COMP4DRONES

DELIVERABLE

D7.9 – Training Strategy and Plan

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Electronic Components and Systems for European Leadership

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Abstract (few lines):	This deliverable presents intended activities of the consortium to spread **knowledge** acquired during the project execution, mainly **internal** to the consortium but also to **external** parties, within both the **academic** and **industrial** domains. This document outlines the training **methods** and **tools**, target **audience**, training **strategy**, and the training **plan**.

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Definitions, Acronyms and Abbreviations

Acronym	Title
C4D	Comp4drones project
ESL	Electronic System-Level
GA	Grant Agreement
HITL	Human-in-the-loop
ICT	Information and Communication Technologies
SoA	State-of-the-Art
SoS	System of Systems
TRL	Technology readiness level

Executive Summary

The **COMP4DRONES** project aims to define technological framework made of interchangeable **components** according to the functionality or capability. This will make the drone adaptable for required missions. Additionally, background **design technologies** are also provided. These design methods and tools can be used to improve the process of **designing, verifying, and deploying software and hardware** of drone architectures, and to enable **cost-effective** composition design and assurance of drone modules and systems.

The **COMP4DRONES** training activities target two main domains: **industry** and **academic**. Such activities require the innovative packaging of knowledge including case studies, exercises, and support material and knowledge appraisal to be delivered through internet-based training.

Deliverable D7.9 (Training Strategy and Plan) aims to identify the **target audience**, the **training modules** to be developed and the associated planning, and **scheduling** of training development and **quality** control.

1 Introduction

The aim of the **COMP4DRONES** project is to provide a **framework of key enabling technologies** for safe and autonomous drones[1]. Those key enabling technologies are disclosed to the public and drone ecosystem through dissemination activities following the recommendation of the European Commission under H2020 program. As part of the dissemination, training (internal and external) are central activities that allow immediate ownership of project results in order to shorten the exploitation delay.

In **COMP4DRONES**, there are three types of actors with specific role to training task: end users, technology providers, and knowledge providers. First, the **end-user** partners will provide high-impact use cases, and specify their needs and requirements ensuring compliance with civilian drone regulations, in terms of non-functional properties, safety, tools and process. Second, the **technology providers** who provide the key technologies, with interest in internal and external dissemination of these technologies and where training activities play a major role in technology transfer. Finally, **knowledge providers**, who share the project results with the scientific and research community.

The **knowledge providers** of the **COMP4DRONES** project (i.e., universities, labs, transfer institutes, and applied research centres) will exploit the **COMP4DRONES** findings in ways that will help expanding their knowledge base, and enabling them to remain at the forefront of technological and environmental developments through covering the ICT, drone technologies, as well as the transport, construction, logistics, inspection and agricultural domains. Furthermore, by being involved in such advanced and application-oriented innovation activities, the knowledge providers will ensure that they stay competitive for future research as well as innovation-related initiatives, the exploitation can be summarized as follows:

- **Enhancing teaching scope and quality** by introducing new findings and technologies into the curriculum, thereby **delivering well-trained data professionals and data scientists**, which are urgently needed in industry.
- **Offer professional training** on drone technologies and relevant use cases (proof points).
- Present project results to students, university staff and the research community by means of seminars, tutorials, as well as renowned conferences and events, including presentations jointly with industry partners, thereby **increasing awareness and adoption of the project results**.

The **COMP4DRONES** training activities will target two main domains: **industry** and **academic**.

- *Industrial Training*: Skills and knowledge will be imparted through structured demonstrations and exercises around the **COMP4DRONES** technologies.
- *Academic Training*: Training programs for the researchers working in academia will be targeted at understanding the core technologies for research challenges.

Each of these training programs will be available through the **COMP4DRONES** web site, and the success in delivering such training will be summarized as part of periodic project reporting.

In the following sections, we start, in Section 2, by describing the training methods and tools. Then, in Section 3, we present the training strategy. Finally, the training plan is discussed in Section 4.

2 Training Methods and Tools

Knowledge transfer and communication always had an essential role in the advancement of societies. Currently, it plays a key role in the success of organizations and dictates if new ideas are ever considered by mainstream research.

[1] GRANT AGREEMENT NUMBER 826610 — COMP4DRONES: Annex 1 - Description of action

The aim of this deliverable is not to carry out a comprehensive analysis of the different training methods and tools, where only the most common ones that are used for training activities in the context of the **COMP4DRONES** project are presented. It is also explained through which media the associated training materials and documents can be made available on the website to a broad community, both in the (industrial) drone ecosystem and the open-source communities. This section aims to summarize the fundamental *training methods* (i.e., in situ training, and online training), and *tools* (i.e., the use of simulation, and tools to make training materials available online).

2.1 In-situ Training

In this section, we describe the in-situ training methods, which include both academic- and industry-based trainings.

2.1.1 Academic In-situ Training Methods

Academic on-site training is intuitively very clear and has a long history. It includes three types of activities: a course, a summer school, and a training workshop.

First, in higher education, a **course** is a unit of teaching that typically lasts one academic term, is led by one or more instructors (teachers or professors), and has a fixed roster of students. A course usually covers an individual subject. Courses generally have a fixed program of sessions every week during the term, called lessons or classes.

Second, **summer school**[2] is a school, or a program generally sponsored by a school or a school district, or provided by a private company, that provides lessons and activities during the summer vacation.

Third, single lecture or in a more interactive way called **training workshop**[3] is a type of interactive training where participants carry out a number of training activities rather than passively listen to a lecture or presentation. Broadly, two types of workshops exist: a general workshop is put on for a mixed audience, and a closed workshop is tailored towards meeting the training needs of a specific group[4].

In universities there is still an inclination towards valuing knowledge more than practice, nevertheless, the development of social economy and the requirement of modernization brings a trend in academical in-site training towards the development of practical education[5]. This aspect has to be taken into account when disseminating **COMP4DRONES** research results through academic channels.

2.1.2 Industrial In-situ Training

Industrial training is often on-site training and usually the only possible option because of:

- Heavy industrial equipment (construction, medicine).
- Moving objects (plane, cars, and drones) often requiring dedicated aerodromes.
- Connection with geographical position (fields in agriculture).
- Demonstration, or certification which demands real performance.

In the **COMP4DRONES** project, we can have several training domains such:

- Training connected to drone (e.g., pilot testing, control application testing, etc.).
- Use case training (i.e., training of the technologies developed for use case).

[2] https://en.wikipedia.org/wiki/Summer_school
[3] https://en.wikipedia.org/wiki/Training_workshop
[4] Jolles, Robert L (2005). How to Run Seminars and Workshops (3 ed.). John Wiley & Sons. pp. 5, 12, 48, 155, 320. ISBN 978-0-471-71587-0. Retrieved 2014-11-23
[5] Chen, Shengli "Higher Education Development Path Based on Practical Education Pattern". Eurasia Journal of Mathematics, Science and Technology Education, vol. 13, no. 12, 2017, pp. 7921-7927. https://doi.org/10.12973/ejmste/80764

- Domain training (i.e., training concerned with domain such as agriculture, transport, logistics, construction).

Currently such training is still difficult, but this is a subject to change with the availability of more sophisticated tools and training infrastructure. The only possible way is to migrate training activities to online environment through simulation. Such option is often used when it is not practical or safe to train people on the actual equipment or within the actual work environment. We will further explore this option in Section 2.3.

2.2 Online Training Methods

Online training[6], also known as computer-based training (CBT), distance learning, or e-learning, is a form of instruction that takes place completely on the internet. It involves a variety of multimedia elements including graphics, audio, video, and web-links, which all can be accessed through an internet browser. These elements are used in place of traditional classroom components.

In addition to presenting course material and content, online training gives students the opportunity for live interactions and real-time feedback for such things as quizzes and tests. Interactions between instructor and students are also conducted via an online medium, through such methods as chat, e-mail, or other web-based communication.

One of the online training methods that will be adopted by the **COMP4DRONES** project is webinars. A **webinar** is a live, web-based video conference that uses the internet to connect the individual (or multiple individuals) hosting the webinar to an audience of viewers and listeners from all over the world. Hosts can show themselves speaking, switch to their computer screens for slideshows or demonstrations, and even invite guests from other locations to co-host the webinar with them.

Webinar platforms also offer interactive features that the audience can use to ask questions and chat with the host. Many people who host webinars include a question and answers session at the end to answer viewers' questions about the content from the presentation[7].

2.3 Using Simulation in Training

COMP4DRONES project heavily uses simulation for testing and development purposes, and then it is good to include the developed simulation models also for training purposes. In the context of training activities, we will look only on human-in-the-loop simulation related to the drone usage.

Human-in-the-loop[8] (HITL) is defined as a model that requires human interaction. HITL is associated with modelling and simulation in the live, virtual, and constructive taxonomy. In this type of simulation, a human is always part of the simulation and consequently influences the outcome in such a way that is difficult if not impossible to reproduce exactly. HITL is often referred to as interactive simulation, which is a special kind of physical simulation in which physical simulations include human operators, such as in a flight or a driving simulator.

2.4 Making Training Materials Available Online

The training material can be made available online (i.e., online-based dissemination) by one of the following means:

[6] https://saidwaraa.com/online-training/
[7] https://www.lifewire.com/what-is-a-webinar-3486257
[8] https://en.wikipedia.org/wiki/Human-in-the-loop

- An **electronic book**, also known as an **e-book** or **eBook**, is a book publication made available in digital form, consisting of text, images, or both, readable on the flat-panel display of computers or other electronic devices[9].
- **Video lecture, and video tutorial** is a format of training using a video stream. The choice of content is very broad. Mainly can be used for putting in site training available both academic and industrial on internet, but also specially for the video prepared content can be used.
- Now, mostly presentation tools are used by presenter/teacher to prepare training material[10], which makes such **electronic presentations** easily available on the web.

3 Training Strategy

In this section, we present the training strategy which include recommendation for performing a training, training announcement through the project website, training quality assurance and control, and the procedure followed in the project to conduct a training.

3.1 Recommendations for Training

In **COMP4DRONES**, the main groups of audience of the project results are:

- Academic (e.g., students, researchers, etc.)
- Industry (e.g., hardware engineers, software engineers, and software designers)
- Drone ecosystem
- End users (including local organizations in the end user domains)

Taking in account the very diverse dissemination goals in each auditory, it is clear, that this requires for availability of very different types of training. All researched training methods, have their advantages and disadvantages, depending of the purpose of training and target group.

COMP4DRONES is strategically oriented to preferably conduct training online. It is more available to different types of auditory, partners and easier to conduct. **Webinars** mostly chosen for online interactive training. Webinar tool have to be chosen by training provider, based on the feature set of Webinar platform, ensuring that it is covering training program requirements (for example, quiz and poll feature, if required). Practically all existing webinar platforms cover those functions so no restrictions or preferences are set.

Project is set to make online training, but we cannot fully avoid on-site training, as it sometimes is the only possible way to conduct the training because of the required equipment. Also, sometimes it is most appropriate way, as the auditory, for exmple, domain end-users, is near to the in-situ places. **Seminars**, **workshops**, and **summer schools** are most popular training methods with interactivity with the trainees.

COMP4DRONES project requires that each of the training programs is available through the project web site. So, providing materials on the project website is a separate task arising for both training methods, online and on-site external training. If training materials are prepared on the basis of the presentation tool, as in the case of workshops, simplest way is to record workshop on video and use as video tutorial. For online webinars recording feature is available, that makes it very easy and automatic way to prepare recorded material. If the quality of the training course is required high, a prepared video tutorial may be used. It takes more time and other resources but have more polished information flow. Depending on training material format many traditional methods maybe used for preparing training

[9] Gardiner, Eileen and Ronald G. Musto. "The Electronic Book." In Suarez, Michael Felix, and H. R. Woudhuysen. The Oxford Companion to the Book. Oxford: Oxford University Press, 2010, p. 164.
[10] Rouse, Margaret (March 2011)."Presentation software (presentation graphics)". WhatIs.com. Retrieved 25 May2013

material. For example, for printed material it can be prepared as online documents (electronic presentation, e-books, etc.) for emphasizing deeply prepared training content.

3.2 Training Announcement through C4D Website

The project website is planned to be a source for information about training activities. The website provides a placeholder for training information (See deliverable D7.1- Web presence and periodic update). Information about training activities on website will be compiled in two lists: planned and executed trainings. Each activity will contain the following information:

- Partner name.
- Title of training activity.
- Short description about training activity.
- Date/Time of training activity.
- Information about type of training activity and possibility to join online, where applicable.
- Information about training material format and instructions how and where to view it.

Such information will be made available also using **COMP4DRONES** social channels:

- Twitter https://twitter.com/ecsel_c4d
- Youtube https://www.youtube.com/channel/UCUH27sjlF7ECC7IcH9gCRSA
- Facebook https://www.facebook.com/Comp4Drones-618870145620479/

For the internal training, materials will not be available in website and it will be stored in the internal workspace of the project (For more details, see the deliverable D8.1: Project Handbook).

3.3 Quality Assurance and Quality Control

External Training activities which is a part of dissemination activities, have to obey the following GA articles for dissemination activities:

Article 29.4 - Information on JU funding and support from JU members — Obligation and right to use the JU logo and the EU emblem unless the JU requests or agrees otherwise or unless it is impossible, any dissemination of results (in any form, including electronic) must:

a) display the JU logo (the required logos can be downloaded here: https://www.ecsel.eu/useful-information) and
b) display the EU emblem and
c) include the following text: “This project has received funding from the ECSEL Joint Undertaking (JU) under grant agreement No 826610. The JU receives support from the European Union’s Horizon 2020 research and innovation programme and Spain, Austria, Belgium, Czech Republic, France, Italy, Latvia, Netherlands”.

This is the list of the other relevant articles:

- Subsection 3: Rights and Obligations Related to Results
  - Article 26 — Ownership of Results
  - Article 27 — Protection of Results — Visibility Of JU Funding and Support from JU Members Article
  - Article 28 — Exploitation of Results Article
  - Article 30 — Transfer and Licensing of Results
  - Article 31 — Access Rights to Results

This articles have to be obeyed for all training material dissiminated for the project. However, it is not mandatory for the internal project training, where such trainings are organized internally and only project participants attend and, training materials are not disseminated as results.

Other methods for quality assurance, will include:

- Analysing feedback from the training participants, where available
- Recommended questions to be consider by the trainers:
  - Who is the target audience - who do I want to reach?
  - What do I want to achieve with the training?
  - Which needs should be satisfied?

3.4 C4D Procedures for Conducting Training Activities

Preparation of training materials and conduct of training activities is the responsibility of partner providing it. For each training activity, the following procedure is followed:

- A partner fills a set of data about the training activity (see Table 1)
- The training activities coordinator, informed by everyday notification, act on new entries, according to entry type:
  - Notify partners for internal training proposals and time.
  - In case of external training, if applicable, transfers information to webmaster for including in planned training activities list on the project website.
  - In case if training materials are reported, they are put in the project workspace and quality control on the entry is performed.

Table 1: Template for annoncing an training

Partner	
Technology (Training name)	
TRL	
Description	
Type of Activity	
Target/Audience (could be Internal or External (I/E)	
Date and Place	
Number of attendees	
Link to Material	

The following are the guidelines to fill the information in Table 1:

- If several partners provide collaborative training activities, please copy partners row, for each additional partner.
- Technology is the name of (tool, technology) under training.
- TRL shows the approximate readiness level of a technology.
- Auditory is either industrial, students, ecosystems, or end users.
- I/E (Internal or External training).
- Type of activity could be academic course, workshop, in-situ training on demonstration site, webinar, online document, presentation or other similar.
- When is the activity time (i.e., in period P1=M19-M24, P2=M25-M30, P3=M31-M36),
- The date and place should reference under which event or a program the training is organized.
- Link to materials where a link is visible on the **COMP4DRONES** web page for external training, or a link in Basecamp[11] for internal training.

[11] Basecamp (https://basecamp.com/) is the COMP4DRONES project internal workspace

4 Training Plan

The **COMP4DRONES** project plan for training activities are divided into four groups: a summer school, a final workshop, webinars, academic trainings, and industrial trainings. In the following, we describe these activities.

4.1 Summer School

The consortium will organise a training event during the summer next year (2022). The "**COMP4DRONES** school" will be a summer school for high-degree students and early-stage researchers of the involved institutions (both academia and enterprises), with well-defined focus, in line with the progress of activities of the project.

4.2 Final Workshop

At the end of the Project, the consortium will organise a workshop conference entitled: "COMP4DRONE Key Enabling Technologies". The workshop will focus on the drone technologies that has been implemented through the project life time.

It is envisaged that the workshop will be organised with ESWEEK-Embedded Systems Week 2022. Embedded Systems Week (ESWEEK) is the premier event covering all aspects of hardware and software design for smart, intelligent and connected computing systems. By bringing together three leading conferences (CASES, CODES+ISSS, EMSOFT), a symposium (NOCS) and several workshops and tutorials, ESWEEK allows attendees to benefit from a wide range of topics covering the state of the art in embedded systems research and development.

4.3 Webinars

Internal and external webinars will be performed during the project. These webinars are presented below and some them are already performed and are planned to be re-executed during the coming months.

4.3.1 On-Board Companion Computer

Partner	**UNISS (IDEA Lab)**
Technology	On-Board companion computer
TRL	(current) 2-3
Description	Seminar on UAVs for Smart and Precision Agriculture: applications, on-board processing and the **C4D** approach.
Type of Activity	Seminar
Target/Audience	INTERNAL (Academic) + EXTERNAL The present seminar has been given as part of the course of Agricultural Engineering for the third-year students of the degree in Computer Engineering of the University of Sassari, and then distributed in a public manner via the Idea Lab Uniss YouTube channel.
Date and Place	16/12/2020 [virtual event] (with possibility to be repeated at P2/P3)
Number of attendees	40 students approx. + 37 views of the video on the channel (info gathered on the 22/03/2021)
Link to Material	https://www.youtube.com/watch?v=8SMqzV8u9z4&t=12s&ab_channel=IdeaLabUniss

	[UNISS + UNIMORE] Unmanned Vehicles in Smart Farming: a Survey and a Glance at Future Horizons (https://dl.acm.org/doi/abs/10.1145/3444950.3444958)

4.3.2 Tutorial on image analysis and machine learning for UAVs and UGVs for Smart and Precision Agriculture applications by the C4D approach

Partner	UNISS (Department of Agriculture)
Technology	UC5 - Demo 1
TRL	TRL 3
Description	Tutorial on image analysis and machine learning for UAVs and UGVs for Smart and Precision Agriculture applications by the **C4D** approach.
Type of Activity	Seminar
Target/Audience	INTERNAL (Academic). The present seminar has been given as part of the course of Agricultural Engineering for the third-year students of the degree in Computer Engineering of the University of Sassari.
Date and Place	09/12/2020 [virtual event] (with possibility to be repeated at P2/P3)
Number of attendees	40 students approx.
Link to Material	No public documentation.

4.3.3 Cryptographic Primitives and Protocols

Partner	AIT Austrian Institute of Technology GmbH
Technology	Cryptographic primitives and protocols
TRL	3-4
Description	The component presents a protocol framework targeting at different aspects of secure communication such authentication, confidentiality, and authenticity by means of various types of protocols such as low-latency key-exchange or privacy-friendly authentication.
Type of Activity	Presentation/Webinar
Target/Audience	I / Industry, Researchers, Students
Date and Place	On demand (P2+)
Number of attendees	TBD
Link to Material	TBD (will be available on basecamp)

4.3.4 ThreatGet Drone: Security Analysis Tool for Compositional Drone Systems

Partner	AIT Austrian Institute of Technology GmbH
Technology	ThreatGet Drone: Security analysis tool for compositional drone systems
TRL	3
Description	Website: https://www.threatget.com/

	Video (Automotive): https://www.youtube.com/watch?v=48-PVfl0gcs For the drone environment a specialized IoT Toolbox (Modelling elements and threats) is in development and compositional threat modelling is in research
Type of Activity	Webinar / recorded Video
Target/Audience	I&E / Industrial, security engineers
Date and Place	TBD (P2/P3)
Number of attendees	Not limited
Link to Material	TBD (will be available on basecamp)

4.3.5 MoMuT - Model-based Testing

Partner	**AIT Austrian Institute of Technology GmbH**
Technology	MoMuT - Model-based testing
TRL	3-4
Description	Website: https://momut.org/ Software code should be as safe and fault free as possible. Model-based testing provides a way to ensure that a software implementation conforms to its requirements. It generates tests from a specification model, guaranteeing a certain test coverage. This reduces the test design and testing efforts and thereby costs, while improving test quality and maintainability. In **C4D**, model-based testing features to better test drone communication protocols are under development.
Type of Activity	Webinar / recorded Video
Target/Audience	I&E / Industry, Researchers, Students
Date and Place	TBD (P2/P3)
Number of attendees	Not limited
Link to Material	TBD (will be available on basecamp)

4.3.6 S3D and SoSim

Partner	**University of Cantabria**
Technology	S3D and SoSim
TRL	5-6
Description	Website: http://s3d.unican.es S3D is a model-driven design framework based on UML/MARTE supporting a “single-source approach” and ESL design activities, which improves design productivity. By single source, the integration around the model of all the information needed to perform the required design steps (i.e., system modeling, schedulability analysis, simulation, performance analysis, validation, verification, etc.) is meant.

	SoSim is the improvement of VIPPE towards the simulation of SoSs. VIPPE is a native system simulator able to provide time, power and energy estimations. It includes global metrics and metrics related to application and platform elements. Breakdowns per platform elements (processors, buses, memories) and information on metrics like cache performance, are provided to let the early analysis of performance bottlenecks.
Type of Activity	Presentation/Webinar
Target/Audience	I / Industry, Researchers, Students
Date and Place	On demand A first course will be given in the 2nd Summer School on "Cyber Physical Systems and Internet of Things" in June 7-10
Number of attendees	TBD. Depending on the focus, more theoretical or more practical, with hands-on practices, the number of attendees may be smaller (up to 10) or larger (up to 50)
Link to Material	TBD (will be available on basecamp)

4.3.7 Papyrus for Robotics

Partner	**Commissariat à l'énergie atomique et aux énergies alternatives (CEA)**
Technology	Papyrus for Robotics
TRL	4-6
Description	Papyrus for robotics is an Eclipse-based, open-source model-driven tool for the development of embedded and safety-critical systems. While being developed originally for the Robotics domain, its use is also possible in other domains with similar properties, notably the development of drone systems. It is based on the Papyrus UML modeller. It provides the code generation and reverse engineering capabilities for ROS2 as well as safety analysis and a high-level modelling of tasks. The latter can be used to model drone missions.
Type of Activity	Youtube videos, workshops & webinars, currently online, eventually in form of physical meetings once possible again.
Target/Audience	Software architects and designers.
Date and Place	2019 – ongoing
Number of attendees	Up to ~50 if online, 10-15 if physical meeting
Link to Material	Homepage: https://www.eclipse.org/papyrus/components/robotics/ Wiki: https://wiki.eclipse.org/Papyrus/customizations/robotics Youtube: youtube.com/playlist?list=PL9nkS1KDTMm6Ji0EMbiIx6YZ5sxA3OwMg

4.3.8 ROS/Gazebo

Partner	University of Sannio (UNISANNIO)
Technology	ROS/Gazebo
TRL	2-4
Description	The Robot Operating System (ROS) is a set of open-source software libraries and tools that help you build robot applications (drivers, algorithms, and developer tools). Gazebo is a free robot simulation tool that allows to test algorithms, design robots,

	perform regression testing and train AI system using realistic scenarios. It can also simulate populations of robots in complex indoor and outdoor environments. ROS and Gazebo can be used for the design, simulation and testing of UAV applications.
Type of Activity	Seminar
Target/Audience	Internal (Academic) – External Control system engineers, mechatronic engineers and in general everybody who is interested in learning the standard tools for design, simulate and test UAV applications.
Date and Place	TBD, possibly 2021-3rd Q
Number of attendees	TBD
Link to Material	Homepage ROS: https://www.ros.org/ Homepage Gazebo: http://gazebosim.org/ Further links will be available as soon as the seminar is given

4.3.9 Path Planning Algorithms Through Formal Approaches

Partner	**University of Sannio (UNISANNIO)**
Technology	Path planning algorithms through formal approaches
TRL	n.a.
Description	Path planning is a central problem in UAV autonomous operations especially when it comes to consider different practical aspects that often are conflicting. Formal methods can help to design algorithms where such aspects are handled.
Type of Activity	Seminar
Target/Audience	Internal (Academic) – External Control system engineers, mechatronic engineers and in general everybody who is interested in learning the standard tools for design, simulate and test UAV applications.
Date and Place	TBD, possibly 2021-3rd Q
Number of attendees	TBD
Link to Material	Links will be available as soon as the seminar is given

4.3.10 Seminar on Smart and Precision Agriculture Applications

Partner	**UNIVAQ**
Technology	UC5 - Demo 1
TRL	TRL 3/4
Description	Seminar on Smart and Precision Agriculture applications in the context of the **C4D** EU project.
Type of Activity	Seminar
Target/Audience	INTERNAL (Academic).

	The present seminar has been given as part of the course of "Livestock e Precision Farming" for the second year students of the Master degree in Faculty of Veterinary Medicine at University of Teramo.
Date and Place	3/12/2020 [University of Teramo – Google meet seminar] (with possibility to be repeated at P2/P3)
Number of attendees	25 Master Degree Students
Link to Material	https://drive.google.com/file/d/1pRy4wnG_hQJf6eLhWc9HBMm-IDYnR21e/view?usp=sharing

4.3.11 Tools and Navigation Methods

Partner	**Brno University of Technology**
Technology	Tools and Navigation Methods
TRL	N/A
Description	The project work and results are being used in PhD studies at Faculty of Information Technology, Brno University of Technology. In PhD studies, the PhD students/researchers are actively participating in the project and the project as well as experience from it and the results are becoming part of their studies. The project results are also being planned for use in MSc study as a part of content of various elective MSc courses (e.g. Image Processing, Computer Vision, etc.) This is planned since September 2021.
Type of Activity	Presentation/Study
Target/Audience	PhD students/Researchers, MSc students
Date and Place	PhD/research activities already started since September 2020, the MSc activities are expected to take place since September 2021.
Number of attendees	Approximately 5+ PhD students, approximately 10-50 MSc students
Link to Material	N/A (possibly records and/or lecture material in the future)

4.3.12 A RISC-V-based FPGA Overlay to Simplify Accelerator Deployment for Unmanned Vehicles

Partner	**University of Modena and Reggio Emilia (UNIMORE)**
Technology	On-board Companion Computer
TRL	3-4
Description	A RISC-V-based FPGA Overlay to Simplify Accelerator Deployment for Unmanned Vehicles
Type of Activity	Seminar
Target/Audience	Internal (Academic) – External Computer Scientists and Engineers, electronic and computer engineers
Date and Place	May 2021

Number of attendees	N.A. (Approx. 40)
Link to Material	Further links will be available as soon as the seminar is given

4.3.13 Programming Models and Offloading Mechanism for Heterogenous UAV Computing Platforms

Partner	**University of Modena and Reggio Emilia (UNIMORE)**
Technology	On-board Companion Computer
TRL	3-4
Description	Programming Models and Offloading Mechanism for Heterogenous UAV Computing Platforms
Type of Activity	Seminar
Target/Audience	Internal (Academic) – External Computer Scientists and Engineers, electronic and computer engineers
Date and Place	May 2021
Number of attendees	N.A. (Approx. 40)
Link to Material	Links will be available as soon as the seminar is given

4.3.14 On-board Companion Computer Tutorials and Hands-on

Partner	**University of Modena and Reggio Emilia (UNIMORE)**
Technology	On-board Companion Computer
TRL	3-4
Description	On-board Companion Computer Tutorials and Hands-on
Type of Activity	Webinar
Target/Audience	Internal (Academic) – External Computer Scientists and Engineers, electronic and computer engineers
Date and Place	TBD Q2-2021
Number of attendees	N.A.
Link to Material	Links will be available as soon as the seminar is given

4.3.15 Predictable and Composable real-time robotic development

Partner	**Technical University of Eindhoven (TU/e)**
Technology	Predictable and Composable real-time robotic development
TRL	(current) 2-3
Description	Design, Automation, and Test in Europe Conference (DATE2021)

Type of Activity	Conference
Target/Audience	INTERNAL (Academic) + EXTERNAL The 24th DATE conference and exhibition is the main European event bringing together designers and design automation users, researchers and vendors as well as specialists in hardware and software design, test and manufacturing of electronic circuits and systems. DATE puts strong emphasis on both technology and systems, covering ICs/SoCs, emerging technologies, embedded systems and embedded software.
Date and Place	(1-5)/2/2021 [virtual event] (with possibility to be repeated at P2/P3)
Number of attendees	TBD
Link to Material	https://www.date-conference.com/ https://www.researchgate.net/publication/346917568_Modeling_implementation_and_analysis_of_XRCE-DDS_applications_in_distributed_multi-processor_real-time_embedded_systems

4.3.16 Flying multi-copter using MAVLink and Simulink like function blocks

Partner	**UWB**
Technology	Flying multi-copter using MAVLink and Simulink like function blocks
TRL	TRL 4-6
Description	The webinar will introduce PX4 based developer multi-copter Drone-X as a reference solution used for DronePort development. You will learn: How to program the drone using Simulink like Function blocks (via REXYGEN) How to use MAVLink building blocks for offboard mod How to control the drones in offboard mode deployed in Software in the loop simulation using Gazebo or in reality.
Type of Activity	Seminar / Webinar
Target/Audience	INTERNAL (Industry, Researchers, Students). + EXTERNAL audience
Date and Place	Period P2+, Worldwide webinar
Number of attendees	Not limited
Link to Material	TBD (will be available on basecamp) and as record on Youtube

4.3.17 UAV-based LiDAR mapping and sensor fusion

Partner	**IMEC-BG**
Technology	UAV-based LiDAR mapping and sensor fusion
TRL	4-6

Description	IMEC-BG (UAV Research Centre, Ghent University) is involved in co-organizing the summer school of IEEE IGARSS 2021 (https://igarss2021.com), especially in the courses and demos on UAV-based LiDAR mapping and sensor fusion. Due to the current covid-situation, this summer school (with in-situ training on demonstration site of Droneport Belgium) will be cancelled and replaced with online webinar on the complete acquisition workflow, which will be held during IGARSS conference.
Type of Activity	Online webinar (academic course)
Target/Audience	Students, researchers
Date and Place	M20 (July 2021), Brussels (virtual)
Number of attendees	+/- 50 attendees
Link to Material	https://igarss2021.com/SummerSchoolProgram.asp

4.4 Academic Training

During the project a number of academic training will be performed by the project partners. In the following, we present some of such trainings, and some them are already performed and are planned to be re-executed during the coming months.

4.4.1 Coarse-grained reconfigurable accelerator, enhanced with monitoring infrastructure

Partner	**UNISS (IDEA Lab) -UNIVAQ**
Technology	Coarse-grained reconfigurable accelerator, enhanced with monitoring infrastructure
TRL	(current) 3-4
Description	Video tutorial
Type of Activity	Tutorial
Target/Audience	EXTERNAL The present tutorial was prepared for the attendance of the University Booth at DATE 2021, and then distributed in a public manner via the Idea Lab Uniss YouTube channel.
Date and Place	02/02/2021 [virtual event] (with possibility to be repeated at P2/P3)
Number of attendees	112 views of the video on the channel (info gathered on the 22/03/2021)
Link to Material	https://www.youtube.com/watch?v=w7EoDlxgzI0&t=254s&ab_channel=IdeaLabUniss

4.4.2 Coarse-grained reconfigurable accelerator, enhanced with monitoring infrastructure

Partner	**UNISS (IDEA Lab) - UNIVAQ**
Technology	Coarse-grained reconfigurable accelerator, enhanced with monitoring infrastructure
TRL	(current) 3-4
Description	Video tutorial
Type of Activity	Tutorial
Target/Audience	EXTERNAL

	The present tutorial was prepared for the attendance of the University Booth at DATE 2020, and then distributed in a public manner via the Idea Lab - Uniss YouTube channel.
Date and Place	virtual platform opened on the 3rd of April 2020 and closed on the 30th of June 2020
Number of attendees	112 views of the video on the channel (info gathered on the 22/03/2021)
Link to Material (if public)	https://www.youtube.com/watch?v=w7EoDlxgzI0&t=254s&ab_channel=IdeaLabUniss

4.4.3 Electronic System-Level HW/SW Co-Design

Partner	**HEPSYCODE - UNIVAQ**
Technology	Mixed-Criticality design space exploration for HW/SW partitioning, mapping, and architectural definition.
TRL	(current) TRL 3/4
Description	Electronic System-Level HW/SW Co-Design - Course in the context of the "PhD Program in ICT" - 2020, Università degli Studi dell'Aquila
Type of Activity	Lecture course – HEPSYCODE presentation (theoretical aspects and live demos)
Target/Audience	Ph.D. Student in ICT
Date and Place	06-07/2020 [Online course] (with possibility to be repeated at P2/P3)
Number of attendees	Approx. 10 Ph.D. Student
Link to Material	http://www.pomante.net/sito_gg/HEPSYCODE/2020-PHD_COURSE_HW-SW-CO-DESIGN-HEPSYCODE.rar

4.4.4 Hardware-based security products

Partner	**Infineon (IFAT)**
Technology	Hardware-based security products
TRL	5-7
Description	Workshop participation in the course of Academical project, where each participant presented their field of expertise. Including hands-on-tutorial and presentations by IFAT with respect to necessity and functionality of hardware-security for drones and other types of vehicles was explained and also used during the workshop.
Type of Activity	Academical Training/Workshop
Target/Audience	Participants of academical project
Date and Place	2020/01 - 2020/03, Munich/DE (with possibility to be repeated at P2/P3)
Number of attendees	40
Link to Material	**"Digital Product School"**, https://digitalproductschool.io/ (non-public, closed-group workshop)

4.4.5 Hardware-based security concepts

Partner	Infineon (IFAT)
Technology	Hardware-based security concepts
TRL	5-7
Description	PhD Seminars, with participants from several industrial partners and various related projects. State-of-the-Art and current work is presented, including IFAT presentation & tutorials focusing on problems and related solutions in regard hardware-support for security of UAVs.
Type of Activity	Academical Training/Workshop
Target/Audience	Academical and Industrial PhD students
Date and Place	2020/10 - ongoing
Number of attendees	~25
Link to Material	Graz University of Technology – Institute of Technical Informatics https://www.tugraz.at/en/institutes/iti (seminar content not published)

4.4.6 HEPSYCODE - Tutorial on HW/SW Co-design

Partner	UNIVAQ
Technology	HEPSYCODE - Mixed-Criticality design space exploration for HW/SW partitioning, mapping and architectural definition.
TRL	TRL 3
Description	Tutorial on HW/SW co-design of dedicated (embedded and real-time) systems based on heterogeneous parallel architectures and presents the last advancements of a framework (with related methodology and prototypal tools), called HEPSYCODE, developed in the context of **C4D** EU project.
Type of Activity	Tutorial
Target/Audience	EXTERNAL (Academic and industries)
Date and Place	22/01/2020 [HiPEAC 2020, Bologna, Italy] (with possibility to be repeated at P2/P3)
Number of attendees	Approx. 20/25
Link to Material	https://www.hipeac.net/2020/bologna/#/program/ http://www.pomante.net/sito_gg/HEPSYCODE/HiPEAC_tutorial_2020_web.zip

4.4.7 HEPSYCODE - Tutorial on HW/SW co-design

Partner	UNIVAQ
Technology	HEPSYCODE - Mixed-Criticality design space exploration for HW/SW partitioning, mapping and architectural definition.
TRL	(current) TRL 3-4
Description	Tutorial on HW/SW co-design of dedicated (embedded and real-time) systems based on heterogeneous parallel architectures and presents the last advancements of a

	framework (with related methodology and prototypal tools), called HEPSYCODE, developed in the context of **C4D** EU project.
Type of Activity	Tutorial
Target/Audience	EXTERNAL (Academic and industries)
Date and Place	20/01/2021 [HiPEAC 2021 virtual event] (with possibility to be repeated at P2/P3)
Number of attendees	Approx. 20/25
Link to Material	https://www.hipeac.net/2021/budapest/#/program/sessions/7867/ http://www.pomante.net/sito_gg/HEPSYCODE/HiPEAC_tutorial_2021_web.zip

4.4.8 Application development for drones using ROS and MATLAB

Partner	**IMCS (Institute of Mathematics and Computer Science)**
Technology	Application development for drones using ROS and MATLAB
TRL	4-6
Description	Model based mission design for safety-critical applications for drones. Detailed description will be added later
Type of Activity	Workshop
Target/Audience	students
Date and Place	P3,Vidzeme University of applied Sciences, University of Latvia
Number of attendees	10-15
Link to Material	

4.5 Industrial Training

A number of industrial trainings will be performed by the project partners during the project execution. In the following, we describe some of them.

4.5.1 Simcenter Amesim - System simulation software

Partner	Siemens Digital Industries Software
Technology	Simcenter Amesim - System simulation software
TRL	8-9
Description	The training is divided into two sessions. The first aims to introduce attendees to system simulation, the software tool, and its capabilities. The second session is dedicated to the application on UAVs, including the modelling of flight dynamics, propellers, powerplant, and electrical systems.
Type of Activity	Industrial Training, Workshops & Demonstrations (online or presential)
Target/Audience	Simulation engineers working in industry and academia. **C4D** partners.
Date and Place	On demand.

Number of attendees	TBD
Link to Material (if public)	Available upon request. For **C4D** partners, introductory material available in Basecamp (WP7, D7.10)

4.5.2 Modular component-based software architecture framework

Partner	**Institute of Electronics and Computer Science (EDI)**
Technology	Modular component-based software architecture framework (part of Modular SoC-based embedded reference architecture)
TRL	4-6
Description	For the purpose of developing and designing software stack, as a part of Modular SoC-based embedded reference architecture and previous projects PRYSTINE, EDI supplies and develops frameworks for software component management (COMPAGE, https://gitlab.com/rihards.novickis/compage), component intercommunication (ICOM, https://gitlab.com/rihards.novickis/icom) and real-time monitoring (RTCLM, not yet available for public) frameworks.
Type of Activity	**Industrial Training** / Workshops & Demonstrations (online, initial demonstration available at https://makonis.edi.lv/f/2911482)
Target/Audience	Software architects and designers.
Date and Place	2019 - ongoing
Number of attendees	
Link to Material	https://gitlab.com/rihards.novickis/compage https://gitlab.com/rihards.novickis/icom https://makonis.edi.lv/f/2911482

5 Conclusion

In this deliverable, we have identified the **target audience**, the **training modules** to be developed and the associated planning, and **scheduling** of training development and **quality** control.

The **COMP4DRONES** training activities are targeting two main domains: **industry** and **academic**. Such activities are either done through a **summer school**, a **final workshop**, **seventeenth webinars**, **eight academic trainings**, and **two industrial trainings**.