

The SEnDIng project

Data Science and Internet of Things professionals' training

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Abstract. Data Science (DS) and Internet of Things (IoT) are currently among the key drivers of skills and competences required by the IT market. As a skills' gap is projected in the DS and IoT domains, substantial effort is required by training providers for the upskilling of IT workforce. The SEnDIng project aims to address the skills' gap of Data Scientists and IoT engineers by developing and delivering two learning outcomes-oriented, modular VET programmes. Trainings will be delivered into three phases: e-learning, face-to-face and work-based learning. During the self-paced online training, trainees will be upskilled on DS or IoT, face-to-face training will cultivate their transversal skills and work-based learning will allow trainees to apply the acquired skills on realistic case studies in their workplace with mentoring support. Upon successful completion of the training, participants will go through the certification which is designed and developed by SEnDIng and is aligned with the NQFs, EQF and ECVET.

Keywords: Data Science, Internet of Things, Curriculum Design, Knowledge, Skills, Competences, Transversal Skills, Certification.

1 Introduction

Although Internet of Things (IoT) and Data Science (DS) are still in their early stages they can offer vast potential to enterprises and organizations, and disrupt existing business models and processes [1]. In addition, their value for the EU economy is huge; it is projected that the value of the EU Data Economy will reach 739 billion by 2020, while IoT with a value of €120 billion will solely contribute to an increase of 7 points of European GDP by 2025, through productivity improvement and value distributed to end customers [2].

One of the main barriers preventing the full exploitation of DS and IoT potential, is the skills gap observed at both domains. According to predictions, the demand for Data Scientists will increase by 28% in 2020, with the unfilled DS positions at the same time estimated at 485,000. In addition, the need for IoT skills is huge, as 68% of businesses struggle to hire IoT experts. These forecasts, together with the rapid and continuous evolution of DS and IoT technologies and their application in many industries (i.e. ICT,

banking, energy) make the skills required by IT professionals increasingly sophisticated, and the need for their constant update imperative.

The SEnDIng project [3] aims to address the DS and IoT skills' gap of IT professionals, by providing them with skills and competences that meet the current needs of DS and IoT industries, are transferable and recognized among EU countries. To achieve this goal, SEnDIng designs two multi-disciplinary VET programs that address three areas: Data Science, Internet of Things and Soft (Transversal) skills. SEnDIng is a 36 month Erasmus+ Sector Skills Alliance project coordinated by the University of Patras and is scheduled to finish in November 2020.

2 Project Description

The SEnDIng project aims to:

- Address the skills' gap of Data Scientists and IoT engineers, by developing 2 VET programs -one for DS and another for IoT- that combine technical knowledge and skills with transversal skills and competences. The programs are based on learning outcomes-oriented and modular curricula and will be delivered using innovative training methodologies.
- Provide to Data Scientists and IoT engineers skills and competences that are transferable and recognized among EU countries according to well-known EU frameworks and standards.
- Contribute to the increased demand of sectors other than the ICT (e.g. banking, energy and logistics) for highly qualified Data Scientists and IoT engineers.
- Make the provided training more relevant to the actual needs of the labor market, by jointly developing the program with the key beneficiaries (IT SMEs and companies) and including work-based learning.

To achieve the aforementioned objectives, the SEnDIng work plan is divided into four core work packages (**Fig. 1**), supported by three horizontal ones addressing management, quality assurance and dissemination. Targeted outputs comprise:

- Definition of the learning outcomes in terms of knowledge, skills and competences of the 2 VET programs.
- Design of a common reference scheme of competences, skills, knowledge and proficiency levels of DS and IoT professionals, in compliance with the European eCompetence Framework [4] and ESCO [5] ensuring transparency, comparability and transferability between European countries.
- Design of two modular and learning outcomes-oriented curricula, one targeting DS and another targeting IoT.
- Delivery of vocational trainings into three phases.
- Design of a mechanism for the certification of the learning outcomes acquired and provision of recommendations for the validation, certification and accreditation of the 2 VET programs in alignment with the NQFs of Greece, Bulgaria and Cyprus, EQF and ECVET.



Fig. 1. Work breakdown structure with core WPs.

Each SEnDIng VET program will be delivered in three phases: (1) Online training (103 hours per program) through self-paced online courses aiming to upskill trainees on DS or IoT; (2) Face-to-face training (20 hours) aiming to cultivate the transversal skills of the trainees in both programs; (3) Work-based learning (4 months) where trainees will work on realistic case studies in their workplace with mentoring support.

The consortium consists of organizations from 4 European countries and includes higher education institutions, VET providers, private-sector companies, associations of IT companies and IT scientists, as well as a certification organization.

3 Current project status

The outcomes reached so far concern WP2, WP3 and WP5, while there has been some initial investigation for WP4. WP2 defined the learning outcomes of each VET program (in terms of knowledge, skills and competences), the respective training curricula, as well as the training and assessment methodology. To establish a close connection between the developed curricula and the actual needs of the market, a survey was designed and conducted in April 2018 and addressed SMEs, companies and organizations that are knowledgeable and experienced in IoT and DS (it integrates feedback received from 43 stakeholders from the IoT and 36 from the DS sector). The survey presented a listing of knowledge, skills and competences for both curricula based on a thorough desk research on programs that higher education institutions, VET providers and companies offer in the areas of DS and IoT and asked respondents to state degree of agreement and suggest additional topics to be addressed by the SEnDIng training programs. Details about the 2 developed curricula can be found in deliverable D2.3, available at [3].

As the professional roles involved in a DS or an IoT project are many and are characterized by different training needs, SEnDIng proposed a mapping between professional roles and the proficiency level each one requires in terms of DS (**Table 1**) or IoT

(Table 2) training units. This mapping allows for more flexibility and guidance to trainees with specific needs, even after the end of the project, and provides added value to the sustainability of the online training programs by specifying alternative learning paths through the developed training units. Unit levels refer to Introductory (I), Core (C) and Advanced (A) levels of proficiency. The transversal skills curriculum includes units for effective communication and presentation, change management, team working, goal setting and creative thinking.

Table 1. Mapping of DS training unit level to professional roles (professional roles in DS were adopted from the EDISON project [6])

Data Science Training Units	Data Analyst	Data Architect	DB Administrator	Machine Learning Engineer	Data Scientist
Introduction to DS	I	I	I	I	A
Python for DS	A	C	I	A	A
Statistics for DS	C	C	I	A	A
Storing and Retrieving Data	C	A	A	C	A
Applied Machine Learning	I	I	I	A	A
Data Visualization	A	I	I	C	A

Table 2. Mapping of IoT training unit level to professional roles.

IoT Training Units	IoT Product Manager	IoT Architect	IoT Software Developer	Data Scientist	IoT Cloud Engineer	IoT Industrial Engineer
Introduction to IoT	I	I	I	I	I	I
IoT Devices	C	C	I	C	C	A
IoT Communication technologies	C	C	C	C	A	C
Architectural design and applications in IoT	C	A	A	C	A	C
IoT Security and Privacy	I	C	C	I	A	C
IoT Business Value	A	I	I	I	I	C

WP3 regards the authoring of the training units, as well as the accompanying assessment tests and their formatting for uploading in the online platform. WP5 includes the design and population of the online platform with the training units of the two curricula as well as the delivery of the VET programs, which is scheduled to start in November 2019. All interested will be invited to participate in the VET program through an open call which will be issued in July 2019.

4 Conclusions and future work

This technical report presented the SEnDIng project, an Erasmus+ Sector Skills Alliance for the design and delivery of innovative VET programmes to Data Science and Internet of Things professionals. The project is halfway through its duration and has so far delivered two modular learning outcomes-oriented curricula (on DS and IoT respectively) and a platform which will be used for the delivery of the online training. In the second half, the project will deliver the two training programmes and the upskilling of participating trainees will be certified. SEnDIng aims to foster the sustainability of its main outputs (i.e. the two VET programs) through its online platform and by promoting the flexibility of alternative, adequately tailored learning paths determined by the identified professional roles in both DS and IoT. For more information please visit www.sending-project.eu or contact the project manager (Dr. Maria Rigou, rigou@ceid.upatras.gr) and the technical manager (Dr. Vasileios Gkamas, gkamas@ceid.upatras.gr).

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References

1. Dijkman, R. M., Sprenkels, B., Peeters, T., & Janssen, A.: Business models for the Internet of Things. *International Journal of Information Management*, 35(6), 672-678 (2015).
2. Kearney, A. T.: The Internet of Things: A New Path to European Prosperity, <https://www.at-kearney.com>, last accessed 2018/11/05.
3. The SEnDIng Erasmus+ project, www.sending-project.eu, last accessed 2019/07/07
4. European e-Competence Framework (e-CF), <http://www.ecompetences.eu/>, last accessed 2018/12/05
5. European Skills, Competences, Qualifications and Occupations (ESCO) classification, <https://ec.europa.eu/escos/portal>, last accessed 2019/07/07.
6. Manieri, A., Brewer, S., Riestra, R., Demchenko, Y., Hemmje, M., Wiktorski, T., Ferrari, T., Frey, J.: Data Science Professional uncovered: How the EDISON Project will contribute to a widely accepted profile for Data Scientists. In: IEEE 7th International Conference on Cloud Computing Technology and Science, pp. 588-593, IEEE.