DRIVES

Development and Research on Innovative Vocational Education Skills

# Functional Safety Engineer

Job Role Skill Set

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

Development and Research on Innovative Vocational Skills -DRIVES – Project number 591988-EPP-1-2017-1-CZ-EPPKA2-SSA-B

# DOCUMENT TITLE

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|---|---|---|---|
| Report Title: | Functional Safety Engineer Job Role Skill Set | | |
| Author(s): | Dr. Richard Messnarz | | |
| Responsible Project Partner: | ISCN | Contributing Project Partners: | ISCN, TU-Graz |

| | | | | |
|---|---|---|---|---|
| Document data: | Status: | (draft/final) | Dissemination level: | Public |
| Project title: | Development and Research on Innovative Vocational Educational Skills | | GA No.: | 2017-3295/001-001. |
| WP title: | WP3 – Skills Framework | | Project No.: | 591988-EPP-1-2017-1-CZ-EPPKA2-SSA-B |
| | | | Deliverable No: | D3.1 |
| | | | Submission date: | 30/04/2020 |
| Keywords: | automotive sector, skill card, skill set, job roles, ECTS, ECVET | | | |
| Reviewed by: | Damjan Ekert (Formal Review) | | Review date: | 30/04/2020 |
| | | | Review date: | |
| Approved by: | Anke Blume<br>Richard Messnarz | | Approval date: | 30/04/2020 |

More information about DRIVES project and contact:

www.project-drives.eu

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# 1 INTRODUCTION

## 1.1 OBJECTIVE

The objective of this deliverable is to provide an introduction to described Job Role within the applied skills definition model.

## 1.2 PURPOSE OF THE DELIVERABLE

The purpose of this deliverable is to define skills definitions of the Functional Safety Engineer job role within the ECQA skills definition model.

## 1.3 SCOPE OF THE DELIVERABLE

The deliverable contains

- Description of the content of the Job Role
- Description of used Skill Sets and skills definitions, coverage of Qualification Schemas

The deliverable does not cover:

- Course development, as this will be done after the skill definitions clearly outlined the set of required courses.

# 2 ECQA SKILLS DEFINITION MODEL

A skills definition contains the following items (see **Fehler! Verweisquelle konnte nicht gefunden werden.**):

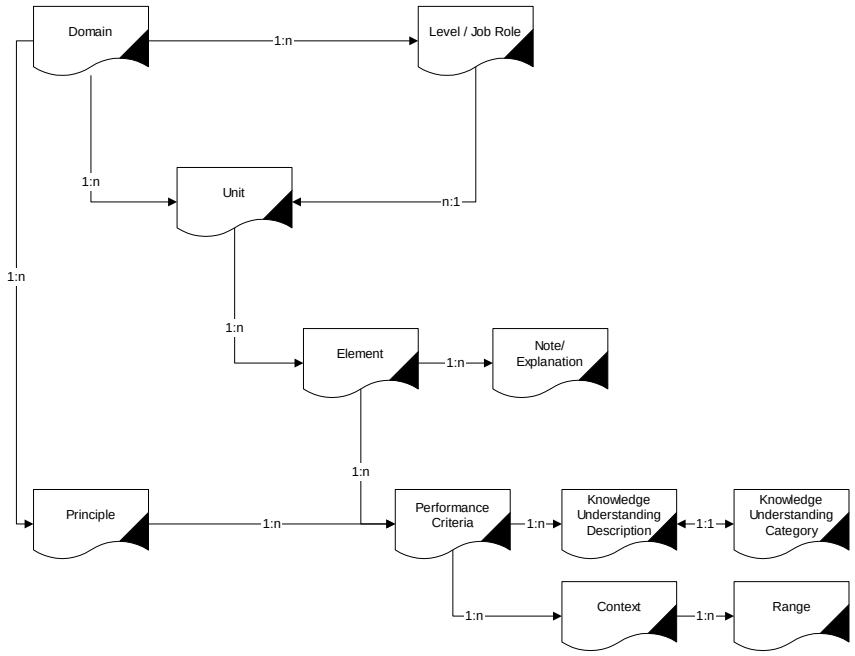


**Figure 1: The Skill Definition Model (1:n = one to many relationship)**

**Context**: A category of ranges; it represents some terminology used in a performance criterion that consists of different context, conditions or circumstances. A participant must be able to prove competence in all the different circumstances covered by the context.

**Domain**: An occupational category, e.g. childcare, first level management or software engineering.

**Element:** Description of one distinct aspect of the work performed by a worker, either a specific task that the worker has to do or a specific way of working. Each element consists of a number of performance criteria.

**Evidence:** Proof of competence.

**Knowledge and understanding category:** A category of knowledge and understanding descriptions.

**Knowledge and understanding description:** A description of certain knowledge and understanding. To be judged competent in a unit a participant must prove to have and to be able to apply all the knowledge and understanding attached to it.

**NVQ (UK based):** The National Vocational Qualification standard of England, Wales and N. Ireland.

**Performance criterion:** Description of the minimum level of performance a participant must demonstrate in order to be assessed as competent. A performance criterion may have relevant contexts.

**Principle:** A statement of good intentions; it underpins all competent domain practice.

**Range:** Description of a specific circumstance and condition of a performance criterion statement.

**Qualification:** The requirements for an individual to enter, or progress within a certain occupation.

**Job Role**: A certain profession that covers part of the domain knowledge. E.g. domain = Functional Safety, job role = Functional Safety Manager.

**Unit:** A list of certain activities that have to be carried out in the workplace. It is the top-level skill in the UK qualification standard hierarchy and each unit consists of a number of elements.

The rationales for developing the ECQA skills definition model is based on the skills definition proposed by the DTI (Department of Trade and Industry) in the UK for the NVQ (National Vocational Qualification) standards. These models have been re-used and slightly modified by other countries when they started employing skill cards [1], [2].

ECQA standards are used to describe the skills sets delivered within the DRIVES project (www.project-drives.eu). Further description and rationales are attached in annexes of this document. The ECQA structure was mapped in DRIVES project to DRIVES Reference and Recognition Framework with the links to ESCO[7], EQF[8], ECTS[9] and ECVET[10]. See more in deliverable DRIVES-D4.1.1 Reference and Recognition Framework – Analysis.pdf (www.project-drives.eu).

# 3 SKILLS DEFINITION FOR THE JOB ROLE FUNCTIONAL SAFETY ENGINEER

## 3.1 THE SKILLS HIERARCHY

Using the terminology outlined in the skills definition model and including the skills identified in the "Functional Safety Manager (SafEUr)" project and in the working party SOQRATES (www.soqrates.de), the job roles for functional safety have been defined.

1. Functional Safety Manager Strategy Level
2. Functional Safety Project Manager
3. Functional Safety Engineer

The overall set of units and elements for functional safety have also been assigned to levels of skills (awareness, practitioner, expert level), see Fig. 2 below.

| Elements of the training and skill set of the job role | Functional Safety Manager Strategy Level | Functional Safety Project Manager | Functional Safety Engineer |
|---|---|---|---|
| Unit 1 - Functional Safety Strategy | | | |
| U1.E1 Motivation and Introduction to Functional Safety | awareness | | |
| U1.E2 Hazard and Risk Analysis and Safety Goals | awareness | | |
| U1.E3 Impact of Functional Safety on Product Design and Cost | awareness | | |
| Unit 2 - Management of Functional Safety | | | |
| U2.E1 Safety management on organisational level | | expert | |
| U2.E2 Safety Case Definition | | expert | |
| U2.E3 Overview of Required Engineering and V&V Methods | | practitioner | expert |
| U2.E4 Safety management on project level | | expert | |
| Unit 3 - Engineering aspects of Functional Safety | | | |
| U3.E1 Implementing System Hazard Analysis and Safety Concept | | practitioner | expert |
| U3.E2 Integrating Safety in System Design & Test | | awareness | expert |
| U3.E3 Integrating Safety in Hardware Design & Test | | awareness | expert |
| U3.E4 Integrating Safety in Software Design & Test | | awareness | expert |
| Unit 4 - Safety on Product Level | | | |
| U4.E1 Reliability in design on product and system level | | practitioner | expert |
| U4.E2 Safety in the Production, Operation and Maintenance | | expert | practitioner |
| Unit 5 - Legal Aspects and Qualification | | | |
| U5.E1 Legal aspects and Liabilities | | expert | |
| U5.E2 Regulatory & Qualification Requirements | | expert | |

**Figure 2: The Skills Set for ECQA Certified Functional Safety Roles**

In this document we describe the skills set for the Functional Safety Engineer.

## 3.2 THE SKILLS DESCRIPTIONS –FUNCTIONAL SAFETY ENGINEER JOB ROLE

**Domain Acronym:** Engineering

**Domain title**: Functional Safety

**Domain Description**:

Functional safety of modern products and industry systems containing embedded systems has become a first priority in several industrial sectors. The IEC61508 group of standards require companies to have in place "Functional Safety Management". Domain specialized standards like ISO 26262 for the passenger cars complement IEC 61508. The objective of SafEUr is to create a European-wide accredited training and certification program for Functional Safety Managers, based on a skill card which is compliant to the European Qualification Framework. SafEUr delivers modern e-learning based training that is based on practical case studies and best industry practices. This training will be complemented by a world-wide unique web-based integration platform for industry and academia in the domain of Embedded Systems. Certified SafEUr trainers are available all across Europe, assuring a major impact and sustainability of this ECQA job role.

SafEUr developed a Europe-wide agreed syllabus and skills set for a Certified Functional Safety Manager with a clear focus on practice. The need for qualified safety personnel is obvious, also the need for a commonly agreed skills set for a Functional Safety Manager. As SafEUr is designed as a modular course, a trainee can attend course Units and Elements separately and independently, although it is recommended to attend the entire SafEUr course.

In the DRIVES project (2018 – 2021) the former ECQA Functional Safety Manager job role has been updated and split into three job roles based on a jointly used skills hierarchy. Please compare with figure 8 above.

1. Functional Safety Manager Strategy Level
2. Functional Safety Project Manager
3. Functional Safety Engineer

Please note that this rework of the SafEUr skills card and the development of the MOOC training for the Functional Safety Manager Strategy Level has been performed within the DRIVES project.

**Job Role Acronym:** SAFEUR

**Job Role Title**: Functional Safety Engineer

**Description**:

The Skill card comprises the following thematic learning units, and learning elements

1. Unit 2 - Management of Functional Safety
    a. U2.E3 Overview of Required Engineering and V&V Methods (expert)

2. Unit 3 - Engineering aspects of Functional Safety
    a. U3.E1 Implementing System Hazard Analysis and Safety Concept (expert)
    b. U3.E2 Integrating Safety in System Design & Test (expert)
    c. U3.E3 Integrating Safety in Hardware Design & Test (expert)
    d. U3.E4 Integrating Safety in Software Design & Test (expert)
3. Unit 4 - Safety on Product Level
    a. U4.E1 Reliability design on product and system level (expert)
    b. U4.E2 Safety in the Production, Operation and Maintenance (practitioner)

## 3.3 UNIT SAFEUR.U2 MANAGEMENT OF FUNCTIONAL SAFETY

**Acronym**: SAFEUR.U2

**Title:** Management of Functional Safety

**Description:**

This unit investigates major management aspects of functional safety engineering on organisational and project level. The definition and management of so-called Safety Cases assumes a central role in the functional safety management activities, as safety cases are at the root of modern functional safety engineering methods.

### 3.3.1 Unit SAFEUR.U2 - Element 3: Overview of Required Engineering and V&V Methods

**Acronym:** SAFEUR.U2.E3

**Element Title**: Overview of Required Engineering and V&V Methods

**Element Note**:

This element investigates methods for engineering, validation and verification (V&V) that are required to implement functional safety on a project / product / system level.

**Performance Criteria**:

The student must be able to show evidence of competencies for the following performance criteria (PC):

| Performance Criterion | Evidence Check: The student can demonstrate |
|---|---|
| **SAFEUR.U2.E3.PC1** | The student is able to select the right engineering and, validation and verification approaches based on the provided method tables, the identified safety integrity level and the product architecture. |

| Performance Criterion | Evidence Check: The student can demonstrate |
|---|---|
| **SAFEUR.U2.E3.PC2** | The student is able to set up a V&V Plan which covers all necessary validation and verification activities during the design and test phases, and evidences of 100% functional safety coverage /compliance. |
| **SAFEUR.U2.E3.PC3** | The student is able to practically understand and implement safety related testing, such as fault injection testing, diagnostic coverage testing, equivalence class testing, load testing, branch coverage in testing, and more. |
| **SAFEUR.U2.E3.PC4** | The student is able to draw up a compliance map demonstrating the use of qualified tools and qualified engineering methods as part of the safety plan. |

**Table 1: Performance Criteria for the Element SAFEUR.U2.E3**

## 3.4 UNIT SAFEUR.U3 ENGINEERING ASPECTS OF FUNCTIONAL SAFETY

**Acronym**: SAFEUR.U3

**Title:** Engineering aspects of Functional Safety

**Description:**

This unit is the essential complement of Unit 2, i.e., the unit covering the management aspects of functional safety. Its main objective is to bridge the gap between the theoretical standards, and the practical implementation of the latter's rules and requirements. This is considered the main particularity that distinguishes SafEUr from com-parable trainings in the same field.

### 3.4.1 Unit SAFEUR.U3 - Element 1: Implementing System Hazard Analysis and Safety Concept

**Acronym:** SAFEUR.U3.E1

**Element Title**: Implementing System Hazard Analysis and Safety Concept

**Element Note**:

This element addresses the building blocks at the very basis of every functional safety engineering project: the identification of hazards, and the establishment of a safety concept.

**Performance Criteria**:

The student must be able to show evidence of competencies for the following performance criteria (PC):

| Performance Criterion | Evidence Check: The student can demonstrate |
|---|---|
| **SAFEUR.U3.E1.PC1** | The student is able to explain the differences between the standards IEC 61508, ISO 26262 and ISO 13849 regarding their hazard- and risk-analysis. |
| **SAFEUR.U3.E1.PC2** | The student is able to explain the terms harm, hazard, hazardous event, severity, exposure, controlability, risk, safety goal, hazard analysis and risk assessment, reasonably foreseeable event. The student can give examples of his/her own domain. |
| **SAFEUR.U3.E1.PC3** | The student is able to explain an environment in which his system runs and can describe his item definition. |
| **SAFEUR.U3.E1.PC4** | The student is able to explain the difference of functional and non-functional behaviour of his system. |
| **SAFEUR.U3.E1.PC5** | The student is able to moderate a system analysis and hazard identification. The student is able to provide a template for a development department to give guidelines for the discussion. |

**Table 2: Performance Criteria for the Element SAFEUR.U3.E1**

### 3.4.2 Unit SAFEUR.U3 - Element 2: Integrating Safety in System Design & Test

**Acronym:** SAFEUR.U3.E2

**Element Title**: Integrating Safety in System Design & Test

**Element Note**:

This element looks at the integration of safety aspects in system design and test.

**Performance Criteria**:

The student must be able to show evidence of competencies for the following performance criteria (PC):

| Performance Criterion | Evidence Check: The student can demonstrate |
|---|---|
| **SAFEUR.U3.E2.PC1** | The student is able to explain the terms availability, reliability, safe state, verification criteria |
| **SAFEUR.U3.E2.PC2** | The student is able to understand and show the allocation of subsystems to his systems requirements and system design. |
| **SAFEUR.U3.E2.PC3** | The student is able to explain the difference between system requirements and system design, and functional safety |

| Performance Criterion | Evidence Check: The student can demonstrate |
|---|---|
| | requirements and technical safety requirements. Student is able to explain the link between system requirements and system test. |
| **SAFEUR.U3.E2.PC4** | The student is able to show a signal path and its influence on his system design. He can show the link between system design and system integration test. |
| **SAFEUR.U3.E2.PC5** | The student is able to describe a state machine on system level and allocate time slots for the subsystems on the safety critical path for the identified system reaction time. |

**Table 3: Performance Criteria for the Element SAFEUR.U3.E2**

### 3.4.3 Unit SAFEUR.U3 - Element 3: Integrating Safety in Hardware Design & Test

**Acronym:** SAFEUR.U3.E3

**Element Title**: Integrating Safety in Hardware Design & Test

**Element Note**:

This element focuses on hardware issues in system design and test.

**Performance Criteria**:

The student must be able to show evidence of competencies for the following performance criteria (PC):

| Performance Criterion | Evidence Check: The student can demonstrate |
|---|---|
| **SAFEUR.U3.E3.PC1** | The student is able to explain the terms Failure, Fault, Error, Reliability, failure rate. The student can give examples of his/her own domain. |
| **SAFEUR.U3.E3.PC2** | The student is able to allocate safety goals with (A)SIL levels to the elements of a hardware architecture. |
| **SAFEUR.U3.E3.PC3** | The student is able to to explain the basic terms of modelling HW fault tolerance (Reliability, failure rate – FIT, MTTF, etc.) and select the right modelling strategy for hardware fault tolerance. |
| **SAFEUR.U3.E3.PC4** | The student is able to calculate and evaluate hardware safety metrics: architectural (Single-Point Failure Metric, Latent Failure Metric) and random hardware failure metrics |

| Performance Criterion | Evidence Check: The student can demonstrate |
|---|---|
| **SAFEUR.U3.E3.PC5** | The student is able to devise the appropriate hardware tests based of the chosen hardware design. |

Table 4: Performance Criteria for the Element SAFEUR.U3.E3

### 3.4.4 Unit SAFEUR.U3 - Element 4: Integrating Safety in Software Design & Test

**Acronym:** SAFEUR.U3.E4

**Element Title**: Integrating Safety in Software Design & Test

**Element Note**:

This element focuses on software issues in system design and test.

**Performance Criteria**:

The student must be able to show evidence of competencies for the following performance criteria (PC):

| Performance Criterion | Evidence Check: The student can demonstrate |
|---|---|
| **SAFEUR.U3.E4.PC1** | The student is able to understand the design of a safety-critical signal path in the software architecture |
| **SAFEUR.U3.E4.PC2** | The student is able to understand different software architectural measures to cover Level-2 and Level-3 diagnosis based on E-Gas reference model |
| **SAFEUR.U3.E4.PC3** | The student is able to understand how to specify a diagnosis matrix covering all safety diagnosis functions required to achieve the diagnostic coverage |
| **SAFEUR.U3.E4.PC4** | The student is able to understand strategies for plausibility checks, voting, and diversity |
| **SAFEUR.U3.E4.PC5** | The student is able to develop software tests (e.g. fault injection) on the hardware target to show the diagnostic coverage |
| **SAFEUR.U3.E4.PC6** | The student knows the basic software test methods and is able to select the appropriated test methods for SW unit test, SW integration and SW test. |

Table 5: Performance Criteria for the Element SAFEUR.U3.E4

## 3.5 UNIT SAFEUR.U4 SAFETY ON PRODUCT LEVEL

**Acronym**: SAFEUR.U4

**Title:** Safety on Product Level

**Description:**

The Unit addresses reliability and safety engineering aspects for integrated product design, and covers as well the required safety control mechanisms in production and maintenance.

### 3.5.1 Unit SAFEUR.U4 - Element 1: Reliability in design on product and system level

**Acronym:** SAFEUR.U4.E1

**Element Title**: Reliability in design on product and system level

**Element Note**:

This element includes aspects of how reliability engineering can be integrated into the design process. It deals with methods of establishing the links between top safety events and the design parameters of a given problem, as well as the link between the modelling of the physical behaviour of the system and the design parameters.

**Performance Criteria**:

The student must be able to show evidence of competencies for the following performance criteria (PC):

| Performance Criterion | Evidence Check: The student can demonstrate |
|---|---|
| **SAFEUR.U4.E1.PC1** | The student understands reliability models in design and their relationship with FIT rate modelling |
| **SAFEUR.U4.E1.PC2** | The student understands how reliability models are used to predict failures of electronic parts |
| **SAFEUR.U4.E1.PC3** | The student is able to apply reliability measurements in design decisions |

**Table 6: Performance Criteria for the Element SAFEUR.U4.E1**

### 3.5.2 Unit SAFEUR.U4 - Element 2: Safety in the Production, Operation and Maintenance

**Acronym:** SAFEUR.U4.E2

**Element Title**: Safety in the Production, Operation and Maintenance

**Element Note**:

This element includes safety aspects in productions systems, including safe start and stop modes and safety control specifications.

**Performance Criteria**:

The student must be able to show evidence of competencies for the following performance criteria (PC):

| Performance Criterion | Evidence Check: The student can demonstrate |
|---|---|
| **SAFEUR.U4.E2.PC1** | The student understands how the safety analysis results are to be considered in the production planning |
| **SAFEUR.U4.E2.PC2** | The student understands how the assembly and integration of products (as well as interfaces) which have ASIL classification influences the preproduction planning and process |
| **SAFEUR.U4.E2.PC3** | The student knows how to develop an integration and assembly strategy and mapping qualification methods to the safety critical steps and interfaces in the production process. |

**Table 7: Performance Criteria for the Element SAFEUR.U4.E2**

# ANNEXES

The annex provides overview of used skills set, coverage of Qualification Schemas and Legal background for Certification

# ANNEX A ECQA DESCRIPTION

## ECQA – EUROPEAN CERTIFICATION AND QUALIFICATION ASSOCIATION

ECQA standards are used to describe the skills sets delivered within the DRIVES project (www.project-drives.eu). ECQA is the pilot Certification body, which structure is mapped to DRIVES Reference and Recognition Framework providing the EU-wide overview of training courses and possible certifications, and micro-credentials. DRIVES Reference and Recognition Framework provides links to ESCO[7], EQF[8], ECTS[9] and ECVET[10]. See more in deliverable DRIVES-D4.1.1 Reference and Recognition Framework – Analysis.pdf (www.project-drives.eu).

Europe Wide Certification

The ECQA is the result of a number of EU supported initiatives in the last ten years where in the European Union Life Long Learning Programme different educational developments decided to follow a joint process for the certification of persons in the industry.

Through the ECQA it becomes possible that you attend courses for a specific profession in e.g. Spain and perform a Europe wide agreed test at the end of the course.

Access to a Vast Pool of Knowledge

ECQA currently supports 27 professions in Europe and with the continuous support until 2012 by the European Commission the pool is growing to 30 certified professions in Europe. ECQA offers certification for professions like IT Security Manager, Innovation Manager, EU project manager, E-security Manager, E-Business Manager, E-Strategy Manager, SW Architect, SW Project Manager, IT Consultant for COTS selection, Internal Financial Control Assessor (COSO/COBIT based), Interpersonal Skills, Scope Manager (Estimation Processes), Configuration Manager, Safety Manager, and so forth.

The ECQA guide can be downloaded at www.ecqa.org -> Guidelines.

Defined procedures are applied for:

- Self assessment and learning

- http://www.ecqa.org/fileadmin/documents/Self_Assessment/eucert-users-self-assessment-learning-guide-v5-doc.pdf
- Exam performance
- http://www.ecqa.org/fileadmin/documents/ECQA_Exam_Guide_Participant_v2.pdf

## ECQA SKILLS DEFINITION MODEL

The ECQA skills definition model, used for Job Role definition, is described in section 2 of this document.

## ECQA SKILL SET STRATEGY

Imagine that in the future Europeans will have a skill set like a card with a chip which stores your skill profile to fulfil specific professions, job roles, and tasks. It's working like an ID card. This future scenario requires -

- A standard way to describe a skill set for a profession, job, or specific task.
- A standard procedure to assess the skill and to calculate and display skill profiles.

Such a common set of skill sets in Europe is needed due to the free mobility of workers. European countries such as UK, The Netherlands, and France already have well established open universities which support APL (Accreditation of Prior Learning). In APL the skills of students are assessed, already gained skills are recognised, and only for the skill gaps a learning plan is established. The skill assessment bases on defined skill units and a skill profile displaying how much of the skill units are covered.

In a previous project CREDIT (Accreditation of Skills via the Internet) [1] in which some of the project partners were involved such an Internet based skills assessment system has been built. Therefore another possible scenario of the future is that representative educational bodies per country in Europe maintain skill profiles in databases which can be accessed via defined ID codes for people.

## ECQA SKILLS ASSESSMENT MODEL

**Step 1** – Browse a Skills Set: You select a set of skills or competencies, which are required by your profession or job using national standards or your company standards. You browse different skills cards and select a job role you would like to achieve.

**Step 2 – Register for Self Assessment with a Service Unit** : This can be a service unit inside your own company (e.g. a personnel development department) or a skills card and assessment provider outside

your company which offers skills assessment services. In case of the Safety Manager Project the registration will automatically assign a predefined service unit.

**Step 3 – Receive an Account for Self-Assessment and Evidence Collection** : With the registration you automatically received an account to login to the working space in which you can go through the steps of online self assessment and the collection of evidences to prove that you are capable of certain performance criteria.

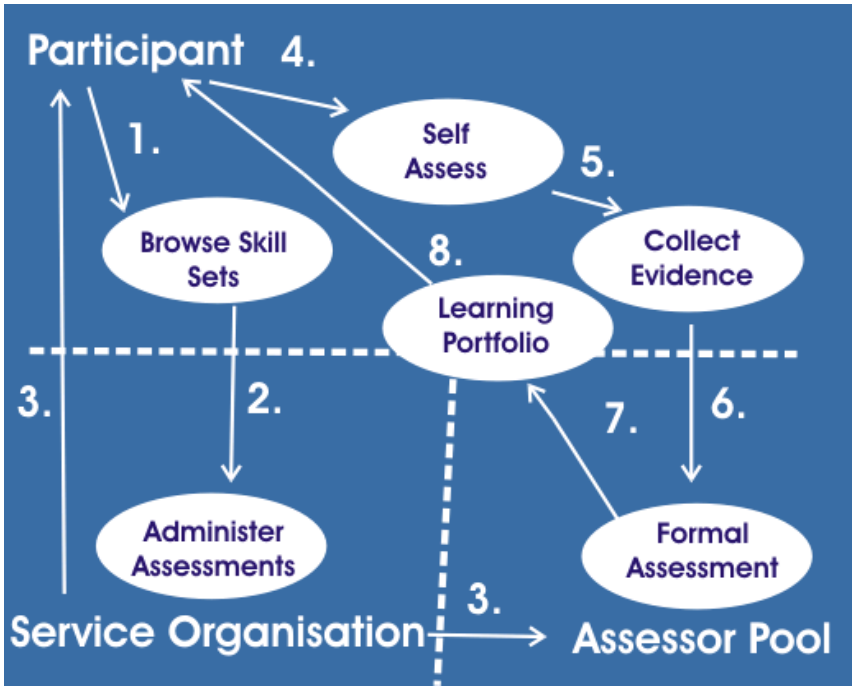


Figure 3 Basic steps of the skills assessment model

**Step 4 – Perform Self Assessment:** You log into the system , browse through the skills required and self assess performance criteria, whole elements or whole units with a standard evaluation scale of non-applicable, not adequate, partially adequate, largely adequate, and fully adequate. A skills gaps profile can be generated and printed illustrating in which areas your self assessment shows improvement potentials.

Testing of Skills (Addition to Step 4) – The system provides a multiple-choice test for each performance criteria so that you can check your capabilities as realistically as possible.

**Step 5 – Collect Evidences:** Before you want to enter any formal assessment you need to prove your skills by evidences. Evidences can be any electronic files (sample documents, sample graphics, results of some analysis, etc.) or any references with details (e.g. a certificate received from a certain

institution). Evidences you can then link to specific performance criteria or whole elements of skills units.

Testing of Skills (Addition to Step 5) – In traditional learning schemes people have always needed to go to a learning institution (university, accreditation body, professional body, etc.) to take exams and they received a certificate if they pass. This traditional approach however is insufficient when it comes to measuring experience and (soft) skills learned on the job and fails to give recognition to skills gathered on the job. The APL (Accreditation of Prior Learning) approach, by contrast, collects so called evidences. Evidences can be certificates obtained in the traditional way, but also references from previous employers, materials from previous projects in which the person took ownership of results (e.g. a test plan) to prove their capability, as well as any kind of proof of competence gathered on the job. The assessors will then evaluate the evidences provided and not only rely on certificates and exams.

**Step 6 – Receive Formal Assessment:** Formal assessors are assigned by the service unit to the skills assessment. Once formal assessors log into the system they automatically see all assigned assessments. They select the corresponding one and can see the uploaded evidences. They then formally assess the evidences and assess the formal fulfilment of performance criteria, whole elements or whole units with a standard evaluation scale of non-applicable, not adequate, partially adequate, largely adequate, and fully adequate. In case of missing competencies they enter improvement recommendations, a well as learning options.

**Step 7 – Receive Advise on Learning / Improvement Options:** After the formal assessment the participants log into the system and can see the formal assessment results from the assessors, can print skills gaps profiles based on the assessor results, and can receive and print the improvement recommendations and learning options. If required, the generation of learning options can also be automated through the system (independent from assessor advises).

## ECQA CERTIFICATE TYPES

In the standard test and examination procedures for levels of certificates are offered:

- Course Attendance Certificate
  - Received after course attendance
  - Modular per Element
- Course / Test Certificate
  - Test in a test system (European pool of test questions)
  - 67% satisfaction per element

- Summary Certificate
    - Overview of covered elements where the student passed the test, all elements shall be covered
    - Generation of certificate
- Professional Certificate
    - Uploading applied experiences for review by assessors
    - Rating by assessors
    - Observation of 2 years

The certificates show credited elements in comparison to all required.

# ANNEX B ECQA COVERAGE OF QUALIFICATION SCHEMAS

## MAPPING BASED ON NVQ QUALIFICATION LEVELS

**Qualification / training levels:** Five levels of qualification / training are defined by European legislation and this structure can be used for comparability of vocational qualifications from the different European countries.

- Level 1: semi-skilled assistant performing simple work
- Level 2: basic employee performing complex routines and standard procedures
- Level 3: skilled professional with responsibility for others and performing independent implementation of procedures
- Level 4: middle management & specialist performing tactical an strategic thinking
- Level 5: professional / university level

In most cases the same job role can be offered on different levels. e.g. IT Security Manager Basic Level (NVQ level 2), IT Security Manager Advanced level (NVQ Level 3), and IT Security Manager Expert Level (NVQ Levels 4 and 5).

Development and Research on Innovative Vocational Skills -DRIVES – Project number 591988-EPP-1-2017-1-CZ-EPPKA2-SSA-B
The European Commission support for the production of this publication under the Grant Agreement Nº 2017-3295/001-001 does not constitute an endorsement of the contents which reflects 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.

## MAPPING BASED ON EUROPEAN QUALIFICATION FRAMEWORK (EQF) LEARNING LEVELS

- Six level taxonomy:

Level 0: I never heard of it

1. Knowledge (I can define it):
2. Comprehension (I can explain how it works)
3. Application (I have limited experience using it in simple situations)
4. Analysis (I have extensive experience using it in complex situations)
5. Synthesis (I can adapt it to other uses)
6. Evaluation (I am recognized as an expert by my peers)

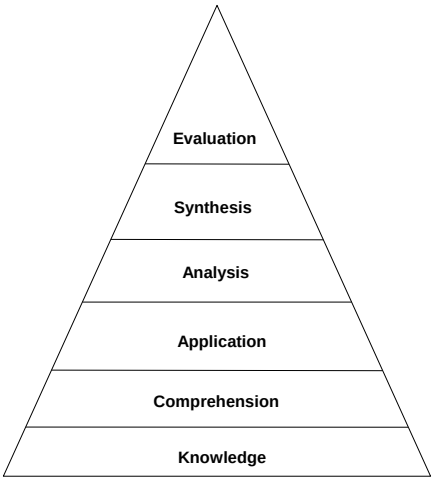


Figure 4 Blooms Learning levels

| Level | Knowledge | Example |
|---|---|---|
| Level 1 | Basic general knowledge | |
| Level 2 | Basic factual knowledge of a field of work or study | |
| Level 3 | Knowledge of facts, principles, processes and general concepts, in a field of work or study | Six Sigma Yellow Belt |
| Level 4 | Factual and theoretical knowledge in broad contexts within a field of work or study | |
| Level 5 | Comprehensive, specialised, factual and theoretical knowledge within a field of work or study and an awareness of the boundaries of that knowledge | |
| Level 6 | Advanced knowledge of a field of work or study, involving a critical understanding of theories and principles | Six Sigma Green Belt |
| Level 7 | • Highly specialised knowledge, some of which is at the forefront of knowledge in a field of work or study, as the basis for original thinking and/or research | Six Sigma Black Belt |

| Level | Knowledge | Example |
|---|---|---|
| | • Critical awareness of knowledge issues in a field and at the interface between different fields | |
| Level 8 | Knowledge at the most advanced frontier of a field of work or study and at the interface between fields | Six Sigma Master Black Belt |

Figure 5 EQF Learning levels

## MAPPING BASED ON ECTS AND ECVET SCHEMA

ECQA has established a procedure to map ECQA skills sets onto the ECTS (European Credit Transfer System) and the ECVET framework n the European Union.

A job role is assigned ECTS and ECVET points using a defined framework.

### ECTS Mapping

Each element of the skills set is assigned hours of lecturing and exercises. These hours determine the ECTS points which are then agreed among a cluster on different universities in Europe.

| Level | Knowledge | AQUA | ECTS | Safety Manager | ECTS |
|---|---|---|---|---|---|
| Level 1 | Basic general knowledge | - | | - | |
| Level 2 | Basic factual knowledge of a field of work or study | - | | - | |
| Level 3 | Knowledge of facts, principles, processes and general concepts, in a field of work or study | | | | |
| Level 4 | Factual and theoretical knowledge in broad contexts within a field of work or study | | | | |
| Level 5 | Comprehensive, specialized, factual and theoretical knowledge within a field of work or study and an awareness of the boundaries of that knowledge | | | | |
| Level 6 | Advanced knowledge of a field of work or study, involving a critical understanding of theories and principles | AQUA - Automotive Quality Integrated Skills - presentations / theory | 3 | AQUA - Automotive Quality Integrated Skills - presentations / theory | 3 |
| Level 7 | - Highly specialized knowledge, some of which is at the forefront of knowledge in a field of work or study, as the basis for original thinking and/or research - Critical awareness of knowledge issues in a field and at the interface between different fields | AQUA - Automotive Quality Integrated Skills - with exercises to apply on nan example (e.g. ESCL) | 4 | AQUA - Automotive Quality Integrated Skills - with exercises to apply on nan example (e.g. ESCL) | 4 |
| Level 8 | Knowledge at the most advanced frontier of a field of work or study and at the interface between fields | AQUA - Automotive Quality Integrated Skills - implementation in a research at PhD level / with link to a real project | 5 | AQUA - Automotive Quality Integrated Skills - implementation in a research at PhD level / with link to a real project | 5 |

Figure 6 Example Automotive Quality Engineer and Safety Manager

The 2 job roles illustrated in the picture above have been assigned to ECTS and are taught using the same skills set at industry and also universities.

## ECVET Mapping

Also ECQA provides a framework to assign ECVET points onto elements of the skills set. The ECQA guidance recommends to offer the ECQA course (which is offered as a lecture at university) as a short course (2 weeks with exercises) in industry to retrain for a job role in industry. The recommended size is 30 ECVET points in total. The lecturing time and exercise per element determine how many ECVET points ae assigned to an element of the skills set.

| Automotive Quality Engineer | | | |
|---|---|---|---|
| | | | ECVET L7&8 |
| U1 | 4 | U1.E1: Introduction | 2 |
| | | U1.E2: Organisational Readiness | 2 |
| U2 | 32 | U2.E1 Life Cycle | 8 |
| | | U2.E2 Requirements | 8 |
| | | U2.E3 Design | 8 |
| | | U2.E4 Test and Integration | 8 |
| U3 | 12 | U3.E1: Capability | 2 |
| | | U3.E2: Hazard and Risk Management | 8 |
| | | U3.E3 Assessment and Audit | 2 |
| U4 | 12 | U4.E1: Measurement | 6 |
| | | U4.E2: Reliability | 6 |
| | | ECVET Points Total | 60 |

Figure 7 ECVET Mapping example - Automotive Quality Engineer

| Functional Safety Manager / Engineer | | | |
|---|---|---|---|
| | | | ECVET L7&8 |
| U1 | 2 | U1.E1 International Standards | 1 |
| | | U1.E2 Product Life Cycle | 1 |
| | | U1.E3 Terminology | |
| U2 | 4 | Safety management on organisational | 1 |
| | | Safety Case Definition | 1 |
| | | Overview of Required Engineering an | 1 |
| | | Establish and Maintain Safety Plannin | 1 |
| U3 | 16 | System Hazard Analysis and Safety Co | 4 |
| | | Integrating Safety in System Design & | 4 |
| | | Integrating Safety in Hardware Design | 4 |
| | | Integrating Safety in Software Design | 4 |
| U4 | 4 | Integration of Reliability in Design to I | 2 |
| | | Safety in the Production,Operation an | 2 |
| U5 | 4 | Legal aspects and Liabilities | 2 |
| | | Regulatory & Qualification Requireme | 2 |
| | | | |
| | | ECVET Points Total | 30 |

Figure 8 ECVET Mapping example – Functional Safety Manager / Engineer

# ANNEX C ECQA LEGAL BACKGROUND FOR CERTIFICATION

## ISO/IEC 17024 STANDARD FOR PERSONNEL CERTIFICATION PROGRAMMES

The ISO/IEC 17024 standard describes standard processes for the examination and certification of people. Some of the basic principles described include:

- Standard exam procedure
- Standard certification procedure
- Identification of persons receiving the certificate
- Independence of examiner and trainer
- Certification system that allows to log the exam to keep a record/proof that the examinee passed the exam
- Mapping of processes towards ISO 17024

## ECQA AND ISO/IEC 17024 STANDARD

- ECQA defined standard exam processes
- ECQA defined standard certification processes
- ECQA developed an exam system that generates random exams and corrects exams.
- ECQA developed a certification database to identify persons and map them to exam results
- ECQA established a mapping onto the ISO 17024 norm and published that in form of a self declaration.

## LIASION WITH NATIONAL UNIVERSITIES

ECQA established cooperation with national universities who teach job roles with ECTS. The same job roles are offered with ECVET on the market by training bodies.

Development and Research on Innovative Vocational Skills -DRIVES – Project number 591988-EPP-1-2017-1-CZ-EPPKA2-SSA-B
The European Commission support for the production of this publication under the Grant Agreement Nº 2017-3295/001-001 does not constitute an endorsement of the contents which reflects 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.

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