



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



# *DigiS: Building up a Digital Skills Alliance for the Enhancing of Programming Competencies*

## **JOINT QUALIFICATION STANDARD** *UAS Developer and Operator*

EQF level 4

Final\_D2.1: 16 June 2021

*Disclaimer: The European Commission's support for the production of this publication does not constitute an endorsement of the contents, which reflect the views only of the authors, and the Commission cannot be held responsible for any use which may be made of the information contained therein.*

The „DigiS“ project – „Building up a Digital Skills Alliance for the Enhancing of Programming Competencies“ – is co-funded by the Erasmus+ programme of the European Union under the Grant Agreement No. 621690-EPP-1-2020-1-CZ-EPPKA2-SSA.

## Methodology

The aim of this part of the text is to describe the content of individual items and the methodological basis for why they contain given text. Our aim below is to explain what the individual chapters' titles mean, why we proceeded in the way and what we want to achieve.

*Vocational qualification* is defined as “the ability of a person to properly perform a certain work activity or a set of work activities in a certain profession, or in two or more professions”. The sets of activities defined in this way are usually more briefly defined than the specific occupations for which the so-called "Job Description" is defined and which allow a certain professional fulfilment. The definition of the professional qualification is based on the "Job Description" - see separate files.

Each *vocational qualification* has its own *qualification standard* and *evaluation standard*.

A *qualification standard* is a structured description of the professional competence of a person for the proper performance of a certain work activity or set of work activities in a certain profession, or in two or more professions. The *qualification standard* determines what knowledge and skills the applicant should have in the given profession. The *qualification standard* is defined by the so-called vocational qualification, which introduces professional competence.

An *assessment standard* is defined as “a set of criteria and organizational and methodological procedures established for verifying the attainment of professional competence to perform a certain work activity properly or a set of work activities in a certain profession, or in two or more ones”. The assessment standard of a professional qualification sets out how to verify whether an applicant for a certain professional qualification meets the requirements (i.e. competences) set for this qualification in its qualification standard. The *assessment standard* follows the qualification standard and determines the evaluation criteria and methods of verification of individual requirements (i.e. competencies) of the qualification standard. While competencies describe what a candidate must demonstrate, the evaluation criteria describe how to prove it. The *assessment standard* is further defined by the *evaluation criteria* and the *method of verification*.

When formulating the evaluation criteria, it is necessary to respect their clarity and feasibility in order an examiner be able to decide whether or not the examinee has validated competence, not to allow more possible interpretations, to be verifiable and applicable in each evaluation as much as possible and not to allow striking differences in test claims.

The criteria must be formulated in a comprehensible manner so that they are clear to both the examiners and the examinees and, at the same time, ensuring whether or not the examinee has met a criterion. The criteria can be focused both on the process, i.e. on the verification of how the examinee performs the assigned task, and on the result, i.e. on the verification of what the examinee performed, executed or created.

While an abbreviation UAV stands for “Unmanned Aircraft Vehicle” and is equivalent to term “drone”, an abbreviation UAS stands for “Unmanned Aircraft System” and represents a complex system consisting of UAVs, Ground control stations and other subsystems.

Therefore, the position has been renamed as “UAS Developer and Operator”.

## 1 Qualification standard

### 1.1 Vocational knowledge and skills

- Analysis and algorithmization of practical tasks
- Ability to understand hardware of UAS and software architecture
- Development of UAS solution
- Data processing of UAS solution generated data
- Development of simulation and testing environment
- Processing systemic documentation of development process of UAS solution
- Implementation of a developed UAS solution into operation at a customer's environment
- Development of end user documentation and training programs
- Designing standard UAS operations processes
- Ability to operate a specified drone / UAS system
- Ability to operate in multirole cooperative environment
- Knowledge of regulatory framework for UAS operations
- Health conditions based on national requirements

### 1.2 Digital competences

- Analysing of customers' needs, conditions and environment
- Principles of system software and hardware architecture
- Principles of programming and programming languages
- Informatics and characteristics of information systems
- Understanding of hardware and software systems
- Tasks' algorithmization
- Integrated development environment, software's testing and localization, operating systems
- Principles of hardware and software integration and communication
- Software tools for system simulations

### 1.3 General skills

- Computer skills
- System automation knowledge
- Maths and physics knowledge
- Meteorological knowledge
- Economic knowledge
- Legal knowledge

- Language proficiency in national language
- Language proficiency in English language

#### 1.4 Soft skills

- Flexibility
- Autonomy
- Problem solving
- Systematic approach
- Following standard procedures and rules
- Lifetime learning
- Stress tolerance
- Active approach
- Team cooperation
- Effective communication
- Customer orientation
- Safety orientation
- Work planning and organizing
- Search capabilities and orientation in information
- Open and honest feedback
- Respect to values and individuals

## 2 Assessment standard

In Assessment standard can be found description of single vocational competences, their evaluation criteria and methods of knowledge verification.

### 2.1 Vocational competence

Overall overview of all vocational abilities:

- Analysis and algorithmization of practical tasks
- Ability to understand hardware of UAS and software architecture
- Development of UAS solution
- Data processing of UAS solution generated data
- Development of simulation and testing environment
- Processing systemic documentation of development process of UAS solution
- Implementation of a developed UAS solution into operation at a customer's environment
- Development of end user documentation and training programs
- Designing standard UAS operations processes
- Ability to operate a specified drone / UAS system
- Ability to operate in multirole cooperative environment
- Knowledge of regulatory framework for UAS operations
- Health conditions based on national requirements

#### 2.1.1 Analysis and algorithmization of practical tasks

Evaluation criteria	Method of verification
<p><i>Carry out analysis of the needs and goals of the practical assignment:</i></p> <ul style="list-style-type: none"> <li>• Analyse time responses of the algorithms;</li> <li>• Decompose systems to individual functional blocks and their reciprocal data interfaces;</li> <li>• Propose list of needed constants and variables including data types;</li> <li>• Specify quantities that can be parametrized</li> </ul> <p><i>Carry out task's algorithmization:</i></p> <ul style="list-style-type: none"> <li>• Propose flow diagrams for single functional blocks;</li> <li>• Determine priorities of realization and sequences of the functional blocks.</li> </ul>	<p>Practical demonstration and/or oral verification and/or written verification (depending on national regulations)</p>
<p><i>Student has to be prepared to demonstrate knowledge of all criteria but will be examined based on instructions provided by examiner.</i></p>	

### 2.1.2 Ability to understand hardware of UAS and software architecture

Evaluation criteria	Method of verification
<p><i>Propose suitable hardware and software architecture for specific business scenario:</i></p> <ul style="list-style-type: none"> <li>• Propose decomposition into functional blocks</li> <li>• Propose communication links between blocks</li> <li>• Define interfaces</li> </ul> <p><i>Complete system analysis regarding:</i></p> <ul style="list-style-type: none"> <li>• Efficiency and expected performance</li> <li>• Reliability in production environment</li> <li>• Maintainability in production environment</li> <li>• Suitability for production environment</li> <li>• Costs of ownership</li> <li>• Regulatory implications</li> </ul> <p><i>Development tools' update:</i></p> <ul style="list-style-type: none"> <li>• Search for needed version of development tool for given SW and HW development.</li> </ul>	<p>Practical demonstration and/or oral verification and/or written verification (depending on national regulations)</p>
<p><i>Student has to be prepared to demonstrate knowledge of all criteria but will be examined based on instructions provided by examiner.</i></p>	

### 2.1.3 Development of UAS solution

Evaluation criteria	Method of verification
<p><i>Propose high level UAS solution for specific business scenario:</i></p> <ul style="list-style-type: none"> <li>• Define expected solution outputs and characteristics towards end user requirements</li> <li>• Define functional diagram of UAS and other involved systems functional blocks</li> <li>• Define interfaces / protocols between blocks</li> <li>• Define system operational requirements</li> </ul> <p><i>Complete system analysis regarding:</i></p> <ul style="list-style-type: none"> <li>• Efficiency and expected performance</li> <li>• Reliability in production environment</li> <li>• Maintainability in production environment</li> <li>• Suitability for production environment</li> <li>• Costs of ownership</li> </ul>	<p>Practical demonstration and/or oral verification and/or written verification (depending on national regulations)</p>

- Regulatory compliance.

*Student has to be prepared to demonstrate knowledge of all criteria but will be examined based on instructions provided by examiner.*

#### 2.1.4 Data processing of UAS solution generated data

Evaluation criteria	Method of verification
<p><i>Propose process for specific UAS output data transformation into user required information:</i></p> <ul style="list-style-type: none"> <li>• Define other required data sources</li> <li>• Define functional diagram</li> <li>• Define algorithms</li> <li>• Define final output for end user</li> <li>• Define system operational requirements</li> </ul> <p><i>Complete system analysis regarding:</i></p> <ul style="list-style-type: none"> <li>• Efficiency and expected performance</li> <li>• Reliability in production environment</li> <li>• Maintainability in production environment</li> <li>• Suitability for production environment</li> <li>• Costs of ownership</li> <li>• Regulatory compliance.</li> </ul>	<p>Practical demonstration and/or oral verification and/or written verification (depending on national regulations)</p>
<p><i>Student has to be prepared to demonstrate knowledge of all criteria but will be examined based on instructions provided by examiner.</i></p>	

#### 2.1.5 Development of simulation and testing environment

Evaluation criteria	Method of verification
<p><i>Propose simulation and testing environment for specific UAS solution:</i></p> <ul style="list-style-type: none"> <li>• Define testing objectives</li> <li>• Define testing scenarios</li> <li>• Propose simulation and testing approach</li> <li>• Propose simulation and testing technologies tools</li> <li>• Define functional diagram</li> <li>• Define interfaces / protocols</li> <li>• Define system operational requirements</li> </ul> <p><i>Complete system analysis regarding:</i></p>	<p>Practical demonstration and/or oral verification and/or written verification (depending on national regulations)</p>

<ul style="list-style-type: none"> <li>• Efficiency and expected performance</li> <li>• Reliability in production environment</li> <li>• Maintainability in production environment</li> <li>• Suitability for production environment</li> <li>• Costs of ownership</li> <li>• Regulatory compliance.</li> </ul>	
<p><i>Student has to be prepared to demonstrate knowledge of all criteria but will be examined based on instructions provided by examiner.</i></p>	

### 2.1.6 Processing systemic documentation of development process of UAS solution

<b>Evaluation criteria</b>	<b>Method of verification</b>
<p><i>Define process of development documentation of proposed UAS solution:</i></p> <ul style="list-style-type: none"> <li>• Define documentation objectives;</li> <li>• Define subprocess for documentation of end user requirements</li> <li>• Define subprocess for development project management</li> <li>• Define subprocess for both software and hardware development tracking</li> <li>• Define subprocess for change management and upgrade / update deployment</li> <li>• Define subprocess for end user documentation development</li> <li>• Define subprocess for end user trainings programs development</li> </ul> <p><i>Complete system analysis regarding:</i></p> <ul style="list-style-type: none"> <li>• Efficiency and expected performance</li> <li>• Reliability in development environment</li> <li>• Maintainability in development environment</li> <li>• Suitability for development environment</li> <li>• Costs of ownership</li> <li>• Regulatory compliance.</li> </ul>	<p>Practical demonstration and/or oral verification and/or written verification (depending on national regulations)</p>
<p><i>Student has to be prepared to demonstrate knowledge of all criteria but will be examined based on instructions provided by examiner.</i></p>	

### 2.1.7 Implementation of a developed UAS solution into operation at a customer's environment

<b>Evaluation criteria</b>	<b>Method of verification</b>



<p><i>Propose implementation process for specific UAS solution into customer's environment:</i></p> <ul style="list-style-type: none"> <li>• Define customer business requirements and expectations</li> <li>• Define implementation objectives</li> <li>• Define acceptance requirements</li> <li>• Propose implementation approach</li> <li>• Define solution functional diagram</li> <li>• Define interfaces to 3<sup>rd</sup> party systems involved</li> <li>• Define system operational requirements</li> </ul> <p><i>Complete system analysis regarding:</i></p> <ul style="list-style-type: none"> <li>• Efficiency and expected performance</li> <li>• Reliability in production environment</li> <li>• Maintainability in production environment</li> <li>• Suitability for production environment</li> <li>• Costs of ownership</li> <li>• Regulatory compliance.</li> </ul>	<p>Practical demonstration and/or oral verification and/or written verification (depending on national regulations)</p>
<p><i>Student has to be prepared to demonstrate knowledge of all criteria but will be examined based on instructions provided by examiner.</i></p>	

### 2.1.8 Development of end user documentation and training programs

<b>Evaluation criteria</b>	<b>Method of verification</b>
<p><i>Design and prepare end user documentation of specific UAS solution:</i></p> <ul style="list-style-type: none"> <li>• Define objectives of end user documentation</li> <li>• Define end user documentation approach</li> <li>• Define end user documentation structure</li> <li>• Define tools for end user documentation development</li> <li>• Define process for end user documentation updates and version control</li> <li>• Discuss regulatory compliance</li> </ul> <p><i>Design and prepare structure of end user training:</i></p> <ul style="list-style-type: none"> <li>• Define objectives of end user training</li> <li>• Define end user training approach</li> <li>• Define end user training structure</li> <li>• Define tools for end user training development</li> <li>• Define process for end user training updates and version</li> </ul>	<p>Practical demonstration and/or oral verification and/or written verification (depending on national regulations)</p>

control <ul style="list-style-type: none"> <li>• Discuss regulatory compliance.</li> </ul>	
<i>Student has to be prepared to demonstrate knowledge of all criteria but will be examined based on instructions provided by examiner.</i>	

### 2.1.9 Designing standard UAS operations processes

Evaluation criteria	Method of verification
<i>Design standard process how to operate specific UAS solution:</i> <ul style="list-style-type: none"> <li>• Define objectives of operation process</li> <li>• Define operations process approach</li> <li>• Define operations process schema</li> <li>• Define operations process roles and responsibilities</li> <li>• Define detailed operations activities</li> <li>• Define safety requirements and rules</li> <li>• Define process improvement procedures</li> <li>• Discuss regulatory compliance.</li> </ul>	Practical demonstration and/or oral verification and/or written verification (depending on national regulations)
<i>Student has to be prepared to demonstrate knowledge of all criteria but will be examined based on instructions provided by examiner.</i>	

### 2.1.10 Ability to operate a specified drone / UAS system

Evaluation criteria	Method of verification
<i>Demonstrate knowledge to operate specific drone / UAS solution:</i> <ul style="list-style-type: none"> <li>• Describe system typical scope of operations</li> <li>• Describe system functional blocks</li> <li>• Describe system user flight control subsystem</li> <li>• Describe system telemetry data and other data outputs</li> <li>• Describe system operational limits</li> <li>• Describe system performance</li> <li>• Describe system operations procedures, checklists etc.</li> <li>• Describe system operations safety rules</li> <li>• Describe system maintenance</li> <li>• Describe regulatory implications for system operations</li> </ul>	Practical demonstration and/or oral verification and/or written verification (depending on national regulations)
<i>Demonstrate practical ability to operate specific drone / UAS solution on specific mission:</i>	

<ul style="list-style-type: none"> <li>• Conduct mission briefing</li> <li>• Conduct mission in compliance with system operations procedures, regulatory and local Civil Aviation Authority rules and requirements</li> <li>• Conduct mission debrief</li> <li>• Prepare mission required end user outputs in expected format.</li> </ul>	
---	--

*Student has to be prepared to demonstrate knowledge of all criteria but will be examined based on instructions provided by examiner.*

### 2.1.11 Ability to operate in multirole cooperative environment

Evaluation criteria	Method of verification
<p><i>Demonstrate practical ability in simulation environment to:</i></p> <ul style="list-style-type: none"> <li>• Tolerate stress on mission</li> <li>• Maintain desired level of situational awareness</li> <li>• Maintain desired level of performance</li> <li>• Maintain desired level of reliability</li> <li>• Maintain desired level of decision making</li> <li>• Maintain desired level of prioritization</li> <li>• Maintain desired level of standard of communication</li> <li>• Maintain desired level of error management.</li> </ul>	Practical demonstration (depending on national regulations)

*Student has to be prepared to demonstrate knowledge of all criteria but will be examined based on instructions provided by examiner.*

### 2.1.12 Knowledge of regulatory framework for UAS operations

Evaluation criteria	Method of verification
<p><i>Demonstrate of regulatory framework:</i></p> <ul style="list-style-type: none"> <li>• Describe current regulatory framework</li> <li>• Asses regulatory implications for proposed mission scenario</li> <li>• Describe regulatory implications for UAS operator organisation</li> </ul> <p>Prepare risk assessment for proposed mission scenario.</p>	Oral verification and/or written verification (depending on national regulations)

*Student has to be prepared to demonstrate knowledge of all criteria but will be examined based on instructions provided by examiner.*

### 2.1.13 Health conditions based on national requirements

Evaluation criteria	Method of verification
<p><i>Demonstrate health conditions:</i></p> <p>Provide current certificate of health conditions assessment issued by authorized body – Medical certificate <b>based on national requirements</b>.</p>	<p>Current medical certificate based on national requirements</p>
<p><i>Student has to be prepared to demonstrate knowledge of all criteria but will be examined based on instructions provided by examiner.</i></p>	

## 2.2 Instructions for carrying out exams

The authorized person shall inform which documents the candidate must submit in order for the examination to take place in accordance with the applicable legal regulations. Before starting the self-verification, the examinee must get acquainted with the requirements of safety and health at work and fire protection, about which a written record will be prepared by an authorized person and signed by the examinee. Medical fitness to perform the work activities of this professional qualification is advised based on country specifications.

Verification of specified competencies consists in verifying the candidate's ability to perform the specified operation according to the specified work procedure, to properly perform activities related to UAS operations, including demonstrated mission execution in the field and multirole cooperation performance assessment in simulated environment.

- Written part of the exam can be either test or elaboration of the more complex task.
- Oral part of the exam is usually designed as a structured interview that can be accompanied with questions related to written part of the exam.
- Practical part of the exam should consist of selection of the task(s) by examinee, preparation for their fulfilment and subsequent execution.

Student has to be prepared to demonstrate knowledge of all criteria but will be examined based on instructions provided by examiner. It is expected the course of exam in a way that the examinee will randomly draw one or more topics from the vocational competencies. Depending on national regulations, it is recommended to limit the number of the vocational competencies at the exam between 2-4.

Methods of verification are indicative and their choice and their combination depends on habitual practice in a country/school where exam is carried out.

## 2.3 Final assessment

The examiner evaluates the examinees based on national requirements and result is entered into document about course and result of the exam. The final assessment for a given competence must be "passed" or "failed". The final assessment of the whole exam is either "passed" if the candidate has met all competencies, or "failed" if the candidate has not fulfilled some of the competencies. When evaluating results in "failed", the examiner always states the justification, which the candidate acknowledges with his / her signature.

## 2.4 Number of examiners

The exam takes place in front of authorized person(s) based on national requirements; the examiner is authorized for the relevant professional qualification or he/she is authorized representative of an authorized physical or legal entity, authorized to test relevant professional qualification.

## 2.5 Requirements regarding vocational competence of the authorized person resp. a representative of the authorized person

It is recommended that an authorized person, resp. the authorized representative of the authorized person should meet at least one of the following variants of requirements (depending on national regulations and availability):

- Secondary education with an apprenticeship certificate in the field of education focused on Electrical engineering + at least 5 years of professional experience in the field of Electrical engineering or demonstrable experience as a teacher of practical teaching at secondary schools or colleges in the field of SW programming.
- Secondary education with an apprenticeship certificate in the field of education focused on Electrical engineering and secondary education with a school-leaving examination + at least 5 years of professional experience in the field of Electrical engineering or as a teacher of practical teaching or professional training in the field of Electrical engineering.
- Secondary education with a school-leaving examination in the field of education focused on Electrical engineering + at least 5 years of professional experience in the field of Electrical engineering or as a teacher of practical teaching or professional training in the field of Electrical engineering.
- University education in the study program Electrical engineering + at least 5 years of professional experience in operation or in a section including a workplace with activities in the field of Electrical engineering or as a teacher of professional subjects in the field of Electrical engineering.

## 2.6 Further requirements

Authorized person, resp. authorized representative of an authorized person that does not have a professional qualification of a pedagogical worker or does not have a professional qualification or experience in adults' education (including practice in examining) or does not have a certificate of professional qualification, must be able to organize the examination process including evaluation on PC and issue unified certificate (submission of statutory declaration is satisfactory). The applicant for an authorization shall demonstrate compliance with the requirements for professional competence by submitting a document or a set of documents on the acquisition of professional competence to the authorizing body or by another procedure specified by the authorizing body.

## 2.7 Material and technical necessities for exam completion

It is recommended for a workplace focused on teaching flying with UAS and related software programming that should dispose of the following equipment:

- PC series or Mac series computer
- UAS for teaching and exams
- Auxiliary equipment for installation on drones (cameras, sensors and so on) including tools
- Hardware and software environment for simulations and tests
- Protective aids to ensure work safety

- Room for the written part of the exam
- Stationery and paper

Authorized person, resp. the authorized representative of the authorized person must ensure that the workplace is arranged and equipped so that the working conditions for the execution of the exam in terms of safety and health at work and fire protection correspond to safety requirements and hygienic limits for the working environment. The authorized person shall attach to the application for authorization a list of material and technical equipment demonstrating compliance with the requirements specified in the assessment standard for the purposes of the exam. The authorized person proves the provision of suitable premises for the examination by an appropriate document (e.g. extract from the real estate cadastre, lease agreement, an agreement) enabling their use for the period of validity of the authorization.

## 2.8 Pre-exam time

The examinee is entitled to prepare for an exam within 45 minutes for every day. The time of preparation for the exam does not include the time devoted to familiarization with the place where exam takes place and to instructions related to the requirements of occupational health and safety and fire safety.

## 2.9 Exam time

Total exam time for one examinee is usually 1-4 hours (excluding breaks and pre-exam time) this matter will be specified with regard to the national requirements. One hour is usually 45 up to 60 minutes. Exam can be split into more days if needed.