# The SEnDIng project
## Data Science and Internet of Things professionals' training

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# Project overview

- **Program**: Erasmus+ KA2: Cooperation for innovation and the exchange of good practices - Sector Skills Alliances
- **Call ID**: EACEA-04-2017
- **Lot**: Lot 2, SSA for Design and Delivery of VET
- **Project Number**: 591848-EPP-1-2017-1-EL-EPPKA2-SSA
- **Grant Agreement Number**: 2017-3184/001-001
- **Project Coordinator**: University of Patras
- **Duration**: 36 months
- **Number of Partners**: 12
- **EU grant**: 982.537 €
- **Start Date**: 1$^{st}$ December 2017
- **End Date**: 30$^{th}$ November 2020

# DS and IoT scenery

- Rapid and continuous evolution of DS and IoT technologies and their application in many industries (ICT, banking, energy, marketing, etc.)
- 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
  - IoT with a value of €120 billion will solely contribute to an increase of 7 points of European GDP by 2025
- SKILLS GAP
  - the demand for Data Scientists will increase by 28% in 2020, with the unfilled DS positions at the same time estimated at 485,000
  - the need for IoT skills is huge, as 68% of businesses struggle to hire IoT experts

# SEnDIng objectives

- Address the **skills' gap** of ICT professionals in the domains of Data Science (DS) and Internet of Things (IoT)
- Contribute to the **increased demand** of industry's sectors other than ICT (e.g. banking, energy, logistics) for highly-qualified DS and IoT professionals
- Provide the DS and IoT professionals with skills and competences, that are **transferable** and **recognized** among European countries
- Make the vocational trainings more relevant to the actual **needs of the labor market**

# Target Groups

- ICT professionals and associations
- VET providers
- Certification bodies
- Higher Education Institutes
- Companies & SMEs
- Policy-makers
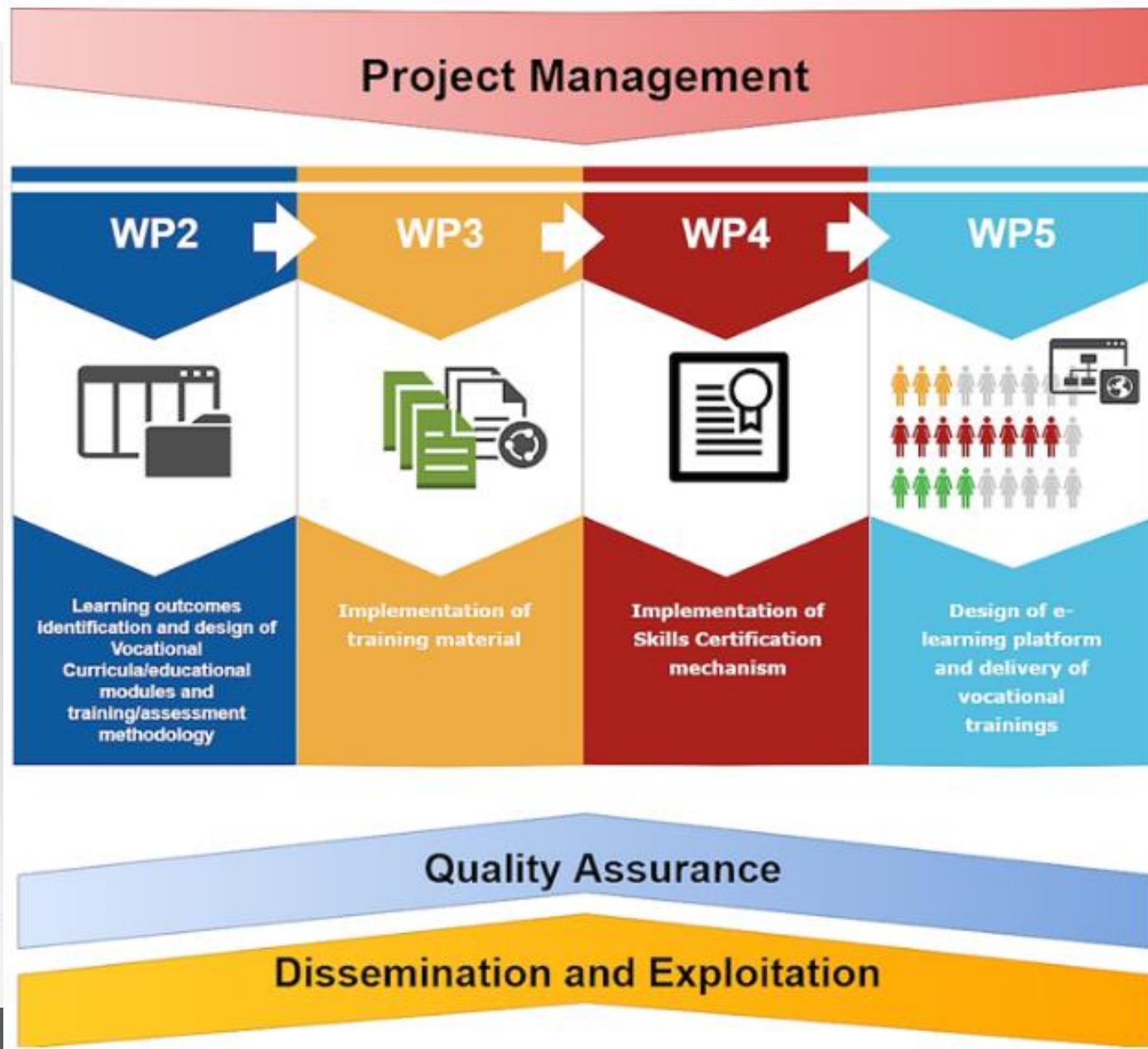
# Main results (1)

- **Learning outcomes** of Data Science and IoT VET programs
- A **reference scheme** of knowledge, skills and competences for Data Scientists and IoT professionals.
- Two modular learning outcomes-oriented **vocational curricula**
  - *Modularity*: each curriculum is divided into educational modules and each module into training units at three levels of proficiency (introduction, core, advanced)
  - *Personalized learning*: a different learning path for each learner according to the occupational profile
- Each VET program will be delivered in three phases
  - e-learning (100 hours),
  - face-to-face (20 hours) and
  - work based learning (4 months)
  - *we will train at least 75 IT professional in DS and 75 in IoT (from GR, BL and CY).*

# Main results (2)

- A **MOOC** that will be used for the online training phase of VET programs
- **Open Educational Resources**
- A **training methodology** incorporating online training, face-to-face training and work-based learning
- A certification framework for the **certification**
- A **survey** for the validation, certification & accreditation of provided VET programs and their alignment with NQFs, EQF and ECVET
- A set of **exploitation toolkits** for Higher Education Institutes, VET providers and enterprises
- **3 Workshops** (Greece, Cyprus and Bulgaria) and a **conference** organized in Greece

# Produced results

- Learning outcomes in terms of Knowledge, Skills and Competences (WP2)
  - **Desktop research** on existing Data Science and Internet of Things curricula and courses -> definitions of skills and knowledge
  - The draft version of the DS and IoT Learning outcomes was discussed among partners and **key experts** in the respective fields
  - Design and distribution of an **online survey** among CIOs of IT companies to explore on their plans and needs (skills and knowledge) in the IoT and the Data Science domains (more than 140 companies and organizations).
    - Data received validated the defined skills and knowledge.
    - Received 36 responses for Data Science learning outcomes and 43 responses for Internet of Things learning outcomes
    - from companies all over the world

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# DS learning outcomes

| Knowledge | Skills | Competences |
|---|---|---|
| ▪ Describe the key concepts of Data Science<br>▪ Describe ICT methods and tools applicable for the storage and retrieval of data<br>▪ Describe methods and tools applicable for the statistical analysis of data<br>▪ Explain basic concepts and requirements related to information security and privacy (e.g. how to deal with people profiling in the context of GDPR) | ▪ Analyse domain specific trends and present them as structured information<br>▪ Create code to statistically analyse data<br>▪ Apply data statistics and data visualization<br>▪ Deploy simple machine learning techniques<br>▪ Deploy data storage and retrieval techniques;<br>▪ Implement data models validation techniques<br>▪ Ensure that IPR, security and privacy issues are respected | ▪ Exercise self-management within the guidelines of work or study contexts that are usually predictable, but are still a subject to change<br>▪ Supervise the routine work of others, taking some responsibility for the evaluation and improvement of work or study activities |

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# IoT learning outcomes

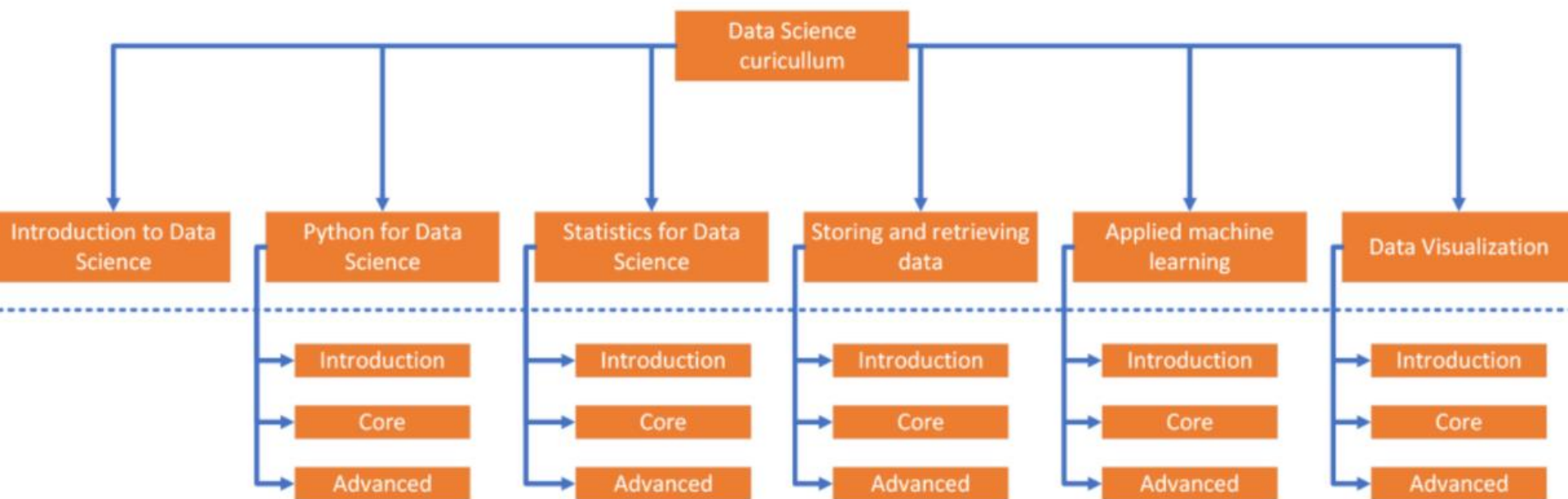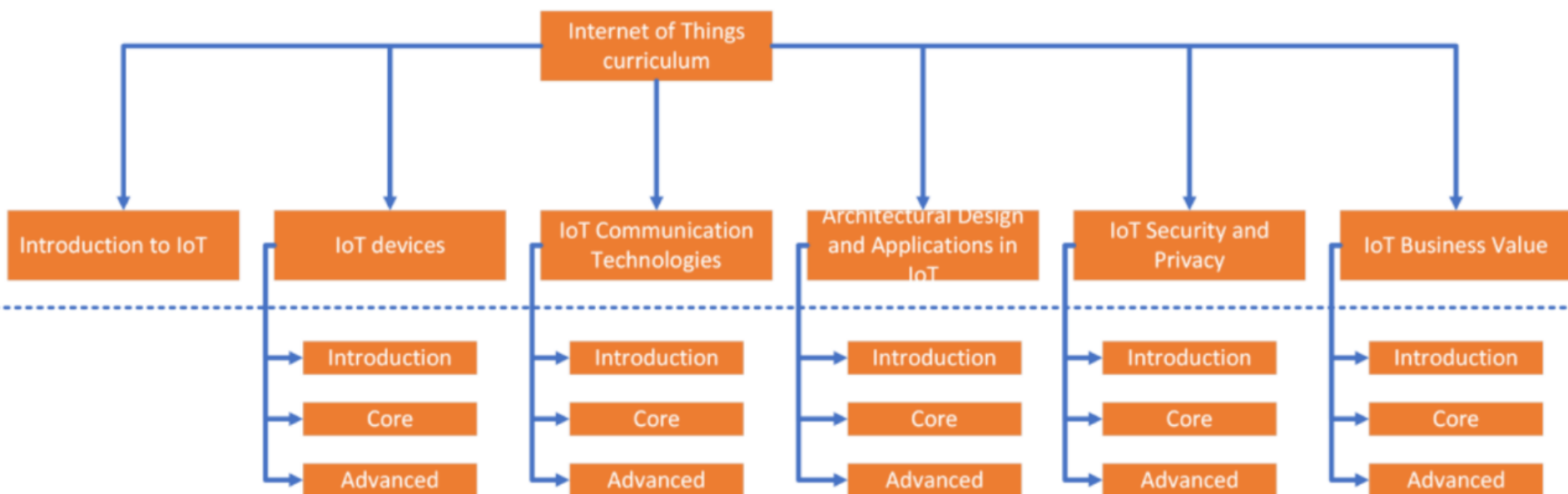| Knowledge | Skills | Competences |
|---|---|---|
| ■ Describe the value that IoT delivers in different business domains<br>■ Explain the business processes related to IoT in specific domains<br>■ Understand IoT architectures and the related network and communication protocols<br>■ Recognize different types of sensors, actuators, displays and related embedded electronics<br>■ Design the application level (e.g. use protocols that support different IoT applications) of IoT in the context of big data, cloud technologies and data science<br>■ Formulate requirements about IoT information security | ■ Analyse, argue and describe the business value of a particular IoT system<br>■ Design an IoT system that includes sensors, controllers, actuators and displays, connected to a cloud platform through internet connection<br>■ Develop and deploy workflows and dashboards for an IoT system that includes sensors, controllers, actuators and displays, connected to a cloud platform through internet connection<br>■ Develop working code for an IoT system that includes sensors, controllers, actuators and displays, connected to a cloud platform through internet connection<br>■ Apply IoT information security concepts | ■ Exercise self-management within the guidelines of work or study contexts that are usually predictable, but still are a subject to change<br>■ Supervise the routine work of others, taking some responsibility for the evaluation and improvement of work or study activities |

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# DS Curriculum

# IoT Curriculum

# Key competences in terms of soft skills

- Communication skills;

- Adaptable to change;

- Team work;

- Ability to present in front of colleagues and clients;

- Goal-oriented;

- Thinking outside the box;

- Agile mindset;

# Data scientist roles

- **Data Analyst**. Analyses large variety of data to extract information about system, service or organization performance and present them in usable/actionable form.

- **Data Architect.** Designs and maintains the architecture of Data Science applications and facilities. Creates relevant data models and processes workflows.

- **Database Administrator.** Designs and implements or monitors and maintains large scale cloud databases.

- **Machine Learning Engineer.** Designs and applies machine learning algorithms.

- **Data Scientist.** Gathers and interprets rich data sources, manages large amounts of data, merges data sources, ensures consistency of data-sets, and creates visualizations to aid in understanding data. Builds mathematical models, presents and communicates data insights and findings.

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# Mapping of DS training unit level to professional roles

| 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 |

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# IoT Engineer roles

- **IoT Product Manager**. Supervises the execution part of the project. Collaborates with the development teams to take care of business requirements and implementations.

- **IoT Architect**. Manages the functional requirements gathering, technology (hardware, software, protocols) selection and solution architectural design for IoT systems and applications. The IoT Architect is responsible for creating effective, efficient, scalable, secure, and innovative IoT Solutions.

- **IoT Software Developer.** Implements IoT systems and applications according to approved designs and conducts rigorous testing of the applications. Deploys the systems and applications to the cloud as well as app stores.

# IoT Engineer roles

- **Data Scientist.** Finds and interprets rich data sources, manages large amounts of structured and unstructured data, merges data sources, ensures consistency of data-sets, and creates visualizations to aid in understanding data collected from IoT systems and applications.

- **IoT Cloud Engineer**. Deploys the IoT system infrastructure on the cloud, from middleware to data storage (e.g. databases) for collecting, storing and processing data from the IoT devices in the network

- **IoT Industrial Engineer**. Looks into the hardware components involved in IoT systems and applications, programs robots and smart embedded devices.

# 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 |

# Current project status

- Active core tasks:
  - Finishing up training material & self assessment quizzes
  - Uploading material to the Open edX platform
  - Defining participation prerequisites and selection criteria
  - Specifying the SEnDIng certification scheme and accreditation mechanism
- Upcoming tasks:
  - Delivery of the 2 vocational training programs (3 phases) – start: Nov 2019
  - Certification of participants
  - Work on a sustainability plan for the online training component

# **Conclusions and future work**

- Our main challenge is to reach the target of 150 trained and certified IT professionals

- (In the long-run) to support the online training component and potentially the certification scheme developed after the end of the project

- SEnDIng aims to foster the **sustainability** of its main outputs (i.e. the two VET programs)
  - through its online platform
  - by promoting the flexibility adequately tailored learning paths according to professional roles in both DS and IoT

# Thank you!

For further information please contact

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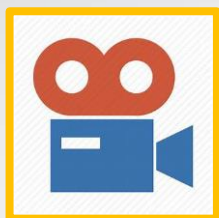
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