DRONE4BUILD

Drone Competency Framework for Construction Professionals

Aligned with DigComp 3.0

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Project Title:

DRONE4BUILD

Elevating the knowledge of construction professionals on the use of drones in construction

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Executive Summary

The Drone Competency Framework (A2.3) represents the third and integrative output of Work Package 2 (WP2) of the DRONE4BUILD project, an Erasmus+ funded initiative supporting the upskilling of construction professionals in drone technologies across five European partner countries: Germany, Greece, Italy, North Macedonia, and Spain.

Building upon the Strategic Technology Roadmap (A2.1) and the consolidated Stakeholder Validation Workshop Report (A2.2), this framework defines the essential skills, knowledge, and competencies required for construction professionals engaged in drone-enabled workflows. It provides a structured, evidence-based reference for curriculum developers, VET educators, training providers, industry partners, and policy stakeholders.

A key aspect of this framework is its alignment with DigComp 3.0 [1], the European Digital Competence Framework for Citizens published by the European Commission in 2025. DigComp 3.0 updates and extends the widely adopted DigComp 2.2 [2] structure by emphasising emerging technologies, human-AI interaction, sustainability, and the ethical dimensions of digital life. Aligning the Drone4Build competencies with DigComp 3.0 helps ensure that the framework reflects current European approaches to digital skills development while remaining relevant to the needs of the construction sector. It also supports consistency with broader EU priorities related to digital transformation, lifelong learning, and sustainable renovation practices.

The framework is structured around six Competency Domains, each comprising multiple competency areas with defined knowledge, skills, and attitudes, cross-referenced to DigComp 3.0, EASA regulatory categories, and EQF proficiency levels 3 to 5. It concludes with a Competency Mapping Matrix and a set of implementation recommendations for the WP3 curriculum development phase.

Key outcome: *This framework defines 6 competency domains, 24 competency areas, and over 80 specific competency descriptors, forming the structural backbone of the Drone4Build VET curriculum to be developed in WP3.*

Introduction

1. Introduction

1.1 Background

The construction sector is one of the largest employers in Europe and is increasingly adopting digital technologies[15][16][17][18] to improve efficiency, safety, and sustainability. Among these technologies, drones offer practical applications in areas such as surveying, building inspection, progress monitoring, photogrammetry, thermal assessment, and renovation activities.

Although drone technologies and the European regulatory framework have matured significantly in recent years, their wider use in construction still depends on the availability of appropriate skills and training. The findings of the A2.1 strategic research and the A2.2 stakeholder validation activities indicate that the main challenge is not access to technology itself, but the ability of professionals to use it effectively in their daily work. This includes planning missions safely, selecting suitable equipment, processing and interpreting data, and integrating drone outputs into BIM and other digital construction workflows.

1.2 The Drone4Build Project

Drone4Build is a two-year Erasmus+ VET Cooperation Partnership designed to address these gaps by developing a comprehensive, modular training programme for construction professionals in drone use. The project consortium includes seven partner organizations across five countries, combining vocational training institutions, construction industry foundations, engineering firms, drone specialists, and technology providers.

Work Package 2 (Digital Skills Ecosystem for Drones) focuses on research, stakeholder consultation, and the development of the competency framework that will underpin the WP3 curriculum. This framework (A2.3) is the final and most integrative output of WP2, synthesising all research and validation evidence into a structured, actionable competency reference.

1.3 Purpose and Scope of the Document

This framework serves four interrelated purposes:

- Definition: It defines the competencies construction professionals need to effectively and safely use drones in their work, covering technical, digital, operational, regulatory, and professional dimensions.
- Alignment: It maps these competencies to DigComp 3.0, and EQF levels 3-5, ensuring European recognition and interoperability.
- Validation: It incorporates and reflects the priorities, gaps, and recommendations identified through stakeholder workshops that took place in all partner countries, ensuring the framework is grounded in real-world practice rather than theory alone.
- Curriculum guidance: It serves as the foundation for WP3 module development, linking competencies to the courses and modules.

1.4 Relationship to WP2 Outputs

Output	Title	Contribution to A2.3
A2.1	Strategic Technology Roadmap for Drone Skills	Provides the technological landscape, identifies workforce skills gaps, competency needs, and future workforce requirements. It presents the strategic roadmap for 2025–2035 and serves as the primary evidence base for the competency framework.
A2.2	Report on Validation Workshops	Validates skills priorities, confirms gaps, introduces cross-country evidence from 126 stakeholders.
A2.3	**Drone Competency Framework**	Combines the results of A2.1 and A2.2 into a structured competency framework aligned with DigComp 3.0, including competency domains, descriptions, and links to the training curriculum.

1.5 Methodology

The Drone4Build Competency Framework was developed using an evidence-based approach that combined previous project activities with the relevant European policy frameworks. The aim was to ensure that the identified

competencies reflect both industry needs and the ongoing digital transformation of the construction sector.

The methodology consisted of three main stages:

- **Stage 1: Strategic Research and Technology Analysis (A2.1)**

The framework builds on the findings of the A2.1 Strategic Technology Roadmap, which explored current and emerging uses of drones in construction and renovation. The report identified key technology trends, skills needs, and competency gaps related to digital construction practices, drone operations, data processing, and regulatory requirements. These findings provided the foundation for defining the competency areas included in this framework.

- **Stage 2: Stakeholder Validation (A2.2)**

The initial findings were discussed and validated through stakeholder workshops organised by the project partners. Participants included representatives from the construction sector, VET organisations, drone professionals, and digital technology experts. The workshops helped confirm priority skills needs, training expectations, and the practical challenges faced by professionals adopting drone technologies in their work.

- **Stage 3: Competency Framework Synthesis and European Alignment (A2.3)**

The final stage involved bringing together the results of A2.1 and A2.2 into a structured competency framework. The identified competencies were organised into six domains covering technical, operational, regulatory, digital, and professional aspects of drone use in construction and renovation activities.

The framework is primarily aligned with DigComp 3.0. The stakeholder validation workshop conducted in Spain worked with and integrated DigComp 2.2, in accordance with what was originally stated in the project proposal. However, during the development of A2.3, the consortium agreed to align the competency framework with DigComp 3.0 to reflect the latest European Digital Competence Framework while maintaining continuity with the workshop findings.

The framework is also supported by the European Qualifications Framework (EQF) and the EASA regulatory framework for drone operations. This ensures that the proposed competencies are relevant to European vocational education and

training contexts and can support the development of the Drone4Build curriculum within WP3.

Finally, the development of the framework considered the European Skills, Competences, Qualifications and Occupations (ESCO) classification. During the stakeholder validation activities, participants identified relevant occupations, skills, and competences associated with the use of drones in the construction sector. These inputs were considered alongside the workshop findings to ensure that the proposed competency domains and competency areas reflect recognised occupational profiles and skills relevant to the European labour market. While the framework is structured around DigComp 3.0, ESCO provided complementary input to strengthen its occupational relevance.

Overall, the methodology ensures that the framework is informed by project research, validated through stakeholder input, and grounded in the practical needs of the construction sector.

1.6 Relationship to the WP3 Training Programme

The competency framework presented in this document serves as the main reference for the development of the Drone4Build training programme under Work Package 3. It builds on the research and stakeholder validation activities carried out in WP2 and provides the structure through which the identified knowledge, skills, and attitudes are translated into training content.

The proposed WP3 programme consists of four courses and eight modules, each addressing a specific group of competencies. The competency areas defined in this framework guide the development of module content, learning objectives, practical activities, and assessment approaches, ensuring consistency between the project research findings and the final training materials.

The mapping between competency areas and the proposed courses and modules is presented in Section 5 of this document. The final structure and content of the training programme will be refined during WP3 implementation.

Course	Course Title	Module	Module Title
Course 1	Fundamentals of Drone Operations for Construction and Renovation	**M1.1**	Drone Systems and Sensors in Construction
		M1.2	Safe Drone Piloting and Regulatory Compliance
Course 2	Drone-Based Building Inspection and Energy Assessment	**M2.1**	Building Inspection and Defect Detection Using Drones
		M2.2	Thermography and Energy Performance Assessment
Course 3	Drone Data Processing, BIM and Digital Construction Workflows	**M3.1**	Photogrammetry, Mapping and 3D Modelling
		M3.2	BIM Integration and Digital Workflows
Course 4	Advanced Drone Applications for Sustainable Construction	**M4.1**	AI-Assisted Inspection and Emerging Technologies
		M4.2	Drone Project Management for Sustainable Renovation

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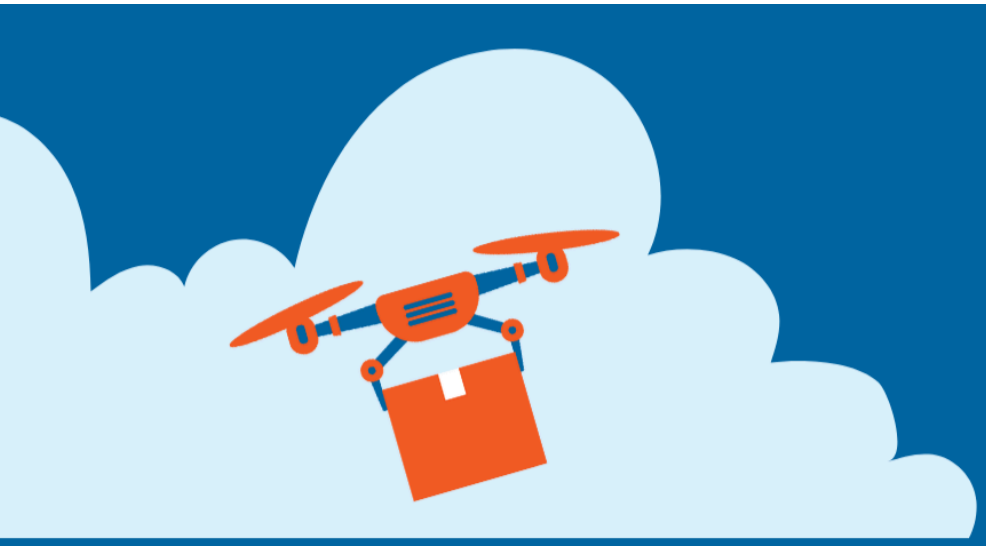

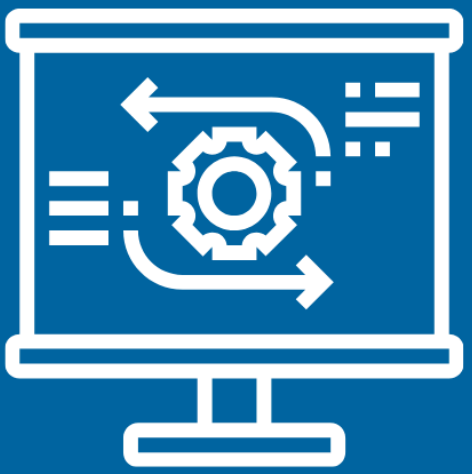

DigComp 3.0

2. DigComp 3.0

2.1 Introduction to Alignment Framework DigComp 3.0

The Digital Competence Framework for Citizens (DigComp) is the European Commission's reference framework for defining, developing, and assessing digital skills. First published in 2013 and updated through versions 2.0, 2.1, and 2.2, the framework was most recently updated to DigComp 3.0 in 2025 in response to the rapid acceleration of AI, automation, data-driven technologies, and the sustainability imperative of the European Green Deal [12].

DigComp 3.0 retains the five-area structure of previous versions while significantly deepening content in areas related to emerging technologies, critical AI literacy, data ethics, environmental sustainability of digital tools, and the evolving nature of human-machine collaboration. It is the official EU benchmark for digital skills policy, referenced in the European Skills Agenda[1], the Digital Decade targets[14], and the Renovation Wave [13].

2.1.1 Digital Competence and the Knowledge-Skills–Attitudes (KSA) Model

The conceptual foundations of this framework build upon the Council Recommendation on Key Competences for Lifelong Learning (European Commission, 2018) [3], which defines digital competence as follows:

"*the confident, critical and responsible use of, and engagement with, digital technologies for learning, at work, and for participation in society. It includes information and data literacy, communication and collaboration, media literacy, digital content creation (including programming), safety (including digital well-being and competences related to cybersecurity), intellectual property related questions, problem solving and critical thinking.*"

This understanding is particularly relevant to the construction sector, where drone technologies are not merely technical tools, but digital instruments embedded within broader workflows involving data management, collaboration, safety, sustainability, and informed decision-making.

Consistent with the DigComp methodology, competencies within the Drone4Build framework are described through the interconnected dimensions of knowledge, skills, and attitudes (KSA):

- **Knowledge** refers to the facts, concepts, principles, regulations, and theoretical understanding that support professional drone use within construction and renovation activities.
- **Skills** describe the ability to apply knowledge in practice, including the operation of drone systems, data acquisition and processing, regulatory compliance, digital workflow integration, and problem-solving in real construction environments.
- **Attitudes** encompass the professional values, behaviours, and mindsets required for responsible drone use, including safety awareness, ethical conduct, environmental responsibility, collaboration, continuous learning, and critical engagement with emerging technologies such as artificial intelligence.

The KSA model therefore provides the structural basis for all competency areas defined in this document. Each competency statement is accompanied by explicit knowledge, skills, and attitudes descriptors, ensuring consistency with European competence frameworks and supporting the development of measurable learning outcomes, assessment criteria, and curriculum content in Work Package 3.

2.2 DigComp 3.0 Structure

DigComp 3.0 organises digital competencies into five core areas, each containing multiple competence items assessed across four broad proficiency levels: Basic, Intermediate, Advanced, and Highly Advanced:

Figure 1 DigComp 3.0 competence areas and competences

Area	Title	Competences	Core Focus (DigComp 3.0)
1	**Information search, evaluation and management**	• 1.1 Browsing, searching and filtering information • 1.2 Evaluating information • 1.3 Managing information	To articulate information needs, and to search for, locate and retrieve digital information and content. To judge the relevance of the source and its content in digital environments. To critically evaluate digital sources, content, and processes used to generate them. To store, manage, organise and analyse digital information and data.
2	**Communication and Collaboration**	• 2.1 Interacting through and with digital technologies • 2.2 Sharing through digital technologies • 2.3 Engaging in citizenship through digital technologies	To interact, share, communicate and collaborate in digital environments while being aware of cultural, generational and other diversity and the features and limitations of digital technologies. To participate in society through digital

		• 2.4 Collaborating through digital technologies • 2.5 Digital behaviour • 2.6 Managing digital identity	technologies. To assert one's rights and exercise choice in digital environments. To manage one's digital presence, identity and reputation.
3	**Content Creation**	• 3.1 Developing digital content • 3.2 Integrating and re-elaborating digital content • 3.3 Copyright and licences • 3.4 Computational thinking & programming	To create and edit digital content. To improve and integrate information and content into an existing body of knowledge while understanding how copyright and licences are to be applied, adopting an ethical and responsible approach in the creation, improvement and integration of digital content. To know how to apply computational thinking and programming techniques to give instructions to a computer system.
4	**Safety, Wellbeing and Responsible Use**	• 4.1 Protecting devices • 4.2 Protecting personal data & privacy • 4.3 Supporting wellbeing • 4.4 Environmental impacts of digital technologies	To protect devices, content, personal data and privacy in digital environments. To support physical, mental and social wellbeing of oneself and others, and to be aware of the benefits and risks of digital technologies for wellbeing and social inclusion. To be aware of the environmental impact of digital technologies and their use, to take action to reduce such impact, and to use digital technologies to support sustainability.
5	**Problem Identification and Solving**	• 5.1 Identifying & solving technical problems	To identify and assess needs, and to use digital technologies and adapt digital environments to

		• 5.2 Identifying needs and digital technological responses • 5.3 Identifying creative solutions using digital technologies • 5.4 Identifying and addressing digital competence needs	meet these needs. To identify and resolve technical and conceptual problems and problem situations in digital environments. To use digital technologies to make improvements in, or new solutions for, processes and products. To build capabilities to operate autonomously in digital environments. To stay informed about digital technological developments and their implications.

2.3 EQF Proficiency Levels

The Drone4Build Competency Framework aligns with both DigComp 3.0 and the European Qualifications Framework (EQF)[4] to ensure consistency with European education, training, and skills policies.

While DigComp provides a reference for digital competences, the EQF establishes a common European framework for describing qualifications and learning outcomes across countries and education systems. The EQF enables the comparison of knowledge, skills, responsibility, and autonomy associated with different learning pathways and professional roles.

The European Qualifications Framework consists of eight levels, ranging from basic education and entry-level vocational training (Level 1) to highly specialised academic and professional expertise (Level 8). Each level describes what learners know, understand, and are able to do upon completion of a learning process.

Although the original project proposal primarily referred to EQF Levels 4-5, the evidence gathered during A2.1 and A2.2 demonstrated the need to include entry-level construction professionals and workers with limited prior digital experience. Consequently, the framework adopts EQF Levels 3-5 to support more inclusive and progressive learning pathways.

EQF Level	Typical Profile	General Descriptor	Relevance to Drone4Build

EQF 3	Entry-level workers, apprentices, and operational staff	Ability to perform tasks using established methods, assume responsibility for completing routine activities, and adapt behaviour to circumstances when solving problems.	Foundation-level drone operation, regulatory awareness, mission preparation, basic inspection activities, and safe flight practices.
EQF 4	Skilled technicians and experienced practitioners	Ability to work independently within predictable but changing contexts, solve specific problems, and supervise routine activities.	Photogrammetry, thermal inspections, data processing, BIM fundamentals, and integrated digital workflows.
EQF 5	Supervisors, coordinators, specialists, and innovation leaders	Ability to manage projects and activities, develop creative solutions, guide others, and evaluate performance in complex environments.	Advanced operations, SORA, digital twins, AI-assisted inspections, cybersecurity, sustainability, and organisational drone integration.

DigComp 3.0 complements the EQF by providing a framework for digital competence development. It defines four broad proficiency levels: Basic, Intermediate, Advanced, and Highly Advanced. These levels describe increasing degrees of autonomy, complexity, responsibility, and critical engagement with digital technologies.

For the purposes of Drone4Build, the framework focuses on the first three proficiency levels, which broadly correspond to the vocational learning pathways addressed by four suggested project courses, under WP3.

DigComp 3.0 Proficiency	Target EQF Level	Drone4Build Learning Stage	Associated Courses
Basic	EQF 3	Foundation and operational readiness	• **Course 1:** Foundations of Drone Operations for Construction and Renovation
Basic to Intermediate	EQF 3-4	Operational Readiness and Applied Building Inspection	• **Course 2:** Drone-Based Building Inspection and Energy-Renovation Applications
Intermediate	EQF 4	Digital Integration and Applied Practice	• **Course 3:** Drone Data Processing, BIM/GIS and Digital Construction Workflows
Advanced	EQF 5	Innovation, Leadership, and Organisational Adoption	• **Course 4:** Advanced Drone Applications for Sustainable Construction
Highly Advanced	EQF 6+	Outside the scope of the present project	Future professional development pathways

Framework Architecture

3. Framework Architecture

3.1 Design Principles

The Drone Competency Framework is designed according to the following principles, derived from DigComp 3.0 methodology, the A2.1 strategic research, and the A2.2 validation workshop evidence:

- Competency-based: The framework defines the knowledge, skills, and attitudes that construction professionals need to use drones effectively in their work.
- Aligned with DigComp 3.0: The framework follows the principles of DigComp 3.0 and connects drone-related competencies to broader European digital skills priorities.
- Progressive: Competencies are organised into three levels (Foundation, Intermediate, and Advanced) corresponding to EQF Levels 3-5 and supporting different learning pathways.
- Focused on construction practice: All competencies are designed specifically for construction, renovation, and retrofitting activities rather than general drone or aviation applications.
- Designed for training delivery: The framework aligns with the four Drone4Build courses and eight modules, providing a practical basis for curriculum development within WP3.
- Evidence-based: The competency framework is grounded in the stakeholder validation activities carried out under Activity A2.2. Workshops conducted in Germany, Greece, Italy, North Macedonia, and Spain confirmed the overall competency architecture identified through the strategic research while also highlighting country-specific priorities that informed the final framework.

Country	Main contributions
Italy	Highlighted the need for interdisciplinary competences combining construction knowledge, drone operations, and digital workflows. Participants also emphasised workflow redesign, return on investment (ROI), regulatory complexity, and stronger integration between technical and organisational competences.

Spain	Placed strong emphasis on BIM/GIS integration, AI-assisted analysis, cybersecurity, digital workflows, hybrid professional profiles, and modular practical training. The workshop also highlighted the importance of trainer preparedness and continuous professional development.
North Macedonia	Identified practical operational skills as the highest priority while stressing engineering interpretation of outputs, staged learning pathways, hands-on training, and improved data processing capabilities to support wider technology adoption.
Greece	Reinforced the importance of construction-specific applications, practical reporting, quality assurance, regulatory compliance, SME adoption, and progressive integration of BIM/GIS competences within professional workflows.
Germany	Highlighted lower organisational readiness and the need to begin with foundational drone knowledge, legal awareness, and practical use cases before progressing to advanced digital workflows. The workshop also identified limited trainer preparedness as a significant implementation challenge.

3.2 Framework Overview

The framework is organised into six Competency Domains. Each domain encompasses multiple Competency Areas (CAs), and each CA is defined by a competency statement, knowledge elements, skill descriptors, and attitude descriptors. The six domains are:

Domain	Title	Brief Description
D1	**Technical and Systems Knowledge**	Understanding drone hardware, sensors, platform types, and maintenance principles as applied in construction and renovation tasks.
D2	**Operational and Flight Competencies**	Safe and effective drone flight, pre-flight preparation, mission execution, and emergency response in construction site environments.
D3	**Regulatory, Safety and Compliance**	Knowledge of the EASA UAS regulatory framework, operational category

		requirements, risk assessment (SORA), airspace management, GDPR, and construction site safety integration.
D4	**Data Acquisition and Digital Processing**	Capturing drone data effectively, applying photogrammetry and thermal imaging, and processing outputs (orthomosaics, point clouds, 3D models) for construction use.
D5	**BIM, GIS, and Digital Workflow Integration**	Integrating drone outputs into Building Information Modelling (BIM), Geographic Information Systems (GIS), digital twin environments, and collaborative construction workflows.
D6	**Professional and Organisational Competencies**	Hybrid professional skills including communication, project planning, data governance, sustainability awareness, business case development, and trainer capacity.

3.3 Relationship with DigComp 3.0

The Drone4Build Competency Framework is organised around six domains that reflect how drones are used in construction and renovation activities. At the same time, the framework follows the principles and competence areas of DigComp 3.0 to ensure consistency with broader European approaches to digital skills development.

Rather than adopting the DigComp structure directly, the framework translates digital competences into practical construction contexts. This allows learners to develop digital skills through activities such as surveying, inspection, data processing, BIM integration, and building renovation projects.

Each domain contributes to one or more DigComp 3.0 competence areas while addressing the specific needs of construction professionals. The relationship between the two frameworks is summarised below.

DigComp 3.0 Area	Core Focus	Primary Drone4Build Domains	Examples of Construction Applications
Area 1: Information Search, Evaluation and Management	Accessing, organising, and managing digital information and data	D1: Technical and Systems Knowledge; D4: Data Acquisition and Digital Processing; D5: BIM, GIS and Digital Workflow Integration	Managing drone datasets, assessing data quality, handling thermal inspection outputs, and organising geospatial project information.
Area 2: Communication and Collaboration	Digital interaction, teamwork, documentation, and participation in collaborative environments	D5: BIM, GIS and Digital Workflow Integration; D6: Professional and Organisational Competencies	Collaborative BIM workflows, inspection reporting, stakeholder communication, and shared digital construction platforms.
Area 3: Digital Content Creation	Creating, integrating, adapting, and managing digital outputs	D4: Data Acquisition and Digital Processing; D5: BIM, GIS and Digital Workflow Integration	Generating orthomosaics, point clouds, 3D models, thermal reports, BIM updates, and digital renovation documentation.
Area 4: Safety, Wellbeing and Responsible Use	Protecting devices, data, people,	D2: Operational and Flight Competencies;	EASA compliance, GDPR implementation, construction site

	privacy, and the environment	D3: Regulatory, Safety and Compliance; D6: Professional and Organisational Competencies	safety, cybersecurity, and environmentally responsible drone operations.
Area 5: Problem Identification and Solving	Addressing technical challenges, selecting technologies, innovating, and identifying competence needs	All domains, with particular emphasis on D1, D2, D5, and D6	Platform selection, mission planning, AI-assisted inspections, digital twins, and continuous professional development.

3.4 EASA Regulatory Framework

The Drone4Build Competency Framework is aligned with the European regulatory framework for unmanned aircraft systems established by the European Union Aviation Safety Agency (EASA). EASA classifies drone operations according to their level of risk, with different requirements applying depending on the complexity of the operation.

The **Open category** covers low-risk operations carried out under predefined operational rules. These operations do not require prior operational authorisation, provided the applicable requirements are met, and are suitable for many common construction activities such as basic inspections, aerial photography, and site monitoring conducted within Visual Line of Sight (VLOS).

The **Specific category** applies to operations that present a higher level of risk, such as flights Beyond Visual Line of Sight (BVLOS), operations near critical infrastructure, or more complex inspection missions. These operations require an operational authorisation or declaration and are supported by a risk assessment,

typically based on the Specific Operations Risk Assessment (SORA) methodology or an approved Standard Scenario (STS).

The **Certified category** is intended for the highest-risk operations, including passenger transport, large cargo operations, or flights over assemblies of people. These operations follow certification requirements similar to those applied in traditional aviation and are outside the scope of the Drone4Build training programme.

As drone operations become more advanced, the U-space regulatory framework supports the safe integration of drones into shared airspace through digital services such as flight authorisation, traffic information, and airspace management. While most Drone4Build training focuses on Open category operations, learners are also introduced to the concepts of Specific category operations, SORA, and U-space to prepare them for future professional applications.

The Six Competency Domains

4. The Six Competency Domains

4.1 Domain 1: Technical and Systems Knowledge

D1-Understanding drone hardware, sensors, and platforms for construction applications

Domain 1 covers the fundamental technical knowledge required for the professional use of drones in construction. The A2.1 research and A2.2 validation activities highlighted the need for better understanding of drone platforms, sensors, payloads, and their application to different inspection, surveying, and renovation tasks. This domain therefore focuses on helping professionals select appropriate technologies and recognise their capabilities and limitations in practice.

DigComp 3.0 Alignment:

- *Area 1 (Information Search, Evaluation and Management) - 1.1 Browsing, searching and filtering data, information and digital content*
- *Area 5 (Problem Identification and Solving) - 5.2 Identifying needs and technological responses.*

D1.1: Drone Systems and Components

Competency Statement: The learner can identify the main components of a drone system, understand their purpose, and recognise how they support surveying, inspection, and renovation activities.

Knowledge	Understands the basic structure of a UAS (Unmanned Aircraft System), including the aircraft, ground control station, communication systems, and payloads. Recognises the role of key components such as sensors, navigation systems, batteries, and flight control systems. Understands important performance characteristics, including flight time, payload capacity, positioning accuracy, communication range, and suitability for different environmental conditions.
Skills	Can identify the main components of a drone system used in construction activities. Can interpret basic technical specifications and select appropriate equipment for different tasks. Can carry out standard pre-flight equipment checks following established procedures.

Attitudes	Demonstrates a responsible and systematic approach to equipment use. Recognises the importance of understanding the capabilities and limitations of drone systems before deployment and values reliability and safety in equipment selection.
EQF / DigComp Level	EQF 3–4 | DigComp 3.0 Basic–Intermediate| Area 1.1, Area 5.2

D1.2: Drone Platform Types and Selection

Competency Statement: The learner can compare and select appropriate drone platforms for specific construction and renovation tasks.

Knowledge	Understands the main characteristics, advantages, and limitations of different drone platforms used in construction, including multirotor, fixed-wing, hybrid VTOL, and tethered systems. Recognises the factors that influence platform selection, such as flight time, payload capacity, positioning accuracy, environmental conditions, indoor or outdoor operation, and regulatory requirements.
Skills	Can assess project requirements and select appropriate drone platforms for different construction activities. Can justify platform choices based on site conditions, data requirements, operational constraints, and applicable regulations. Can recommend suitable solutions for tasks such as surveying, façade inspection, thermal assessment, and progress monitoring.
Attitudes	Approaches platform selection objectively and prioritises suitability, safety, and operational effectiveness over familiarity or cost alone. Demonstrates openness to new technologies and continuous learning as drone capabilities evolve.
EQF / DigComp Level	EQF 3–4 | DigComp 3.0 Basic–Intermediate| Area 5.2, 5.3

D1.3: Sensors, Payloads, and Measurement Systems

Competency Statement: The learner understands the function, capabilities, and limitations of drone sensor systems used in construction and can select appropriate sensors for defined construction objectives.

Knowledge	Understands the main sensor types used in construction applications, including RGB, thermal, LiDAR, multispectral, and photogrammetric systems. Recognises the role of positioning technologies such as RTK and

	PPK in improving data accuracy and understands how sensor selection influences data quality and suitability for different construction tasks.
Skills	Can select appropriate sensors and payloads for specific construction activities, such as surveying, thermal inspections, or progress monitoring. Can configure basic data capture parameters and identify factors that may affect the quality and reliability of collected data.
Attitudes	Values accuracy, reliability, and fitness for purpose when selecting and configuring sensors. Demonstrates responsibility for data quality and remains open to learning about new sensing technologies and applications.
EQF / DigComp Level	EQF 4 | DigComp 3.0 Intermediate–Advanced| Area 1.3, 5.2

D1.4: Equipment Maintenance and Pre-Operational Checks

Competency Statement: The learner can perform systematic equipment maintenance and pre-flight checks to ensure safe and reliable drone operations.

Knowledge	Understands the principles of battery management, including safe charging, storage, transport, and handling procedures. Knows routine inspection requirements for key drone components, such as propellers, motors, sensors, communication systems, and structural elements. Understands the importance of equipment calibration, maintenance, and record keeping to ensure safe and reliable operations.
Skills	Can carry out pre-flight inspections using standard procedures and checklists. Can identify equipment faults or anomalies and take appropriate actions, including postponing operations when necessary. Maintains basic maintenance records and performs routine maintenance activities in accordance with manufacturer guidelines and organisational procedures.
Attitudes	Prioritises safety and equipment reliability over operational pressures or deadlines. Demonstrates a disciplined and methodical approach to maintenance and preparation activities and recognises the importance of following established procedures.
EQF / DigComp Level	EQF 3 | DigComp 3.0 Basic| Area 4.1, 5.1

4.2 Domain 2: Operational and Flight Competencies

D2 - Safe, effective drone operations in construction and renovation environments

The A2.2 stakeholder activities highlighted operational skills as one of the most important areas for construction professionals using drones. However, professional drone use in construction goes beyond basic piloting. It also requires effective mission planning, awareness of changing site conditions, risk management, and the ability to integrate drone operations into wider construction workflows.

This domain therefore focuses on the practical competencies needed to carry out drone activities safely, efficiently, and in accordance with project requirements. It combines flight operations with construction-specific considerations such as site safety, inspection procedures, and the coordination of digital and operational tasks.

DigComp 3.0 Alignment:

- *Area 4 (Safety, Wellbeing and Responsible Use) - 4.1 Protecting devices and digital content; 4.3 Supporting wellbeing;*
- *Area 5 (Problem Identification and Solving) - 5.1 Identifying and solving technical problems; 5.3 Identifying creative solutions using digital technologies.*

D2.1: Mission Planning and Pre-Flight Preparation

Competency Statement: The learner can plan and prepare drone missions for construction applications, incorporating site analysis, airspace assessment, risk identification, and regulatory checks.

Knowledge	Understands the main elements of mission planning for construction activities, including task requirements, site conditions, airspace considerations, weather assessment, safety procedures, and data collection needs. Recognises the role of digital planning tools, geofencing, and applicable operational restrictions.
Skills	Can prepare and document a flight mission for construction and renovation tasks. Can design basic automated flight plans using appropriate digital tools, assess environmental conditions, and determine

	whether operations can be conducted safely. Can coordinate with relevant stakeholders before commencing activities.
Attitudes	Values preparation, organisation, and clear communication as essential elements of safe and effective drone operations. Demonstrates responsibility for planning decisions and follows established procedures and documentation practices.
EQF / DigComp Level	EQF 3–4 | DigComp 3.0 Basic–Intermediate| Area 4.3, 5.1, 5.3

D2.2: Safe Drone Piloting and Flight Execution

Competency Statement: The learner can operate a drone safely and effectively in construction environments, adapting to dynamic site conditions.

Knowledge	Understands the principles of manual and automated flight operations and the procedures required for safe take-off, landing, return-to-home, and emergency situations. Recognises how environmental conditions, site characteristics, and external factors may affect flight performance. Understands the operational requirements and limitations of the EASA Open category relevant to construction activities. Understands the role of drone simulators, Virtual Reality (VR), and Extended Reality (XR) technologies as complementary training tools for safely developing piloting skills, emergency procedures, and mission planning before conducting real-world operations.
Skills	Can operate a drone safely within the applicable Open category requirements and maintain visual line of sight during construction activities. Can safely intervene and assume manual control when required during automated operations. Can adapt flight behaviour in response to changing environmental conditions, obstacles, signal issues, or unexpected events
Attitudes	Prioritises safety above operational objectives and maintains situational awareness throughout all phases of flight. Recognises personal limitations and seeks support or additional training when necessary. Demonstrates a responsible and professional approach to drone operations.
EQF / DigComp Level	EQF 3–4 | DigComp 3.0 Basic–Intermediate| Area 4.1, 4.3, 5.1

D2.3: Site Safety and Construction Environment Awareness

Competency Statement: The learner integrates drone operations into construction site safety protocols and can manage the interaction between aerial operations and ground-based activities.

Knowledge	Understands construction site safety requirements and the integration of drone operations within existing health and safety procedures. Recognises the need for PPE, exclusion zones, coordination with workers and machinery, and emergency response measures. Understands common risks associated with drone use on construction sites, including physical obstacles, environmental conditions, public access, and operational liability.
Skills	Can conduct a site-specific risk assessment before drone operations. Can establish and communicate safe operating areas and exclusion zones. Coordinates activities with site managers, safety officers, and other personnel. Can respond appropriately to unexpected events or emergency situations during operations.
Attitudes	Treats safety as a professional responsibility and promotes safe drone practices within construction teams. Demonstrates proactive communication and collaboration with all stakeholders involved in drone activities. Prioritises the wellbeing of workers, the public, and the surrounding environment.
EQF / DigComp Level	EQF 3–4 | DigComp 3.0 Basic–Intermediate| Area 4.3, 4.4, 5.1

D2.4: Advanced and Automated Operations

Competency Statement: The learner understands and can plan for advanced operation modes including automated missions, BVLOS concepts, and coordinated multi-drone scenarios.

Knowledge	Understands the principles governing advanced drone operations, including the EASA Specific category, Standard Scenarios, and the role of SORA in operational risk assessment. Recognises the requirements and limitations associated with BVLOS operations, automation, U-space services, and emerging technologies such as drone-in-a-box systems.
Skills	Can plan and conduct advanced or automated missions within applicable regulatory constraints. Can identify when an operation requires Specific category authorisation and support the preparation of the necessary documentation. Can evaluate the suitability of automated and autonomous drone solutions for different construction and inspection activities.

Attitudes	Demonstrates a responsible approach to advanced operations and respects regulatory limitations and safety requirements. Remains open to technological innovation while recognising the importance of continuous learning and professional development as regulations and capabilities evolve.
EQF / DigComp Level	EQF 5 | DigComp 3.0 Advanced| Area 5.2, 5.3, 5.4

4.3 Domain 3: Regulatory, Safety and Compliance

D3 - EASA framework, risk assessment, GDPR, and legal responsibilities

The A2.1 research and A2.2 stakeholder activities highlighted regulatory knowledge as an essential competence for the professional use of drones in construction. The European regulatory framework established by Regulations (EU) 2019/947 and 2019/945 provides the basis for safe and harmonised drone operations across Europe.

Construction professionals need to understand the rules that apply to their activities, the importance of operational risk assessment, and the responsibilities associated with privacy, data protection, and site safety. This domain therefore focuses on integrating regulatory compliance into everyday construction and renovation workflows rather than treating it as a separate or purely administrative requirement.

DigComp 3.0 Alignment:

- *Area 4 (Safety, Wellbeing and Responsible Use) — 4.2 Protecting personal data and privacy; 4.3 Supporting wellbeing;*
- *Area 1 (Information Search, Evaluation and Management) — 1.2 Evaluating data, information and digital content.*

D3.1: European UAS Regulatory Framework

Competency Statement: The learner understands the EASA drone regulatory framework applicable to construction operations and can identify the regulatory requirements for planned activities.

Knowledge	Understands the main principles of the European regulatory framework for drone operations, including Regulations (EU) 2019/947 and 2019/945 [5] and their national implementation. Recognises the characteristics of the Open, Specific, and Certified categories and understands the requirements related to registration, pilot competence, operational limitations, and airspace restrictions relevant to construction activities.
Skills	Can determine the appropriate regulatory category for a planned construction drone operation and identify the applicable operational requirements and restrictions. Can apply regulatory considerations during mission planning and ensure that planned activities comply with relevant rules and procedures.
Attitudes	Treats regulatory compliance as a professional responsibility and recognises its importance for safety, privacy, and public trust. Maintains awareness of regulatory developments and remains committed to continuous learning as the framework evolves.
EQF / DigComp Level	EQF 3–4 | DigComp 3.0 Levels 3–4 | Area 4.2, 4.3

D3.2: Airspace Awareness and U-space

Competency Statement: The learner understands airspace classification, restriction zones, and the emerging U-space [11] architecture relevant to construction drone operations.

Knowledge	Understands the main airspace restrictions and geographical zones that may affect construction drone operations. Recognises the principles of U-space and the role of digital services in supporting safe and coordinated drone activities. Understands the responsibilities of drone operators when sharing airspace with other users.
Skills	Can use national digital tools and platforms to verify airspace status and operational restrictions before a mission. Can identify when additional permissions, notifications, or authorisations are required and incorporate these requirements into mission planning.
Attitudes	Demonstrates awareness of evolving airspace management practices and remains open to new digital services and regulatory developments.
EQF / DigComp Level	EQF 3–4 | DigComp 3.0 Basic–Intermediate| Area 4.3, 5.1

D3.3: Operational Risk Assessment (SORA)

Competency Statement: The learner understands the principles of operational risk assessment and can contribute to the preparation of Specific category drone operations when required.

Knowledge	Understands the purpose and principles of operational risk assessment for advanced drone activities. Recognises the role of SORA [10], Standard Scenarios, and mitigation measures in enabling safe and compliant operations within the Specific category. Understands how risk assessment supports decision-making in construction environments.
Skills	Applies SORA logic to identify the risk class of a specific construction drone operation. Identifies appropriate mitigating measures for identified risks. Can contribute to the preparation of documentation required for Specific category operations and support communication with relevant authorities when necessary.
Attitudes	Approaches risk assessment analytically and honestly. Does not minimise risks for operational convenience. Advocates for proportionate but rigorous risk assessment in the organisation.
EQF / DigComp Level	EQF 4–5 | DigComp 3.0 Intermediate–Advanced| Area 4.3, 5.1, 5.2

D3.4: Privacy, GDPR, and Legal Compliance

Competency Statement: The learner understands the legal and ethical obligations related to data protection, privacy, and liability in drone-based construction operations.

Knowledge	Understands the principles of data protection and privacy in relation to drone operations, including the requirements of the GDPR [6]. Recognises privacy risks associated with construction activities and understands the responsibilities of drone operators and organisations when handling personal data.
Skills	Can assess the privacy implications of drone operations and apply appropriate measures during mission planning. Can manage, store, and delete collected data in accordance with legal and organisational requirements. Maintains operational records and documentation as required.
Attitudes	Treats data protection as a fundamental right and professional responsibility. Demonstrates respect for privacy, transparency, and responsible data management, even when operational pressures arise.

EQF / DigComp Level	EQF 3–4 | DigComp 3.0 Basic–Intermediate| Area 4.2, 4.3

4.4 Domain 4: Data Acquisition and Digital Processing

D4 - Photogrammetry, thermal imaging, and the transformation of drone data into construction intelligence

The A2.1 research and A2.2 stakeholder activities highlighted data acquisition and processing as one of the most important competence areas for the effective use of drones in construction. While many professionals are becoming familiar with drone operations, there is a growing need for skills related to data quality, photogrammetry, thermal analysis, reporting, and the interpretation of digital outputs.

This domain focuses on the competencies required to transform raw drone data into information that supports decision-making in surveying, inspection, energy assessment, and renovation projects. It emphasises the importance of selecting appropriate data collection methods, applying suitable processing workflows, and producing reliable outputs that can be integrated into wider construction processes.

DigComp 3.0 Alignment:

- *Area 1 (Information Search, Evaluation and Management) - 1.1 Browsing, searching and filtering; 1.2 Evaluating data, information and digital content; 1.3 Managing data, information and digital content.*
- *Area 3 (Digital Content Creation) - 3.1 Developing digital content; 3.2 Integrating and re-elaborating digital content.*

D4.1: Data Capture Planning and Quality Assurance

Competency Statement: The learner can plan and execute drone data capture missions to produce high-quality, fit-for-purpose datasets for construction applications.

Knowledge	Understands how flight parameters, environmental conditions, and site characteristics influence the quality and accuracy of drone data. Recognises the importance of georeferencing methods and appropriate data formats for subsequent processing and analysis activities.
Skills	Can plan data acquisition activities according to the requirements of different construction tasks. Can configure data capture settings to achieve the desired quality standards and verify the completeness and reliability of collected information before leaving the site.
Attitudes	Values accuracy, consistency, and reliability in data collection activities. Takes responsibility for data quality and is willing to repeat or adapt operations when the collected information does not meet project requirements.
EQF / DigComp Level	EQF 4 | DigComp 3.0 Basic–Intermediate| Area 1.3, 3.1

D4.2: Photogrammetry and 3D Modelling

Competency Statement: The learner can apply photogrammetric processing techniques to generate accurate digital construction outputs including orthomosaics, point clouds, and 3D models.

Knowledge	Understands the principles of Structure-from-Motion (SfM) photogrammetry and the main stages of the processing workflow, including image alignment, point cloud generation, surface modelling, and orthomosaic production. Recognises the importance of accuracy assessment, quality control procedures, and georeferencing methods in construction applications.
Skills	Can process drone imagery to produce digital outputs suitable for construction activities, including orthomosaics, point clouds, and elevation models. Can evaluate processing results, identify potential sources of error, and apply appropriate quality checks. Can derive measurements and other information required for surveying, inspection, and renovation tasks.
Attitudes	Recognises the limitations and uncertainties associated with photogrammetric products and communicates them transparently. Takes responsibility for ensuring that digital outputs are appropriate for their intended use in construction decision-making.

EQF / DigComp Level	EQF 4 | DigComp 3.0 Intermediate–Advanced| Area 1.2, 3.1, 3.2

D4.3: Thermal Imaging and Building Energy Assessment

Competency Statement: The learner can operate thermal imaging equipment and interpret thermal data for building energy performance assessment and renovation planning.

Knowledge	Understands the physics of thermal infrared imaging: emissivity, reflected temperature, atmospheric attenuation. Knows building energy performance concepts: thermal bridges, heat loss pathways, insulation defects, air leakage, moisture anomalies. Understands the conditions required for valid thermographic inspection (delta-T requirements, weather windows, building operational conditions). and is aware of relevant standards (e.g. ISO 6781, EN 13187) [7].
Skills	Configures and operates a drone-mounted thermal camera. Plans and executes a thermal inspection mission for a building façade or roof. Interprets thermal images to identify energy-performance anomalies (thermal bridges, missing insulation, moisture ingress, air leakage). Produces a structured thermal inspection report supporting renovation decision-making.
Attitudes	Applies rigorous methodological standards to thermographic inspection. Clearly communicates the conditions and limitations of thermal assessments in reports.
EQF / DigComp Level	EQF 4 | DigComp 3.0 Intermediate–Advanced| Area 1.2, 1.3, 3.1

D4.4: Inspection Data Management and Reporting

Competency Statement: The learner can organise, manage, and communicate drone-derived inspection data in structured formats that support construction decision-making.

Knowledge	Understands the principles of data organisation, storage, access management, and documentation within construction projects. Recognises the key elements of professional inspection reports and understands how inspection findings support maintenance, renovation, and decision-making processes.
Skills	Can organise drone-derived data in structured digital environments and prepare professional inspection reports integrating different forms of

	evidence, including images, thermal information, and measurements. Can communicate findings clearly to both technical and non-technical audiences and maintain appropriate records to support quality assurance processes.
Attitudes	Values clarity, accuracy, and completeness in data management and reporting. Recognises the professional importance of inspection reports and the need for accuracy, transparency, and traceability in documenting findings.
EQF / DigComp Level	EQF 3–4 | DigComp 3.0 Basic–Intermediate| Area 1.3, 2.2, 3.1

4.5 Domain 5: BIM, GIS, and Digital Workflow Integration

D5 - Connecting drone data to the digital construction environment

The A2.1 research and A2.2 stakeholder activities highlighted BIM and GIS integration as one of the main skills gaps in the construction sector. While drones can generate large amounts of valuable information, this data only creates value when it is integrated into broader digital workflows and used to support project planning, inspection, maintenance, and renovation activities.

This domain focuses on the competencies required to connect drone-derived outputs with BIM models, GIS platforms, digital twins, and collaborative construction environments. It therefore links operational drone activities to wider project management and decision-making processes.

DigComp 3.0 Alignment:

- *Area 3 (Digital Content Creation) — 3.2 Integrating and re-elaborating digital content*
- *Area 2 (Communication and Collaboration) — 2.4 Collaborating through digital technologies.*
- *Area 5 (Problem Identification and Solving) — 5.3 Identifying creative solutions using digital technologies.*

D5.1: Building Information Modelling (BIM) Fundamentals

Competency Statement: The learner understands BIM concepts and their application in construction and renovation projects and can contextualise drone data within BIM workflows.

Knowledge	Understands BIM definitions (ISO 19650 series) [8], LOD (Level of Detail) concepts [9], and BIM maturity levels. Knows leading BIM software environments: Autodesk Revit, ArchiCAD, OpenBIM platforms, and viewer tools (Navisworks, BIMcollab). Understands IFC (Industry Foundation Classes) as the primary open data exchange format. Knows the role of BIM in renovation workflows: existing conditions capture, as-built modelling, renovation planning, and handover documentation.
Skills	Navigates and interrogates a BIM model relevant to a construction or renovation project. Identifies where drone-derived data can contribute to BIM workflows. Imports and overlays photogrammetric point clouds with BIM models for clash detection and as-built verification.
Attitudes	Values interoperability and open standards. Understands BIM as a collaborative environment, not just a software tool. Commits to the accuracy requirements of BIM model inputs.
EQF / DigComp Level	EQF 4 | DigComp 3.0 Intermediate–Advanced| Area 3.2, 2.4

D5.2: GeoBIM and GIS Integration

Competency Statement: The learner can integrate drone-derived geospatial data with GIS platforms and connect spatial data to BIM models through GeoBIM workflows.

Knowledge	Understands GIS principles: coordinate reference systems, spatial data formats (shapefile, GeoJSON, KML, GeoTIFF), and GIS software (QGIS, ArcGIS, web GIS platforms). Understands the concept of GeoBIM: the integration of geospatial context with building-scale BIM models. Knows how drone-produced orthomosaics, DSMs, and point clouds integrate with GIS datasets for site management, urban planning, and infrastructure monitoring.
Skills	Can integrate drone-derived outputs into GIS environments and use geospatial information to support construction activities. Can perform basic spatial analyses relevant to project planning, monitoring, and inspection tasks. Prepares and shares georeferenced data products for use within wider digital construction workflows.

Attitudes	Understands the value of spatial context in construction decision-making. Values coordinate accuracy and spatial data quality as professional obligations.
EQF / DigComp Level	EQF 4–5 | DigComp 3.0 Intermediate–Advanced| Area 1.3, 3.2, 5.3

D5.3: Digital Twins and Collaborative Digital Environments

Competency Statement: The learner understands digital twin concepts and can contribute to collaborative digital construction environments supported by drone data.

Knowledge	Understands what a digital twin is in the construction context: a dynamic, data-enriched virtual replica of a physical asset or site updated with sensor and operational data. Knows how drone data contributes to digital twin creation and maintenance: periodic photogrammetric surveys, thermal assessments, progress monitoring, structural inspection. Understands collaborative digital workflow requirements: data standards, platform interoperability, access control, and version management.
Skills	Can contribute drone-derived data to a shared digital project environment. Compares as-built conditions (from drone survey) with design intent (from BIM model). Supports progress monitoring workflows through regular photogrammetric survey updates. Participates in collaborative model review processes.
Attitudes	Values the continuity and quality of digital asset records. Understands the long-term value of drone data for building lifecycle management beyond the immediate project.
EQF / DigComp Level	EQF 5 | DigComp 3.0 Advanced| Area 2.4, 3.2, 5.3

4.6 Domain 6: Professional and Organisational Competencies

D6 - Hybrid skills, sustainability, project management, and trainer preparedness

Domain 6 addresses the professional and organisational dimension of drone competence: the hybrid skills that enable construction professionals to embed drone workflows into organisational practice, manage projects, communicate effectively, make business cases for adoption, and contribute to sustainable construction goals. This domain emerged strongly from the A2.2 workshops, particularly from Spain and Italy, and reflects the A2.1 strategic report's emphasis

on hybrid drone-data-BIM professional profiles as the most valuable and least available workforce resource.

DigComp 3.0 Alignment:

- *Area 2 (Communication and Collaboration) - 2.1 Interacting; 2.4 Collaborating; 2.6 Managing digital identity*
- *Area 4 (Safety, Wellbeing and Responsible Use) - 4.4 Environmental impacts of digital technologies*
- *Area 5 (Problem Identification and Solving) - 5.2 Identifying needs and digital technological responses; 5.4 Identifying and addressing digital competence needs*

D6.1: Professional Communication and Documentation

Competency Statement: The learner communicates effectively with construction teams, clients, and stakeholders about drone operations and produces professional documentation.

Knowledge	Understands professional communication requirements in construction contexts: stakeholder diversity, technical and non-technical audiences, regulatory documentation, client reporting. Knows what documentation is required for drone operations: flight logs, pre-flight checklists, incident reports, data management records, insurance records.
Skills	Can explain drone capabilities, limitations, and data outputs clearly to non-specialist audiences. Produces complete and accurate operational documentation. Presents drone-derived findings in formats appropriate to construction team needs (inspection reports, survey outputs, progress briefings). Manages client communication through drone project lifecycles.
Attitudes	Values clarity, precision, and transparency in communication. Adapts communication style to audience. Treats documentation as a professional and legal responsibility.
EQF / DigComp Level	EQF 3–4 | DigComp 3.0 Basic–Intermediate| Area 2.1, 2.4

D6.2: Project Planning and Drone Workflow Management

Competency Statement: The learner can plan, organise, and manage drone-based activities within construction and renovation projects.

Knowledge	Understands project management principles applicable to drone deployment: scope definition, resource planning, scheduling, stakeholder coordination, budget management, and quality assurance. Knows how to plan a drone survey or inspection campaign as part of a broader construction project. Understands in-house versus outsourced drone service models and procurement considerations.
Skills	Can plan a drone-based campaign integrated within a construction project schedule. Manages resources (equipment, personnel, data storage) for a drone operation. Coordinates drone activities with other project workstreams. Evaluates project performance and identifies process improvements.
Attitudes	Approaches drone deployment as a project management challenge, not merely a technical operation. Values coordination, communication, and continuous improvement.
EQF / DigComp Level	EQF 4–5 | DigComp 3.0 Intermediate–Advanced| Area 2.4, 5.2, 5.3

D6.3: Business Case Development and Return on Investment

Competency Statement: The learner can evaluate the economic and organisational value of drone adoption and develop business cases for drone integration within construction organisations.

Knowledge	Understands the organisational, economic, and operational factors influencing the adoption of drone technologies in construction. Recognises the costs, benefits, and resource requirements associated with implementing drone workflows and understands the importance of change management, training, and stakeholder engagement
Skills	Can evaluate the feasibility and potential value of drone applications in different construction scenarios. Can prepare a basic business case that considers costs, benefits, risks, and organisational requirements. Can identify the conditions needed to integrate drone technologies into existing workflows and practices.
Attitudes	Approaches technology adoption critically and objectively, recognising both opportunities and limitations. Promotes evidence-based decision-making and supports innovation in a responsible and realistic manner..

EQF / DigComp Level	EQF 5 | DigComp 3.0 Intermediate–Advanced| Area 5.2, 5.4, 2.4

D6.4: Data Governance and Cybersecurity

Competency Statement: The learner can manage drone data securely and ethically, applying cybersecurity principles to drone systems and data pipelines.

Knowledge	Understands the importance of cybersecurity and data protection in drone operations. Recognises common risks related to data transmission, cloud storage, software management, and access control. Understands the principles of data governance, including ownership, retention, traceability, and responsible management of construction data.
Skills	Can apply basic cybersecurity practices to drone operations, including secure data storage, access management, and software maintenance. Can support the implementation of data governance procedures within construction projects and identify situations that require additional technical or organisational safeguards.
Attitudes	Takes cybersecurity and data integrity seriously as professional obligations. Recognises that drone-generated construction data has commercial and legal value requiring protection.
EQF / DigComp Level	EQF 4–5 | DigComp 3.0 Intermediate–Advanced| Area 4.1, 4.2, 5.1

D6.5: Sustainability and Environmental Responsibility

Competency Statement: The learner understands the environmental dimensions of drone technology use and applies sustainability principles to drone operations and construction decisions.

Knowledge	Understands the environmental benefits of drone use in construction: reduced site visits, improved accuracy in renovation scope definition, support for energy efficiency audits, and contribution to building decarbonisation. Knows the environmental impact of drone technology itself: battery chemistry, electronics waste, and operational carbon footprint. Understands the connection between drone-enabled renovation and EU Green Deal, and Renovation Wave [13].
Skills	Can apply sustainability criteria in drone project planning (route optimisation, battery efficiency, equipment lifecycle). Connects drone inspection outputs to energy efficiency improvement recommendations.

	Uses drone data to support Level(s) reporting and environmental performance documentation.
Attitudes	Values the contribution of professional drone use to sustainable construction and building renovation. Actively seeks to maximise the environmental benefit of drone-enabled activities.
EQF / DigComp Level	EQF 4–5 | DigComp 3.0 Intermediate–Advanced| Area 4.4, 5.2, 5.3

D6.6: Emerging Technologies and AI Literacy

Competency Statement: The learner understands the emerging role of artificial intelligence in drone-supported construction and can critically evaluate and apply AI-assisted tools.

Knowledge	Understands the role of machine learning and computer vision in automated defect detection, image classification, and anomaly identification from drone-captured construction data. Knows the types of AI-assisted drone inspection tools available: automated crack detection, façade deterioration analysis, thermal anomaly identification, progress monitoring comparison. Understands the limitations and risks of AI-assisted analysis: false positives/negatives, training data bias, explainability challenges, and liability implications.
Skills	Critically evaluates the outputs of AI-assisted drone inspection tools, distinguishing between reliable findings and artefacts. Integrates AI-generated outputs with human professional judgement. Identifies appropriate use cases for AI assistance versus cases requiring human expertise. Stays current with emerging AI capabilities in the drone and construction domain.
Attitudes	Approaches AI tools critically and responsibly. Does not uncritically accept AI outputs. Maintains professional responsibility for construction decisions regardless of the degree of AI assistance.
EQF / DigComp Level	EQF 5 | DigComp 3.0 Advanced| Area 1.2, 5.3, 5.4

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Competency Mapping Matrix

5. Competency Mapping Matrix

The following matrix provides an integrated view of all 24 Competency Areas, their DigComp 3.0 references, EQF levels, and mapping to the Drone4Build WP3 training courses.

Code	Domain	Competency Area	EQF	DigComp 3.0	Drone4Build Course
D1.1	D1: Technical	Drone Systems and Components	3–4	1.1, 5.2	Course 1, M1.1
D1.2	D1: Technical	Platform Types and Selection	3–4	5.2, 5.3	Course 1, M1.1
D1.3	D1: Technical	Sensors, Payloads, and Measurement Systems	4	1.3, 5.2	Course 1, M1.1; Course 2, M2.2
D1.4	D1: Technical	Equipment Maintenance and Pre-Op Checks	3	4.1, 5.1	Course 1, M1.1
D2.1	D2: Operational	Mission Planning and Pre-Flight Preparation	3–4	4.3, 5.1	Course 1, M1.2
D2.2	D2: Operational	Safe Drone Piloting and Flight Execution	3–4	4.1, 4.3	Course 1, M1.2
D2.3	D2: Operational	Site Safety and Construction Environment Awareness	3–4	4.3, 4.4	Course 1, M1.2; Course 2, M2.1
D2.4	D2: Operational	Advanced and Automated Operations	5	5.2, 5.3	Course 4, M4.1
D3.1	D3: Regulatory	European UAS Regulatory Framework	3–4	4.2, 4.3	Course 1, M1.2
D3.2	D3: Regulatory	Airspace Awareness and U-space	3–4	4.3, 5.1	Course 1, M1.2
D3.3	D3: Regulatory	Operational Risk Assessment (SORA)	4–5	4.3, 5.1	Course 4, M4.2
D3.4	D3: Regulatory	Privacy, GDPR, and Legal Compliance	3–4	4.2	Course 4, M4.2
D4.1	D4: Data	Data Capture Planning and QA	4	1.3, 3.1	Course 3, M3.1
D4.2	D4: Data	Photogrammetry and 3D Modelling	4	1.2, 3.1, 3.2	Course 3, M3.1
D4.3	D4: Data	Thermal Imaging and Energy Assessment	4	1.2, 1.3, 3.1	Course 2, M2.2
D4.4	D4: Data	Inspection Data Management and Reporting	3–4	1.3, 2.4, 3.1	Course 2, M2.1
D5.1	D5: BIM/GIS	BIM Fundamentals	4	3.1, 3.2	Course 3, M3.2
D5.2	D5: BIM/GIS	GeoBIM and GIS Integration	4–5	1.3, 3.2, 5.3	Course 3, M3.2
D5.3	D5: BIM/GIS	Digital Twins and Collaborative Environments	5	2.4, 3.2, 5.3	Course 3–4, M3.2, M4.1

D6.1	D6: Professional	Professional Communication and Documentation	3–4	2.1, 2.4	All Courses
D6.2	D6: Professional	Project Planning and Drone Workflow Management	4–5	2.2, 5.2	Course 4, M4.2
D6.3	D6: Professional	Business Case Development and ROI	5	5.2, 5.4	Course 4, M4.2
D6.4	D6: Professional	Data Governance and Cybersecurity	4–5	4.1, 4.2, 5.1	Course 4, M4.2
D6.5	D6: Professional	Sustainability and Environmental Responsibility	4–5	4.4, 5.2	Course 4, M4.2
D6.6	D6: Professional	Emerging Technologies and AI Literacy	5	1.2, 5.3, 5.4	Course 4, M4.1

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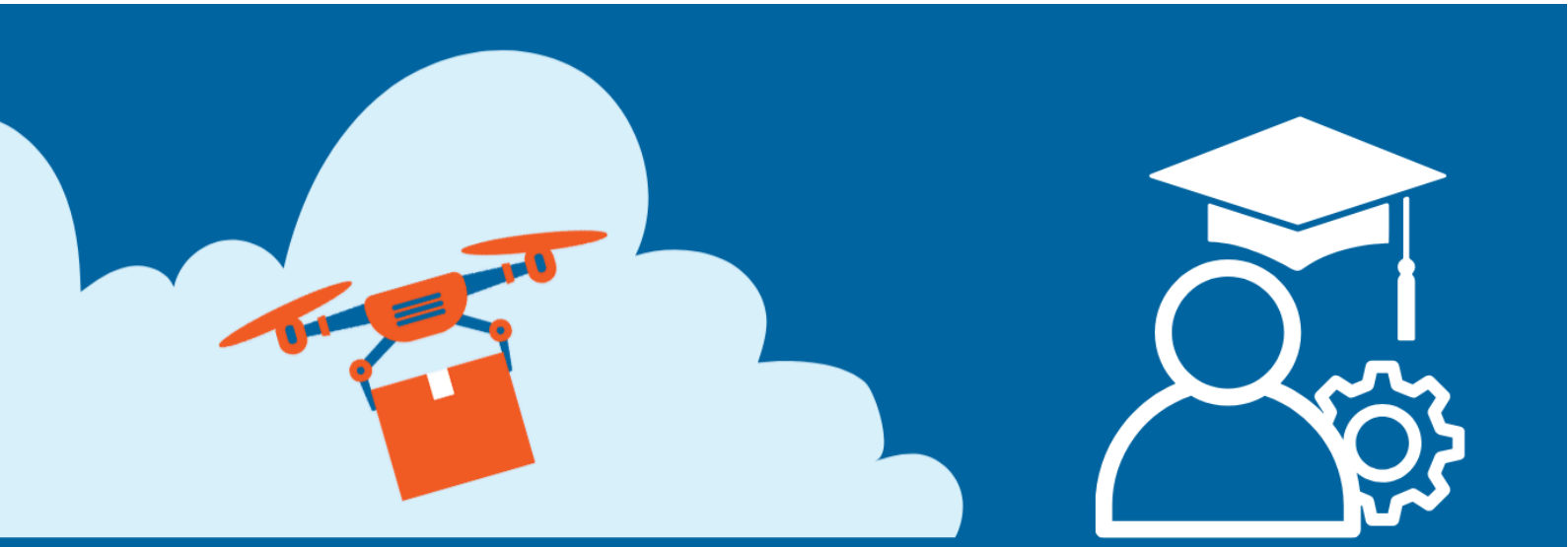

Proficiency Progression Across the Framework

>_ abstract IT Experience. Experience it.
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6. Proficiency Progression Across the Framework

The framework defines three competence levels corresponding to EQF Levels 3-5 & DigComp Framework. Learners can progress gradually from basic drone operation and inspection skills to advanced applications such as BIM integration, digital twins, AI-assisted workflows, and organisational deployment.

Competence Level	EQF/DigComp 3.0	Associated Courses	Learner Profile and Capabilities
Foundation (Operational Readiness)	EQF Level 3 / DigComp 3.0 Basic	• Course 1: Foundations of Drone Operations for Construction and Renovation	Construction professionals with limited or no prior drone experience. Learners can understand basic drone systems, apply essential EASA regulatory requirements, prepare simple missions, and operate drones safely in basic Open category scenarios. Relevant competences: D1.1, D1.2, D1.4, D2.1, D2.2, D2.3, D3.1, D3.2, D3.4, D4.3, D4.4, D6.1.
Foundation-Intermediate	EQF 3–4 / DigComp 3.0 Basic-Intermediate	• Course 2: Drone-Based Building Inspection and Energy Assessment	Learners can perform drone assisted inspections, capture usable visual or thermal data, and produce simple structured inspection reports. Relevant competences: D1.1, D1.2, D1.4, D2.1, D2.2, D2.3, D3.1, D3.2, D3.4, D4.3, D4.4, D6.1.
Intermediate (Digital Integration)	EQF Level 4 / DigComp 3.0 Intermediate	• Course 3: Drone Data Processing, BIM and Digital Construction Workflows	Experienced drone users, construction technicians, or digital construction professionals. Learners can process drone data through photogrammetric workflows, assess data quality, generate orthomosaics and 3D outputs, manage geospatial datasets, integrate drone outputs with BIM/GIS workflows, conduct applied thermal analysis, and contribute to collaborative

			digital construction environments. Relevant competences: D1.3, D4.1, D4.2, D5.1, D5.2, D6.2, D6.4.
Advanced (Innovation and Coordination)	EQF Level 5 / DigComp 3.0 Advanced	• Course 4: Advanced Drone Applications for Sustainable Construction	Senior professionals, BIM coordinators, site managers, drone specialists, trainers, or innovation coordinators. Learners can manage complex drone deployment activities, evaluate advanced and automated drone applications, contribute to SORA-based Specific category operations, assess AI-assisted inspection tools, support digital twin workflows, develop organisational business cases, address cybersecurity and sustainability considerations, and guide others in adopting drone-enabled construction practices. Relevant competences: D2.4, D3.3, D5.3, D6.2, D6.3, D6.4, D6.5, D6.6.

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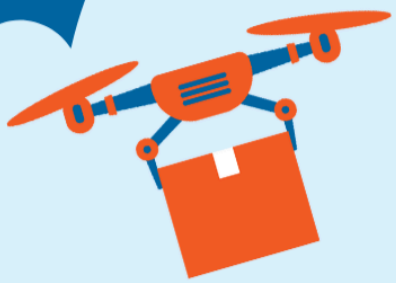

Implementation Recommendations for WP3

>_ abstract IT Experience. Experience it.
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7. Implementation Recommendations for WP3

7.1 Curriculum Design Guidance

The following recommendations are intended to support the development of the Drone4Build training programme within Work Package 3. They are informed by the findings of the A2.1 strategic research, the A2.2 stakeholder validation activities, and the competency framework presented in this document.

- **Maintain the modular structure**

The four-course, eight-module structure proposed in the WP3 Work Plan is well aligned with the competencies identified in this framework. Each module should clearly state its learning objectives and the competencies it aims to develop, ensuring consistency between the curriculum content and the expected learning outcomes.

- **Emphasise practical and learning**

All A2.2 workshops prioritised hands-on, practice-oriented training as the most needed and valued approach. The curriculum should therefore combine theoretical foundations with practical exercises, case studies, demonstrations, and real-world construction scenarios. Wherever possible, learners should have opportunities to apply knowledge through mission planning, inspections, data collection, and digital workflow activities relevant to their professional context.

Additionally, where appropriate, training providers are encouraged to incorporate innovative learning technologies, including drone simulators, Virtual Reality (VR), and Extended Reality (XR), to allow learners to develop operational skills in a safe and controlled environment before undertaking practical flight activities.

- **Ensure alignment with the Competency Framework**

The competency framework should serve as the main reference for curriculum development. Module content, learning outcomes, and assessment activities should contribute to the development of the relevant competency areas identified in this document, while remaining consistent with the broader principles of DigComp 3.0 and European vocational education frameworks.

- **Support flexible learning pathways**

Construction professionals enter training programmes with different levels of experience in digital technologies and drone operations. The curriculum should therefore support flexible progression pathways, enabling learners to build upon existing knowledge and focus on competencies most relevant to their professional roles and organisational needs.

- **Consider trainer preparedness**

Successful implementation depends on trainers possessing both pedagogical skills and sufficient familiarity with construction practices using drones. During the stakeholder validation workshops participants also highlighted the importance of strengthening trainer preparedness, particularly in relation to emerging drone technologies and digital construction workflows. While pedagogical competencies are outside the primary scope of the A2.3 framework, these findings should inform the development of complementary Train-the-Trainer resources and capacity-building activities during the implementation of WP4.

- **Module validation**

As foreseen in the WP3 Work Plan, module content should be reviewed by external experts and stakeholders to ensure relevance, practicality, and alignment with industry needs. Feedback collected during these validation activities should inform the refinement and finalisation of the training materials.

7.2 Assessment and Recognition

Assessment methods should reflect the applied and competency-based nature of drone operations within construction environments. The following principles are recommended:

- **Practical activities:** Operational competencies should be assessed through practical exercises, mission planning activities, and the application of drone technologies in realistic scenarios.
- **Scenario-based tasks:** Assessment activities should encourage learners to apply knowledge and skills to authentic construction and renovation challenges rather than relying exclusively on theoretical testing.
- **Digital deliverables:** Competencies related to data processing, BIM integration, and digital workflows should be evaluated through the quality and relevance of the outputs produced by learners.

- **Recognition of learning outcomes:** Course certificates and training documentation may indicate the competencies and learning outcomes addressed, supporting transparency and facilitating alignment with European vocational education practices.

7.2.2 Example of Competency Progression across EQF Levels

The table below illustrates how competency expectations increase across the three EQF levels adopted by the Drone4Build framework. The example is based on Domain D2-Operational and Flight Competencies.

EQF Level	Example of Expected Competence for D2
EQF 3	Can safely operate a drone within the Open category following established procedures, perform basic mission planning, complete pre-flight checks, and conduct standard visual inspection flights under typical construction site conditions.
EQF 4	Can independently plan and execute construction inspection missions, adapt operations to specific site conditions, evaluate operational risks, collect high-quality inspection data, and communicate results through structured reports.
EQF 5	Can coordinate complex drone operations, support Specific category missions where appropriate, evaluate operational risks, supervise drone activities within construction projects, and contribute to organisational decision-making and continuous improvement of drone workflows.

8. Conclusions

The Drone Competency Framework (A2.3) provides the Drone4Build consortium with a structured, evidence-based, and policy-aligned reference for drone skills development in the construction sector. Building upon the findings of the A2.1 strategic analysis and the A2.2 stakeholder validation activities, the framework establishes a common understanding of the knowledge, skills, and attitudes required for the effective use of drone technologies in construction and renovation contexts.

The six competency domains presented in this document address the technical, operational, regulatory, digital, and professional capabilities needed by construction practitioners to deploy drones safely, efficiently, and responsibly. The framework is intended to support Work Package 3 by providing a clear foundation for curriculum design while avoiding duplication with the development of detailed learning outcomes, teaching materials, and assessment activities.

Alignment with DigComp 3.0, and the European Qualifications Framework (EQF), contributes to the framework's compatibility with broader European approaches to digital skills, vocational education, and lifelong learning. In doing so, Drone4Build supports ongoing efforts to strengthen digital transformation, sustainability, and innovation within the construction sector.

The stakeholder consultations conducted throughout the project demonstrate a growing interest in the adoption of drone technologies for inspection, surveying, energy assessment, and digital construction workflows. However, the successful integration of these technologies depends not only on technical solutions and regulatory frameworks, but also on the availability of appropriately skilled professionals. This framework responds to that need by offering a practical and adaptable reference that reflects both European policy priorities and the realities of professional practice.

Ultimately, the Drone4Build Competency Framework establishes a common basis for future training activities, supports the development of industry-relevant curricula, and contributes to building a workforce capable of leveraging drone technologies to advance safer, more sustainable, and more digitally enabled construction practices.

Glossary

Abbreviation/ Term	Full Form/Definition
AI	**Artificial Intelligence:** Technology that enables computer systems to perform tasks that typically require human intelligence, such as image recognition, anomaly detection, data analysis, and decision support. In drone applications, AI supports automated inspection, object detection, and predictive analytics.
ARC	**Air Risk Class**: A parameter within the SORA methodology that characterises the level of risk a drone operation poses to other aircraft, based on the operational environment and flight characteristics.
BIM	**Building Information Modelling**: A digital process for creating, managing, and sharing information about a built asset throughout its lifecycle. BIM integrates geometric, physical, and functional information to support planning, design, construction, renovation, and maintenance.
BVLOS	**Beyond Visual Line of Sight**: A category of drone operation in which the remote pilot cannot maintain unaided visual contact with the aircraft. Under EASA regulations, BVLOS operations generally require authorisation in the Specific category.
Digital Twin	A dynamic digital representation of a physical asset, process, or environment that is continuously updated using real-world data. In construction, digital twins combine drone data, BIM models, IoT sensors, and other digital information to support monitoring and decision-making.
DigComp	The European Digital Competence Framework for Citizens developed by the European Commission.
DRONE4BUILD	Elevating the knowledge of construction professionals on the use of drones in construction (project acronym)
DSM	**Digital Surface Model:** A georeferenced elevation model representing the terrain surface together with above-ground objects such as buildings, vegetation, and infrastructure, commonly generated from drone surveys.
EASA	**European Union Aviation Safety Agency:** The European agency responsible for civil aviation safety, including the development

	and implementation of regulations governing unmanned aircraft systems (UAS).
ESCO	**European Skills, Competences, Qualifications and Occupations**: The European multilingual classification system developed by the European Commission that describes occupations, skills, competences, and qualifications to support education, employment, and labour market mobility.
EQF	**European Qualifications Framework**: A common European reference framework consisting of eight qualification levels that enables comparison of qualifications across European education and training systems.
EU	European Union
GDPR	**General Data Protection Regulation**: Regulation (EU) 2016/679 governing the collection, processing, storage, and protection of personal data within the European Union.
GeoBIM	The integration of geospatial information with Building Information Modelling to combine geographic context with building-scale digital models for planning, analysis, and asset management.
GIS	**Geographic Information System:** A system used to capture, manage, analyse, and visualise geospatial information to support planning, monitoring, and decision-making.
GRC	**Ground Risk Class**: A parameter within the SORA methodology describing the level of risk a drone operation poses to people on the ground.
IFC	**Industry Foundation Classes**: An open and standardised data format that enables interoperability and information exchange between different BIM software platforms.
IMU	**Inertial Measurement Unit**: An onboard sensor that measures acceleration, angular velocity, and orientation to support drone stabilisation, navigation, and flight control.
KSA Model	The Knowledge–Skills–Attitudes model used in competence frameworks to describe what individuals know, what they are able to do, and the behaviours or attitudes they demonstrate in professional practice.
LiDAR	**Light Detection and Ranging:** A remote sensing technology that uses laser pulses to measure distances and generate highly accurate three-dimensional representations of objects and terrain.

Orthomosaic	A geometrically corrected aerial image created by combining multiple overlapping photographs into a single map with uniform scale and geographic accuracy.
Photogrammetry	The science of obtaining accurate measurements and three-dimensional information from overlapping photographs captured by drones or other imaging systems.
Point Cloud	A dense collection of three-dimensional points generated through photogrammetry or LiDAR that accurately represents the geometry of physical objects or environments.
PPK	**Post-Processed Kinematic**:A satellite positioning technique in which GNSS data are corrected after the flight to improve the positional accuracy of drone survey data.
Remote ID	A digital identification system that enables drones to broadcast information such as their identity, location, altitude, and operator details to support safety, security, and regulatory compliance.
ROI	**Return on Investment**: A financial performance indicator used to evaluate the benefits or value generated by an investment relative to its cost.
RTK	**Real-Time Kinematic**: A high-precision GNSS positioning technique that provides real-time centimetre-level accuracy for drone surveying and mapping operations.
SORA	**Specific Operations Risk Assessment**: A standardised risk assessment methodology developed by JARUS and adopted by EASA to evaluate and mitigate the operational risks of drone flights conducted in the Specific category.
Thermal Imaging (Thermography)	A sensing technique that detects infrared radiation emitted by objects to visualise temperature differences. In construction, it is commonly used to identify heat loss, moisture intrusion, insulation defects, and other building performance issues.
UAS	Unmanned Aircraft System
U-SPACE	A set of digital services and procedures designed to support the safe, secure, and efficient integration of drones into shared airspace, particularly in areas with high traffic density.
USSP	**U-space Service Provider**: An organisation certified to provide U-space services, including digital flight authorisation, traffic information, conformance monitoring, and other services supporting drone operations.

VET	Vocational Education and Training
VLOS	**Visual Line of Sight**: A category of drone operation in which the remote pilot maintains continuous unaided visual contact with the aircraft throughout the flight to ensure safe operation.
VR	**Virtual Reality**: A fully immersive digital environment used for training and simulation. In drone education, VR enables learners to practise flight operations and mission scenarios safely before conducting real-world flights.
XR	**Extended Reality**: An umbrella term that includes Virtual Reality (VR), Augmented Reality (AR), and Mixed Reality (MR). In drone training, XR supports realistic simulation and practical skill development in safe learning environments.

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