Lecture	Brainstorming
Memory activation	Demonstration	Role-play
Questions	Use of multimedia	Simulation
Reflection	Flipped learning	Exercises
Brainstorming	Support with handbooks or other material	Case study
Self-observation	Interview/lecture from expert	Experimenting
Group activities	Self-study	Working in teams
Group discussion	Learning platform	Teambuilding and groups activities
Self-assessment	Group discussion	Presentation by learner
theory/paper critiquing		Peer learning
		Workshops
		Moral dilemma exercises
		Self-assessment
		Reflection
		Individual coaching session
		Action plan
		Concept writing

4 Monitoring and Assessment methodology for transversal skills online training

4.1 Description

Given the general objectives and structure of SEnDIng assessment presented above, during the transversal skills online training formative and summative assessment as well as self-assessment will be implemented.

Summative assessment: It is a more formal type of assessment and often happens at the end of a course. Summative assessment allows learners, trainers and training providers to establish whether the desired learning outcomes have been achieved through the training course and to what extent. It provides the final profile of the learner [14]. According to Sadler [13] summative assessment is geared towards reporting at the end of the training for purposes of certification. It is essentially passive and does not have immediate impact on learning.

Formative assessment has a monitoring function, enabling trainers and trainees to track progress, estimate the effectiveness of the training methods and make adaptations where necessary [14]. In other words formative assessment serves three key purposes a) where learners are in their learning, b) where they need to go, and c) how to get there [12]. Formative assessment involves a continuing cycle of activities which includes the following key elements: a) the provision of clear goals which are shared with the learners, b) learners are in the centre of the process. c) learners take part in gathering and interpreting evidence regarding the accomplishment of goals, d) trainers (if available) and learners make decisions together related to the next steps, e) feedback is provided to learners which is used to adjust training. Formative assessment is therefore the process that leads to the enhancement of learning during learning and feed forward rather than provide feedback after learning [13].

Self-assessment: Adult learners are more self-directed and need to be responsible for their learning. Self-assessment is essential to learning because learners can achieve a learning goal if they understand it and can assess what they can do to reach it. The desired learning outcomes and what is required to complete the tasks successfully need to be made clear in the case of self-assessment [12]. Self-assessment is beneficial for several reasons [15]: a) promotes learning, providing judgment which benefit the learning process, b) gives a raised level of awareness of perceived levels of abilities, c) motivates goal orientation, d) the range of assessment techniques is expanded, e) learners participate in their own evaluation and f) leads to beneficial post course effects. Since ownership of learning is transferred to the learners via self-assessment, the

engagement of learners is improved. Self-assessment consolidates learning, opens up new levels of understanding and drives away misconceptions [16].

Self-assessment is a particularly useful method for adults when assessing transversal competences. The tools to be used for assessment, in Sending, are in line with the teaching methodologies.

Monitoring will be ongoing and it will be implemented throughout the duration of the transversal skills online training using specific tools and exploiting data provided by assessment. The assessment tools that are described in detail in the following paragraph are recommended for each type of assessment (formative, summative, self-assessment). Formative and self-assessment takes place throughout the phase of transversal skills online training, while summative assessment takes place at the end of transversal skills online training.

4.2 Assessment types, structure and tools

The assessment structure and tools proposed for SEnDIng transversal skills online training are presented in the following table. **The training providers and trainers can select the appropriate tools** according to the characteristics of the trainees and the purposes of assessment.

Tools	Assessment Type		
	Formative	Self-assessment	Summative
Case study	x	x	x
Group/team work	x		
Portfolio	x	x	x
Presentation	x		x
Peer evaluation	x		
Role playing	x		x
Mid Test			x
Final test			x
Checklist		x	
Rating scale		x	

The assessment tools have been selected on the basis of their compatibility with the principles of constructivism and adult learning and are presented briefly as follows.

Case study: Case studies are popular tools used for both formative and summative assessment as well as self-assessment. They depict real life situations in which problems

need to be solved. Trainees are introduced to a real or fictional case study, either as individuals or in groups, and they are asked to identify a set of problems, and subsequently apply their knowledge of the subject to the case [14]. Case studies are a powerful learning tool for developing cognitive skills of students; when conducted in groups they can enhance oral communication and team building [17].

Group/team work: allows for the employment of different skills, knowledge and experiences that individuals have. It can be approached both as a skill to be learned and as a means of carrying forward curriculum concerns and of enriching classroom experience [18].

Portfolio: Portfolios are a collection of student work that allows assessment by providing evidence of effort and accomplishments in relation to specific instructional goals [14]. They can be used both as a record of students' development in a number of areas, as well as a means of summative assessment. Portfolios can contain evidence reflecting a wide range of skills and attitudes and can reflect development [13].

Presentation: It is often used to assess students' learning in individual or group projects. It is the process of showing and explaining a topic to an audience. Presentation assessment usually consists of a topic for the student to research, discuss and present. Questions and answers are usually following the presentation.

Peer evaluation: It helps to create a learning community within a classroom. Students are exposed to the thinking of their peers and their alternative feedback as peers' observation may differ from each other. With peer evaluation, students see each other as resources for understanding and checking for quality work against previously established criteria [27].

Role playing: it is considered as a form of experiential learning. Students learn through their exploration as they are provided with opportunities for learning situated in a real-life context through simulating the activities of their profession. Role playing significantly contributes to learning and assessment as it provides opportunities to reflect on learning, to show how tacit knowledge works etc. At a culminating academic moment (such as the end of a module) a role play can take the form of an exhibition or demonstration and can serve as a summative assessment tool.

Tests: depending on the knowledge, skills and competences that need to be assessed, mid-term tests are types of summative assessment [14]. They can be oral or written. In the case of oral exams the presentations skills become an essential aspect of what is evaluated. Written tests can be composed by multiple choice questions, cloze questions, short answers, matching questions, and structured questions [12].

Final test: it can be oral or written, depending on the knowledge, skills and competences that need to be assessed, and is a type of summative assessment. In the case of oral exams the presentations skills become an essential aspect of what is evaluated. Oral exams can take the form of an one-to-one interview as a means to explore what students have learned by using a more personalized oral interaction. An important element here is that the trainer can influence how the interview proceeds in order to test certain skills [14]. Written final tests can be composed by multiple choice questions, cloze questions, short answers, matching questions, and structured questions [12].

For self assessment purposes the self assessment questions in the training material can also be used.

4.3 Monitoring structure and tools

Monitoring of transversal skills online training will be based on objective and subjective approaches. Monitoring will be done through observations, checklists, analysis of attendance and complementary data and answering in questionnaires.

Through observation, learners will be monitored on how they participate in online learning activities, if they need more clarifications and on their performance. Trainers' guidance and encouragement can also be used as feedback for students' learning [14]. Attendance in online training is considered as an important element of the students' learning process. Complementary data that may refer to attendance sheets, comments etc. can be used for the measurement of indicators and the monitoring of several aspects of training.

Furthermore, checklists are going to be employed to monitor learning implementation and trainees' performance serving the identification of areas that need more work and reflection. The outcomes of formative evaluation will also be used for monitoring purposes. Questionnaires are going to be used in order to measure the perspectives of trainees regarding their participation, performance and satisfaction.

4.4 Monitoring and assessment tools

The monitoring and assessment tools utilized are the following:

- Attendance Sheet
- Lesson Sheet
- LO assessment
- Evaluation questionnaire that the trainees will be asked to complete at the end of the training

5 Annex

- Transversal skills online training – Training Material.
- Transversal skills online training - Trainers Handbook.
- Transversal skills online training - Attendance Sheet.
- Transversal skills online training – Lesson Sheet.
- Transversal skills online training and WBL - LOs assessment.
- Transversal skills online training - Trainees evaluation form.
- Transversal skills online training - Trainers evaluation form.

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Appendix B

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

SEnDIng

WBL Trainers' Handbook

Editor(s):	Sotiropoulou Aikaterini, Andrica Rozi, Panagiotopoulou Akrivi
Responsible Organisation(s):	Olympic Training & Consulting Ltd
Document Version-Status:	SEnDIng_DLV2.4 – Annex B
Submission date:	M28
Dissemination level:	Public

SEnDIng

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

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:	Work Based Learning - Trainers' Handbook
Work package:	WP2 "Learning outcomes identification and design of vocational curricula/educational modules and training/ assessment methodology"
Task:	2.4 Training methodology development
Document identifier:	SEnDIng_DLV2.4 – Annex B
Editor(s):	Sotiropoulou Aikaterini, Andrica Rozi, Panagiotopoulou Akrivi
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	Sotiropoulou Aikaterini, Andrica Rozi, Panagiotopoulou Akrivi	Olympic Training & Consulting Ltd	17/03/2020
Reviewed by	Vasileios Gkamas, Maria Rigou	University of Patras	23/03/2020
Approved by	Maria Rigou	University of Patras	24/03/2020

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 program will be provided to employed ICT professionals into three phases that include: (a) 100 hours of online asynchronous training, (b) 20 hours of face-to-face training[1] and (c) 320 hours 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 the project's results.

[1] Initially the training on transversal skills was to be provided face to face. However, due to the COVID19 pandemic and the restrictions it brought, the 20h training on Soft skills had to be delivered online.

TABLE OF CONTENTS

1 Content elements of SEnDIng training

1.1 Target group of the training

The target group of SEnDIng training is ICT professionals and more specific Data Scientists and IoT engineers who work at the ICT sector and other sectors where the Data Science and IoT technologies are applied (e.g. banking, assurance and energy).

1.2 Structure of the training

The training is provided in three phases:

- Online training at Data Science and IoT: http://mooc.sending-project.eu/.
- Online training at transversal skills.
- Work based learning.

The modular form of the curriculum allows the flexible implementation of the courses on the basis of the participants' needs. Each online course (educational module) is divided into training units at three levels of proficiency:

- **Introductory (I):** The educational module is introduced and its most important facts 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.

The order of the modules delivered depends on their content. It is suggested for the modules to be delivered progressively, with the transversal skills module being more flexible in the order of delivery.

The whole training program is presented in table 1 for the Data Science curriculum and in table 2 for the IoT curriculum. For piloting purposes and participation in the certification exams provided during the implementation of SEnDIng project, the trainees have to complete the three phases of training as depicted in the tables 1 for Data Science curriculum and 2 for IoT curriculum.

Table 1: Data Science training program

Modules	Duration
Module 1: Introduction to Data Science (DS-EM1)	**3h**
Module 2: Applied machine learning (DS-EM2)	**20h**
Training units	
Applied machine learning – Introduction (DS-EM2-I)	2h
Applied machine learning - Core (DS-EM2-C)	10h
Applied machine learning – Advanced (DS-EM2-A)	8h
Module 3: Python for Data Science (DS-EM3)	**20h**
Training units	
Python for Data Science – Introduction (DS-EM3-I)	2h
Python for Data Science – Core (DS-EM3-C)	12h
Python for Data Science - Advanced (DS-EM3-A)	6h
Module 4: Storing and retrieving data (DS-EM4)	**20h**
Training units	
Storing and retrieving data – Introduction (DS-EM4-I)	4h
Storing and retrieving data - Core (DS-EM4-C)	10h
Storing and retrieving data – Advanced (DS-EM4-A)	6h
Module 5: Statistics for Data Science (DS-EM5)	**20h**
Training units	
Statistics for Data Science – Introduction (DS-EM5-I)	2h
Statistics for Data Science - Core (DS-EM5-C)	10h
Statistics for Data Science – Advanced (DS-EM5-A)	8h
Module 6: Data Visualization (DS-EM6)	**20h**
Training units	
Data Visualization – Introduction (DS-EM6-I)	2h
Data Visualization - Core (DS-EM6-C)	10h
Data Visualization – Advanced (DS-EM6-A)	8h
Total duration of e-learning	**103h**
Face to face training in transversal skills	**20h**
Work based learning	**320h**

Table 2: Internet of Things training program

Modules	Duration
Module 1: Introduction to IoT (IoT-EM1)	**3h**
Module 2: Architectural Design and Applications in IoT (IoT-EM2)	**20h**
Training units	
Architectural Design and Applications in IoT – Introduction (IoT-EM2-I)	4h
Architectural Design and Applications in IoT - Core (IoT-EM2-C)	8h
Architectural Design and Applications in IoT – Advanced (IoT-EM2-A)	8h
Module 3: IoT Communication Technologies (IoT-EM3)	**20h**
Training units	
IoT Communication technologies – Introduction (IoT -EM3-I)	2h
IoT Communication technologies – Core (IoT -EM3-C)	8h
IoT Communication technologies – Advanced (IoT-EM3-A)	10h
Module 4: IoT Security and Privacy (IoT-EM4)	**20h**
Training units	
IoT Security and Privacy – Introduction (IoT-EM4-I)	2h
IoT Security and Privacy - Core (IoT-EM4-C)	8h
IoT Security and Privacy – Advanced (IoT-EM4-A)	10h
Module 5: IoT Devices (IoT-EM5)	
Training units	**20h**
IoT Devices – Introduction (IoT –EM5-I)	2h
IoT Devices – Core (IoT –EM5-C)	6h
IoT Devices – Advanced (IoT-EM5-A)	12h
Module 6: IoT Business Value (IoT-EM6)	**20h**
Training units	
IoT Business Value – Introduction (IoT-EM6-I)	2h
IoT Business Value - Core (IoT-EM6-C)	12h
IoT Business Value – Advanced (IoT-EM6-A)	6h
Total duration of e-learning	**103h**
Face to face training in transversal skills	**20h**
Work based learning	**320h**

2 WBL training content

2.1 Data Science

Title of unit	Introductory	Core	Advanced
Introduction to Data Science – Introduction	**DS-EM1**		
	–Basic concepts of Data Science –Methodologies involved in tackling Data Science problems –Data Science roles: Data Analyst, Data Architect, Database Administrator, Machine Learning Engineer, Data Scientist –Main duties of different Data Science roles. Data analysis, Databases design and administration, Data Visualization, Infrastructure for Data analysis, Design of machine learning algorithms –Main tools for Data Science: Python, R, Tableau, MapReduce/Spark, Hadoop –Data Science use cases. Data Science applications in ICT, in finance, in		

Title of unit	Introductory	Core	Advanced
	education, in marketing, in energy		
Applied machine learning	**DS-EM2-I**	**DS-EM2-C**	**DS-EM2-A**
	–Aims and purpose of Machine Learning systems –Main types of Learning (e.g. supervised, unsupervised, semi-supervised learning) –Domains and topics of Machine Learning applications	–Approaches used to analyse problems and design Machine Learning systems to face them –Functionality of supervised and unsupervised learning –Functionality of Semi-supervised learning –Reinforcement learning –Classification and Regression –Main streams of Machine Learning methods and techniques –Functionality of machine learning methods –Machine Learning toolkits and frameworks –Evaluation of machine learning systems	–Formulation of Machine Learning Systems –Machine Learning use cases
Introduction to Python for Data	**DS-EM3-I**	**DS-EM3-C**	**DS-EM3-A**
	–Main features of Python programming	–Variables: creating variables,	–The NumPy package: create and

Title of unit	Introductory	Core	Advanced
Science	language –Main libraries of Python for Data Science –Python installation at Windows and Linux environments	variables names, output variables –Built-in datatypes: numeric, tuples and lists, strings, dictionaries, other built-in types –Statements: Assignment statement, import statement, print statement, if: elseif: else: statement, for: statement, while: statement, continue and break statements, try: except: statement, raise statement –Functions: The def statement, Returning values, arguments, local variables, global variables and the global statement, lambda function –Classes and objects: create a simple class, defining methods, constructors, member variables, class variables, class methods and static methods –Modules: create a module, use a module, built-in modules, import from module	examine arrays, stack arrays, vectorized operations –The Pandas library for data analysis: create a dataframe, combine dataframes, rows and columns selection, sorting, descriptive statistics, file i/o –Matplotlib library for data visualization: creating basic plots, creating scatter 2D plots, create density plots –Time series analysis: pandas time series data structure, read data, recode data, exploratory data analysis, trends and seasonality in time series data. –Python libraries for machine learning: Scikit-Learn.

Title of unit	Introductory	Core	Advanced
		–File handling: read files, write/create files, delete files	
Storing and retrieving data	**DS-EM4-I**	**DS-EM4-C**	**DS-EM4-A**
	–Big data and Hadoop –Hadoop framework –Data lake concept –Hadoop clusters	–Architectural differences of Hadoop 1 and Hadoop 2 –The Hadoop Distributed File System (Data Storage) –The Hadoop Operating System (Data Processing) –Key areas of Hadoop Administration	–Running applications – the MapReduce Framework –Running applications – the Spark Framework –Apache Hive and Apache Pig –Securing Hadoop
Statistics for Data Science	**DS-EM5-I**	**DS-EM5-C**	**DS-EM5-A**
	–Main features of R programming language –Main packages of R for Data Science statistical analysis tasks –R installation in Windows and Linux environments	–Variables: creating variables, variables names, output variables –Built-in data types and Objects: scalars, vectors (numerical, character, logical), matrices, data frames, and lists –Control structures: conditional executions (comparison and logical operators, If and Ifelse statements), loops (For, While and Apply Loop	–R functions and libraries for referential statistics (Sampling Distributions & Estimation, Hypothesis Testing, Correlation & Regression). –Data visualization with R: ggplot2 and plotly libraries –R libraries for machine learning: mlr, dmlc XGBoost, caret

Title of unit	Introductory	Core	Advanced
		Family) –Functions and arguments in R –Probability functions supported in R (Chi-Square, Exponential, F-distribution, Poisson, Binomial, Logistic, Normal, Lognormal, Uniform) –Use R to calculate and visualize descriptive statistics (uni-variate analysis, multivariate analysis, function models) using respective R packages –File handling and debugging	
Data Visualization	**DS-EM6-I**	**DS-EM6-C**	**DS-EM6-A**
	–Key concepts of Data Visualization and Data Presentation Architecture –Fundamental principles of visual information / information graphics / statistical graphics	–Methodologies and effective ways to encode information into graphics –Basic diagrams / charts used for Data Visualization –Software tools and programs used for Data Visualization: Python, R, Tableau	–Advanced diagrams / charts used for Data Visualization –Dynamic Data Manipulation and Visualization with innovative software tools

2.2 Internet of Things

Title of unit	Introductory	Core	Advanced
Introduction to IoT	**IoT-EM1**		
	– Introduction to: • IoT Devices • IoT Communication Technologies • Architectural Design and Applications in IoT • IoT Security and Privacy • IoT Business Value		
Architectural Design and Applications in IoT	**IoT-EM2-I**	**IoT-EM2-C**	**IoT-EM2-A**
	– What is IoT – Key aspects of IoT Architecture (IoT Edge Device Types, IoT Gateways, Server-side Infrastructure) – Cloud Computing (service models (SaaS, PaaS, IaaS), deployment models (private, public, hybrid, community),	– Requirements for designing IoT Applications – Major IoT Applications Domains – Selected IoT Applications Analysis – IoT Applications Classification – Software architectural styles in IoT	– IoT Solution Architecture Subsystems – Architecture Subsystems Details – IoT Solution Design Considerations

Title of unit	Introductory	Core	Advanced
	public cloud computing services) – Fog and Edge Computing – Basic Features of Public Cloud Providers		
IoT Communication technologies	**IoT–EM3-I** – presentation of common LPWAN technologies – Competitive advantages of each technology – Devices' market landscape	**IoT-EU3-C** – IoT LPWAN Network Protocols. Principles of: o LTE/NB-IoT o LoRa o Sigfox – Design principles of edge devices with regards to the network protocols – System Design principles for bi-directional traffic over LPWAN – Basics of data exchange between network providers and IoT application development platforms – Private LPWAN	**IoT-EM3-A** – Communication Layers in IoT – IoT Network Protocols. Data exchange with core Networks of: o LTE/NB-IoT o LoRa o Sigfox – Efficient use of limited available bandwidth, – System design: Challenges with various IoT network protocols o bi-directional devices o Battery life o Buffering o Data encoding to comply with short data frames o Over the Air (OTA) upgrade
IoT Security and	**IoT-EM4-I**	**IoT-EM4-C**	**IoT-EM4-A**

Title of unit	Introductory	Core	Advanced
Privacy	– Introduction on IoT Threats, Attacks, and Vulnerabilities.	– IoT applications and vulnerabilities – Types of Attacks – Mirai and Bashilte DDoS attacks – Lessons Learned and how to avoid these types of attacks – Response to an attack	– Set up virtual machine and build private network – Read network traffic using Wireshark – Launch code to simulate Denial of Service attack – Detect Denial of Service attack
IoT Devices – Introduction	**IoT–EM5-I**	**IoT–EM5-C**	**IoT-EM5-A**
	– Electronics for the IoT (signals, GPIO, ADC, microcontrollers). – IoT sensors. – Sensors integration	– Electronics for the IoT – Sensor and Actuator integration – Microcontrollers – System interfaces	– Advanced Interfaces and Programming of IoT devices – Open and closed loop systems using sensor and actuators
IoT Business Value	**IoT-EU6-I**	**IoT-EM6-C**	**IoT-EM6-A**
	– Introduction to IoT Business and their main characteristics. – Smart devices that are used to function as remotes and send commands or request information over the network to IoT devices. – Use the definition of ecosystem (mentioned above) to apply specific industry companies to improve their	– Basic IoT Business model types: compliance monitoring, preventative maintenance, remote diagnostics, asset tracking, automatic fulfilment. – Challenges based on technology, business and society. o Technology: security, connectivity, compatibility and longevity, standards and	– Case studies of known companies that use IoT solutions successfully.

Title of unit	Introductory	Core	Advanced
	future model.	intelligent analysis & actions o Business: consumer, commercial and industrial – Society: social, legal and privacy	

2.3 Transversal Skills

Learning Unit	Content
Effective communication and presentation (TS-EM1)	– Active listening – Barriers to communication – Effective presentation
Change management (TS-EU2)	– Understanding changes – Developing resilience – Change management
Team working (TS-EM3)	– Formation and development of teams – Setting common goals – Developing a team – Team leadership – Effective communication in teams
Goal setting (TS-EM4)	– Overcoming obstacles in goal setting – Effective goal setting
Creative thinking (TS-EM5)	– Methods and techniques of creative thinking – Agile thinking – Characteristics of a creative environment

3 Theoretical background of the recommended training methodology in SEnDIng

The theoretical background of the recommended training methodology in the frame of SEnDIng project WBL is leaning on the following pillars:

- The constructivist approach
- The principles of adult education
- The principles of soft skills training
- The principles of ICT training
- The principles of work based learning

As a result, the proposed training methodology is based on both theoretical and empirical approaches that have been proven successful in adult education and training in the field of ICT.

3.1 The constructivist approach

The SEnDIng courses adopt the constructivist learning theory. In the constructivist paradigm, the learners are in the centre of the learning process and they are active creators and constructors of their own knowledge [1]. Active learning methods that give to trainees significant autonomy and control over the learning process are used. Learning outcomes follow a holistic, generalized concept of competence which is viewed from the perspective of the individuals and learners' personalities and capabilities.

The main implications of constructivism adopted in SEnDIng courses [1,2] are:

1. The trainees construct their own reality based on their previous experience and mental structures and beliefs.
2. Pre-existing conceptions and knowledge of learners are very important. Through training are explored, addressed and new knowledge is built on them.
3. The trainees reflect on their own experiences, assumptions and expectations, and develop critical thinking by analysing and assessing ideas and schemes in safe environments. By this way, they are able to reach a new understanding of things in their profession.
4. The learners assume responsibility for their own learning, by participating actively in the training process.
5. The trainers act as facilitators, helping trainees to construct knowledge rather than to reproduce a series of facts. Under this scope, problem-based learning, investigational work, situated learning, experimental learning, action learning have a pivotal role. Discovery is facilitated by providing resources and effective use of questions.

6. The training in workplaces is very important since trainees can deal with real tasks within communities of practice and coaching by experts.
7. The trainees develop metacognitive skills. Becoming aware of the learning process they are able to analyse monitor and evaluate it. They need to know how to learn by developing effective learning strategies.
8. The collaborative learning is supported by encouraging group work and collaboration in constructing knowledge and not competition. Peer learning and the use of peers are supported. Trainers are encouraged to provide opportunities for more expert and less expert participants to learn from each other. Discussion and debates are promoted.
9. The trainees construct their own reality. Constructivism allows for multiple interpretations and expressions of learning. It is accepted and expected that each trainee will interpret information in different ways.
10. The assessment is performance oriented and does not claim absolute objectivity. It is mainly based on portfolios, projects, role-playing, case studies, self-evaluation etc.

3.2 Adult education principles

Adult education is based to a great extent on the assumptions and principles of the constructivist approach. In the development of the training methodology of SEnDIng the following adult education principles are applied [3,4,5,6,7]:

Principles	Application
Adults bring life experiences and knowledge to the learning environment. Experience is considered a resource of learning	– The experience and expertise of adults should be recognized. – Training should build on them and encourage the learners to actively participate in the creation of new experiences and share their experience and knowledge. – Learning activities should be created in a way that reinforces the use of past experience and knowledge.
Adults tend to prefer self-directed, autonomous learning	– Adult learners need control over the learning process. That gives and requires more responsibility and initiative of them. It also allows them to select, manage and evaluate their learning. – Learners should be involved in setting goals and making decisions. – The trainer should act as facilitator, coach and supporter, by finding ways to involve participants and investigating of what participants want to learn. – Opportunities should be provided to learners to direct their own

	learning. – Action-planning tools and templates to learners should be provided in order to help learners to develop and focus their self-directed efforts and facilitate learning.
Adults have preferences for the way in which they learn	– Acceptance that not all learners respond to a given teaching method or technique. – Providing a customized learning approach according to learners need and developing the appropriate learning strategy. – Use of a wide variety of methods corresponding to all learners' preferences in training delivery. – Make trainers aware of their own learning preferences.
Adults learn best through collaboration and reciprocity. An environment where people learn with others while sharing what they already know	– Low-risk environment for learning should be provided, capitalizing the different levels of knowledge and skills within the learning groups. – The learners' self-esteem should be strengthened through team-based learning on mutual trust and respect.
Adults are motivated to learn by a wide variety of factors	– Adults are motivated by a variety of factors such as personal aspirations, expectations, internal desire or interest, escape from a situation. – Adults need internal motivation for learning rather than external. – Learning should respond to their needs, interests and real-life problems, in other words, be meaningful and relevant. – Relevance is the key factor for motivation so it is important to inquire into the reasons why participants are interested in learning. – The learners should be invited to identify the link between learning and satisfaction of their personal needs. – A connection should be made between the learning content and the long term objectives of each learner, in work and life.
Adults learners are goal oriented, relevancy oriented and practical	– Learners should be asked to identify what they would like to learn. – Clear learning objectives should be established and it should be explained how they relate to training activities. – Learners should be engaged in identifying the challenges they face and the value of addressing these challenges.

	– Training must show relevance to the job or other interests. – Learning has to be applicable to adult work duties or other responsibilities and focus on practical skills, tools, methods. – Opportunities should be given to trainees to apply the knowledge to practical skills and use methods to solve problems.
Adult learners need to be respected and learn in an appropriate learning environment	– Respect, trust and acceptance are vital for successful adult training. – Learners need to feel safe in order to participate freely, take initiatives, experiment, and express themselves. – Mistakes have to be viewed and used as improvement aids and not as failures. – Creativity and an agreeable atmosphere are important, but they have to be balanced with cognitive achievements, stability, and clarity of purpose. – The wealth of knowledge and experiences the participants bring to training should be acknowledged. – Learners should be treated as equals. – The participants should be allowed to voice their opinions freely.
Adult prefer active learning	– The more actively engaged the learner is, the more learning takes place. – Different training methodology and techniques have greater rate of retention.
Adults want guidance	– Adults want information that will help them to improve their situation. – Adults do not want to be told what to do, but they want to choose options based on their needs.
Adults have different learning styles	– Every individual has his/her own learning style depending on the preferred perception channel - visual, auditory, or kinaesthetic. – Techniques appropriate for all types of learners should be used and combined in such a way that different perception channels are employed. – There are also different personal learning styles referring to order, analysis level, abstraction and type of information presented and processed, that may be influenced either by the individual's personality and cognitive characteristics or by the

	educational system, cultural factors and professional specialization. – The learning styles preferred by each group of trainees should be found, in order for the learning experience to be modified accordingly.

3.3 Soft skills training principles

Even though there is lack of consensus on how to define soft skills [18], there is a common understanding that soft skills are the interpersonal human and behavioural skills needed by someone in order to apply technical skills and knowledge in the workplace [19]. Five categories of soft skills constructs have been identified by academics [20] such as communication skills, problem-solving and thinking skills, leadership and team working skills, ethical and moral values, and self-management. The EQAVET working group [18] suggested another typology introducing three interrelated categories of soft skills: a) communication skills, including aspects like oral communication and conversation, b) interpersonal skills, namely the ability to work in teams, relate to people, manage/mediate conflicts, discussions, negotiations and bargaining, and c) problem solving.

Given that soft skills have been positively linked to a strong performance level of professionalism, it is essential for the SEnDIng project to follow the common principles of soft skills training given below, as they have been detected in a broad literature review in order for the training to be successful [8, 18, 20].

- The success of training in soft skills depends on the facilitation of experts, the contextual awareness, and the provision of support, real-world application, self-study and self-awareness.
- Soft skills are more experienced-based and need to be reinforced throughout a person's lifetime. Their development is a dynamic process that needs to be refreshed over time to reflect on career and education changes.
- Active participation of learners, employees and employers is a guarantee that an intervention for soft skills development is "fit for purpose".
- Not everybody learns soft skills in the same way; active learning (cooperative learning, problem-based learning), transformative learning, and making meaning of learners' experiences through reflection, are important.
- Soft skills are imparted in small groups and innovative material is needed. Training material needs to integrate a number of sources in order to achieve real and impactful results and external providers are needed to be brought.

- Since behavioural change happens over long periods of time, individual soft skills development interventions or courses are not enough. Such interventions require multidisciplinary teams to create complex real-life scenarios and simulations.
- Tools should be used interactively, there must be interaction between heterogeneous groups, and learners should act autonomously.

3.4 WBL definitions and principles

Work-based learning is one of the fundamental aspects of vocational training, since it is linked directly to the mission of vocational training and help learners to acquire knowledge, skills and competences which are very important in working life [10]. Generally speaking, work-based learning is a form of experiential learning [11] and implies two characteristics, namely learning in a work context and learning through practice. It can be further understood as the model of learning through work, for work and at work [13]. It is often used in academic context as the educational strategy that combines traditional forms of education with work experiences, where theoretical and technical skills can be combined and applied. WBL is usually applied in school-based and vocational, educational and training programmes to develop basic work habits, occupational identity and specific occupational competences [11]. Through WBL the learners not only acquire specific skills and competences, but also enhance their ability to develop meta-competence and learning to learn skills [13].

The three main models of work-based learning are apprenticeships, on-the-job training periods in companies, as well as WBL integrated into a school-based programme.

Apprenticeships, known as “dual system” are often defined as “systematic long-term training alternative periods at the workplace and in an educational institution or training center” [10]. Learners spend a significant time in companies acquiring general and work-related knowledge and skills and often key competences [10].

The model of **on-the-job training** typically covers internships, work placements, traineeships or in-company training, which are incorporated as compulsory or optional elements of VET programmes leading to formal qualifications [10].

The third model is **WBL that is integrated into a school-based programme**, mainly through on-site labs, workshops, simulations or real business/industry project assignments. The aim of this model is to create real-life work environments, establish cooperation with companies and develop entrepreneurship competences [10].

Across Europe terminology and definition regarding WBL are still varying, and many countries combine the aforementioned three general models.

WBL benefits all parties involved. The following table summarizes these benefits, under the scope of providing WBL for the up-skilling of employees [10, 11, 12].

Learner	– Development of deep professional expertise – Build hard skills, soft skills, as well as other competences and behaviours – Development of carrier managements skills – Career improvements – Improve self-confidence, socialization and motivation – Fostering entrepreneurial skills
Employers	– Address skills gaps through tailor-made training – Improve productivity, innovation and performance – Positive effects on staff development – Enhanced corporate image – Staff retention and work satisfaction – Recruitment impact
VET	– Improved attractiveness of VET programmes – Better quality of VET programmes and learning outcomes – Enhancement of relevance and responsiveness of VET – Positive effect on teaching staff competences and development – Better cooperation between VET and businesses
Society	– Skilled labour force that corresponds better to the labour markets' needs – Cost-sharing of VET between the state and the employers – Contribution to innovation and creativity – Strengthening of social inclusion and improvement of equal opportunities – Increased employability

The following pedagogical and organizational options should be taken into account for successful work-based learning [11, 13]:

- There are many practices that may increase the extent to which work is learnt, such as: encouraging people to reflect on their experience; guidance provided by other workers and/or experts; mentoring; demonstration and practice; simulation; task rotation and task variety; project work; provision of problems to be solved.

- The extent to which employees–learners perceive their job to be meaningful, as well as the sense of progress and accomplishment within a WBL context, influences the learning process.
- The role of employers is crucial since they must devote some of the staff time to planning the learning process, assessment and review, supervision and training.
- The role of supervisors is crucial for the implementation of WBL. They should realize that developing the knowledge, skills and expertise of workers is part of their normal job tasks; and this role must be cultivated as part of the organizational culture. Mutual respect and a collaborative attitude are also crucial.
- Constructive feedback from supervisors, trainers, mentors, co-workers, and support are very important in the learning process.
- Supervisors or in-company trainers should be trained, in order to be able to help and interact with and manage the trainees under their supervision. They should have the required pedagogical and personal skills to support WBL.
- The complexity of the job influences the learning process and potential.
- The allocation of work is also important in stimulating learning; the learning process is affected by the way the tasks are allocated and work is organized. The opportunity to learn at work depends on the daily scheduling of normal work tasks and the production cycle. If such an opportunity is not offered, extra arrangements should be made between the enterprises and the training organizations.
- Encouraging progress and recognizing it stimulates the learning process. The working environment must also be organized in a way so as to encourage learners to take responsibilities and resolve problems by themselves.
- In small and medium-sized enterprises it is difficult to promote and improve the quality of WBL. In these cases the support or assistance of external expertise is valuable; such support could be coaching and training for in-company supervisors or the development of competency lists and learning guides. This expertise could be provided by VET practitioners.
- Practical methods of translating experience into learning could be a key challenge for improving the quality of WBL.

4 Recommended training methodology for WBL

4.1 Forms of WBL adopted by SEnDIng

For the purposes of SEnDIng training the model of WBL that is going to be adopted is the "On the job training" (OJT) and more specifically in-company training or in other words learning at work, which means acquiring knowledge, skills and competences by doing a job and by reflecting on the experience.

OJT is the process of helping people to learn in planned ways at the workplace [14]; it is an approach of training based on regular work and aims at the development of skills, knowledge and competences that are needed in a specific job or work settings. OJT is tailored to the requirements of the workplace; it may be structured or unstructured [17].

In SEnDIng, structured OJT is going to be employed. Structured training implies the use of standardized training materials, processes, trained trainers and performance checklists [17], ensuring consistency and accountability. There is no one right way to implement a structured OJT but some characteristics should be reflected such as management support, trainers support process, checklists, OJT training materials, training of trainers and reporting [17].

The training activities which will result in learning through the model of OJT in the frame of SEnDIng will be planned and be both general and specific such as [14]:

- planned activities resulting in guiding what an employee-learner has to do and learn (e.g. special assignments and/or job rotation that increase general knowledge of certain operational areas),
- carefully structured approaches, such as using specific software to train learners and develop skilled workers.

Useful learning activities that might be carried out on the spot will also be exploited as good opportunities for learning.

OJT embodies many advantages for both trainees-employees and employers. Learning by executing work tasks in real workplace enables employees to develop specific professional expertise, transversal skills and improve their confidence in an easy way for them. For employers, OJT is a flexible cost-effective training method, that can be easily adjusted to the needs of their company and contribute to competitive advantages, improvement of quality, greater productivity, transfer of training, development of desired attitudes and rapid results.

4.2 Recommended training methods and techniques

The phases of the implementation of OJT in the frame of SEnDIng are [15,16]:

a) Information and agreement between all partners involved (enterprise, training provider and employee/trainee) regarding the detailed description of OJT, and preparation of the training.
   - Each company should study this guide and suggest any adaptations, inform the trainees-employees and the rest of the staff about the training, and assign an in-company trainer/mentor. The mentors will be the ones responsible for the day to day implementation of OJT, and prepare the relevant climate as well as establish the priorities (in cooperation with their supervisors) that will enable the smooth and effective implementation of OJT.

b) Implementation and evaluation of training. At this stage:
   - The in-company trainers, based on the training guide tasks and training material, will implement the training, explaining to the employees-trainees what they are required to do and why, let them perform the required tasks autonomously, give them time to replicate tasks, observe carefully without interfering if it is not necessary, provide constructive feedback and guide them to adjust their performance. They will also adapt or provide additional training material if needed.
   - Training providers of the consortium will provide support to the enterprises if needed.
   - Each trainee has to comply with the training and evaluation rules and respect the tasks assigned, as well as to cooperate with the in-company trainer.
   - The in–company trainers have to perform the tasks assigned to them and report progress
   - , as well as to communicate with the training organization.

There are many techniques [14] that have been proposed to be used in training at workplaces such as:

- **Basic techniques**: relatively simple techniques, such as giving feedback about performance, consultation, modelling, supervision, observation, learning by doing, demonstration.

- **Meta-techniques**: making use of the basic techniques and further involving one-to-one relationships between the trainer and the learner such as mentoring, coaching, counselling, peer training, job instruction training.
- **Organized activities** such as job rotation, quality circles, case studies.
- **Media-based techniques,** such as computer-assisted learning, e-learning, reading.
- **Other techniques,** such as action learning, briefings, consultants, delegation, find-out-yourself, meetings, unplanned opportunities.

The following techniques are proposed for the purposes of WBL in the frame of SEnDIng training courses:

Project

This behavioural technique focuses on problem analysis and solving and requires the active involvement of trainees. Trainees are given a description of a situation and are asked to come to decision or solve a problem. This can be done in small groups or individually. Trainers need to provide the ideal solution and be open to assess and discuss solutions proposed by trainees. This technique is particularly useful if the cases reflect real work situations and daily concerns. By this way, trainees can learn how to analyse and solve problems on an actual base. Moreover, the trainees learn the importance of accepting the opinions of others. Projectsf will be developed by the involved project partners and be adopted by in-company trainers, according to the companies and the trainees' needs.

Supervision

The main objective of supervision [15], as used in SEnDIng training courses, is to assist trainees in developing the professional skills and competences described by the learning outcomes. Trainees are guided in developing their competences, role awareness, and effective working methods, according to their developmental level. An essential element of supervision is to teach task and problem analysis. Through this process, trainees gain the necessary motivation, autonomy and self-awareness to successfully move to the next level of professional development. Supervision provided by SEnDIng will have the following characteristics: a) establishes clear performance objectives and promotes quality standards, b) focuses on problem-solving and monitoring performance objectives, c) enables trainees to continuously improve their own performance, d) provides feedback and recommendations, e) motivates and empowers, f) encourages participatory decision making. Effective supervision leads to higher-quality services, enhanced productivity, as well as to employees with a wider range of skills and increased ability to function with

autonomy. In SEnDIng, supervision can play a significant role in the professional development of trainees, not only in terms of technical skills but also in developing transversal skills. Supervision will be held both individually and in groups of trainees.

Coaching

Coaching focuses on the individual's needs and accomplishments providing encouraging feedback and suggestions to improve performance [16]. It is a collaborative solution-focused, results-orientated and systematic process in which the trainer facilitates the enhancement of work performance, self-directed learning and personal growth of the trainee [15]. According to a comparative review [15] coaching appears to be effective during formative education, encouraging motivation and developing skills related to reflection and critical thinking. Coaching will be used in SEnDIng to assist trainees to develop technical and transversal skills. Trainers will work directly with the trainees in individual sessions on regular basis. In line with the desired learning outcomes and according to the trainees' individual needs the trainers will agree with the trainees on a set of tangible and well-defined goals according to the acquisition of skills.

The in-company trainers will determine the frequency and the extent of OJT training techniques, taking into account the unique characteristics of each learner or learner group, the learning styles of the learners involved and the enterprises' needs. Training techniques can be added or omitted according to the needs. Trainers could also use more techniques, such as basic techniques, meta-techniques, organized activities, media-based techniques or other techniques.

There are also some additional elements that could strengthen the trainees' support [16]

- One-to-one feedback sessions
- Individual consultations
- Group discussions, managed on a regular basis
- Consultation in informal settings, e.g. lunch
- Coaching and mentoring in combination with self-managed learning

5 Monitoring and assessment methodology for work based learning

5.1 Description

Assessment and monitoring in WBL is an important part of the learning process, serves several functions [23] and includes the diagnosis of success or failure, the provision of valid and meaningful outcomes of what has been achieved and the maintaining of the learners progress in order to assist them in planning their own learning [23].

The assessment process focuses on both the implementation of work based learning activities and the achievement of the desired learning outcomes. Given that learning takes place in different learning environment and different forms, the assessment in WBL often involves several approaches [23]. It has been argued that reliability of assessment in WBL context is difficult to achieve, since placements are highly individual and learners' opportunities vary [21]. Some learners might have better opportunities than others to demonstrate their potentials.

Assessment in SEnDIng WBL will be formative and summative, based on data collected from multiple sources such as the trainees themselves, the staff of enterprises and trainers. Monitoring will be ongoing, while self-assessment and self-monitoring will be also employed.

The proposed assessment methodology refers to the following aspects:

- The extent to which the learning outcomes in terms of skills and competences have been achieved.
- The application of the knowledge acquired in the previous phases of training (online).
- Further aspects of job performance related to transversal competences and active participation in WBL

In order to balance reliability issues, the following suggestions [21] should be taken into consideration and relative actions will be implemented in WBL assessment and monitoring:

- Involvement of employers, supervisors and other colleagues.
- Clarification of the purposes of assessment to all people involved.
- Careful consideration of the in-company people that will be asked to assess the trainees.
- Ask trainees to produce a personal kind of document that might include hopes, fears, feelings, actions, achievements.
- Using a portfolio to demonstrate work achievements as well as anonymous testimonials from clients and other staff.

The in-company trainers assigned by the companies involved in WBL will be the main responsible for collecting the necessary information.

5.2 Assessment structure

The methods for the assessment of the WBL part of the training are the following [22]:

Discussion allows the cooperation between the trainee and the mentor. Discussions will be done using open-end questions that will allow the identification of the trainee's

opinions and attitudes concerning the implementation of practical training and execution of tasks during WBL. In addition, task, incident and skills analysis regularly performed during supervision sessions will provide further data that is indicative of the trainee's development. During such analysis trainees will be asked to describe real incidents, what and how services/products were provided, what problems emerged, and the solutions found.

Task performance assessment: By this procedure changes in the trainee's performance are measured as a result of the implementation of on-the-job training. Learning outcomes in terms of skills and competences are assessed in a more direct way. Efficiency assessment can take place in a variety of ways, including performance checklists and action plans. In the action plans trainees are asked to describe how they applied or how they intend to apply what they have learned so far, allowing the in-firm trainer to assess problem-solving skills, critical thinking, autonomy, flexibility etc. It should be noted that to a great extent task performance assessment takes place through observation; however the timing and tools used differ somehow.

Assessment from third persons. For assessment to be complete the opinion of other persons working directly with the trainees should be taken into account. Staff from the companies as well as the supervisors will be consulted to offer their perspective on the trainees' performance and progress. Through specific questionnaires they will be asked to provide information on specific aspects of attitude, performance and behavior they can directly observe and evaluate.

Self-assessment. Trainees will be asked to assess their own progress, as well as perceived strengths, weaknesses and challenges. Self-perceived competence and efficiency, as well as the detection of persisting difficulties will help the in-company trainers design more effectively WBL activities. The questionnaires to be used should be in line with the task complexity and the specific objectives of the training.

5.3 Monitoring structure

Monitoring of WBL will be based on objective and subjective approaches and will be ongoing.

Through observation learners will be monitored on their participation in WBL activities and on their performance. Observation will be carried out by both the learners (self-observation) and by others (hetero-observation). In the latter case observation will be conducted by in-company trainers during the supervision sessions. Recording may take place in real time or retrospectively. In the case of self-observation trainees will record behaviors, actions, tasks, problem-solving steps etc. using diaries completed at a weekly

basis. Through this procedure, notes will be taken by the training providers in a systematic way for the production of safe conclusions.

Complementary data such as attendance sheets, internal procedures of the hosting companies, service-user questionnaires, comments etc. will be also used. Such data is particularly useful for the monitoring of further aspects of job performance. Upon completion of WBL the supervisors and in-company trainers draft a final report for each trainee, drawing from all the aforementioned sources. Questionnaires are also going to be used measuring the perspectives of trainees and third persons in companies regarding trainees' participation, performance and satisfaction in WBL procedures.

5.4 Monitoring, Assessment and Evaluation tools and frequency of use

Filled by	Tool	URL	Frequency	Comments
Each in-company mentor/trainer	WBL monitoring	Trainer monthly report	At the end of each month of WBL.	It is the monthly report filled by the trainer. It concerns all trainees under supervision.
Each in-company mentor/trainer	WBL monitoring	Trainer final report	At the end of WBL.	It is the final report filled by the trainer. It concerns all trainees under supervision
Each in-company mentor/trainer	Trainer assessment	Trainer performance checklist	At the end of WBL.	It is the performance checklist filled by the trainer for each trainee.
Each in-company mentor/trainer	WBL evaluation	Trainer WBL evaluation report	At the end of WBL.	It concerns the WBL evaluation by the trainer
Each trainee	WBL monitoring	Trainee attendance sheet	At the end of each month of WBL	It is the daily attendance sheet filled by the trainee. It should be signed by the trainee and trainer. At the end of the work based learning please return a scanned copy of the signed attendance sheet at rigou@ceid.upatras.gr and gkamas@ceid.upatras.gr
Each trainee	WBL monitoring	Trainee weekly report	At the end of each week of WBL.	It is the weekly report filled by the trainee
Each trainee	WBL monitoring	Trainee monthly report	At the end of each month of WBL.	It is the monthly report filled by the trainee
Each trainee	WBL evaluation	Trainee WBL evaluation report	At the end of WBL.	It concerns the WBL evaluation by the trainee

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