DRIVES

Development and Research on Innovative Vocational Education Skills

Connected Vehicles Expert

Job Role Skill Set

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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 Connected Vehicles Expert 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 Fig. 1):

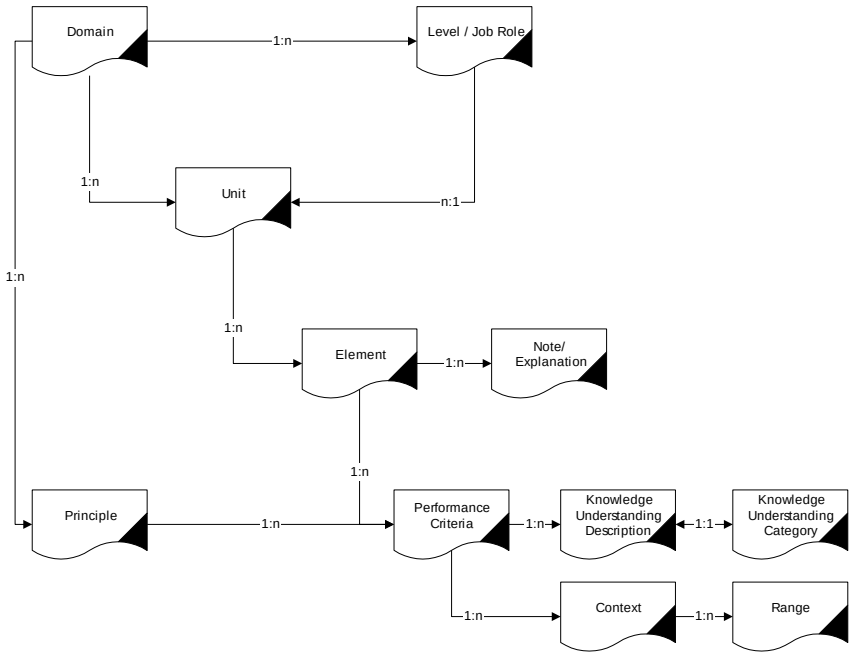


Figure 1 The Skill Definition Model (1:n = one to many relationship)

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 "CONNECTED VEHICLES ENGINEER"

3.1 THE SKILLS HIERARCHY

Using the terminology outlined in the skills definition model and including the skills identified during the demand analysis at the beginning of the project, the following skills hierarchy for the job role "Connected Vehicles Engineer - Advanced" has been designed.

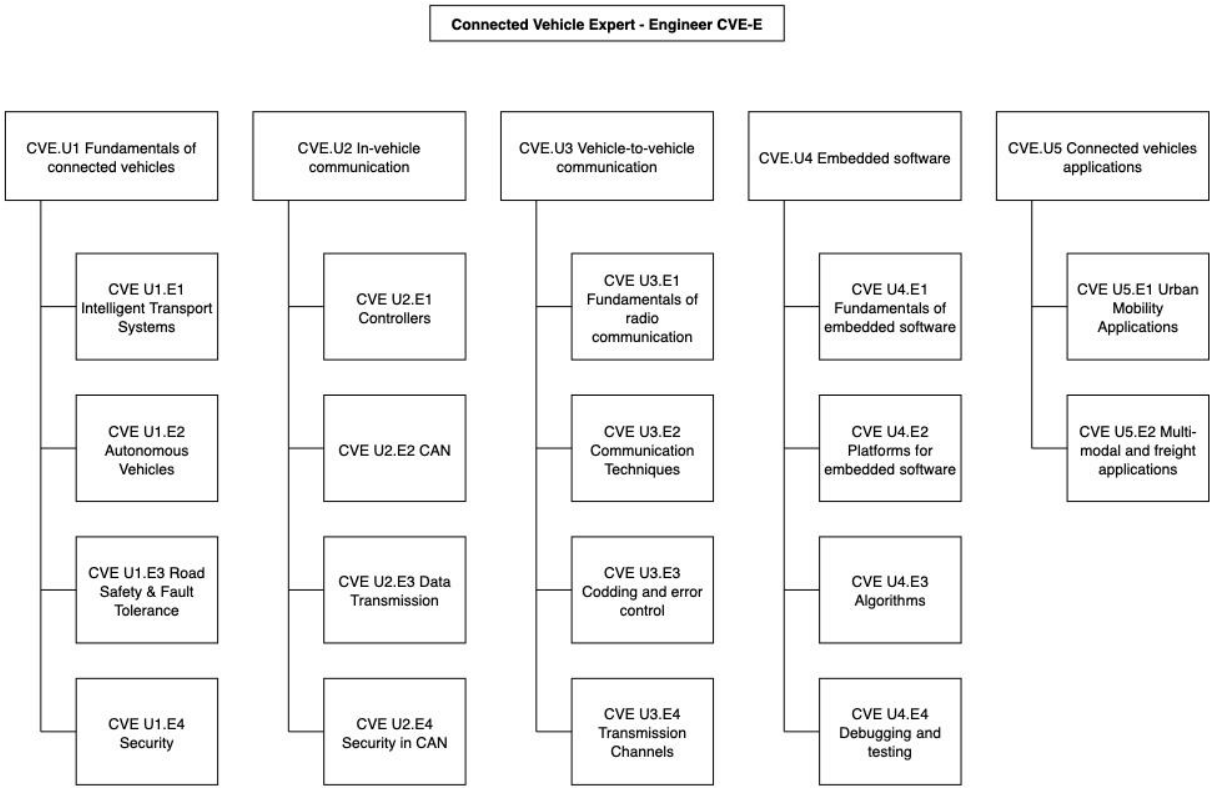


Figure 2: The Skills Set for ECQA Certified Connected Vehicles Engineer

3.2 THE SKILLS DESCRIPTIONS – JOB ROLE CONNECTED VEHICLES ENGINEER

Domain Acronym: VComm

Domain title: Vehicular Communications

Domain Description:

The communication among the vehicle or v2v communication is one of the most important challenge today. The need of transmitting data among vehicles and between vehicle and infrastructure is the base for Intelligent Transport Systems applications and the need of reliable solutions is generated by the road safety.

Job Role Acronym: CVE

Job Role Title: Connected Vehicles Engineer

Description:

The Skill card comprises the following thematic learning units:

1. **Fundamentals of connected vehicles**
2. **In-vehicle communications**
3. **Vehicle to vehicle communications**
4. **Embedded software**
5. **Connected vehicles applications**

3.3 UNIT CVE.U1 FUNDAMENTALS OF CONNECTED VEHICLES

Acronym: CVE.U1

Title: Fundamentals of connected vehicles

Description:

Connected vehicles are part of ITS applications and the most important aspect is to understand the context and the framework where these systems are installed. The main aspects which are included in the design of connected vehicles are also defined and described in this unit.

3.3.1 Unit CVE.U1 - Element 1: Intelligent Transport Systems

Acronym: CVE.U1.E1

Element Title: Intelligent Transport Systems

Element Note:

General knowledge about Intelligent Transport Systems and technologies applied in ITS from various domains like electronics, communications, IT and software.

Performance Criteria:

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

Performance Criterion	Evidence Check: The student can demonstrate
CVE.U1.E1.PC1	The student is able to identify technologies to develop simple and medium-complexity ITS
CVE.U1.E1.PC2	The student knows how to elaborate a simple ITS architecture with the following components: functional, physical and communication

Performance Criterion	Evidence Check: The student can demonstrate
CVE.U1.E1.PC3	The student is able to identify user needs and to convert these needs in ITS services or functions

Table 1: Performance Criteria for the Element CVE.U1.E1

3.3.2 Unit CVE.U1 - Element 2: Autonomous vehicles

Acronym: CVE.U1.E2

Element Title: Autonomous vehicles

Element Note:

General knowledge of autonomous vehicles and the principles of autonomy as well as the technologies applied in this field.

Performance Criteria:

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

Performance Criterion	Evidence Check: The student can demonstrate
CVE.U1.E2.PC1	The student is able to define the main principles of system autonomy.
CVE.U1.E2.PC2	The student knows the technologies needed to be installed in terms of providing autonomous functionalities.
CVE.U1.E2.PC3	The student is able to define the main On-board components of an autonomous vehicle.

Table 2: Performance Criteria for the Element CVE.U1.E2

3.3.3 Unit CVE.U1 - Element 3: Road Safety and Fault Tolerance

Acronym: CVE.U1.E3

Element Title: Road Safety and Fault Tolerance

Element Note:

The element will provide knowledge to understand the principles of road safety and the implementation of road safety in the design of systems based on the fault tolerance approach.

Performance Criteria:

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

Performance Criterion	Evidence Check: The student can demonstrate
CVE.U1.E3.PC1	The student is able to define the main principle of the road safety.
CVE.U1.E3.PC2	The student knows how to use the road safety principle in designing the new connected vehicles systems.
CVE.U1.E3.PC3	The student understands the fault tolerance approach in design of new systems

Table 3: Performance Criteria for the Element CVE.U1.E3

3.3.4 Unit CVE.U1 - Element 4: Security

Acronym: CVE.U1.E4

Element Title: Security

Element Note:

The security is important in terms of providing a level of road safety and in terms of protecting computers and data transmissions.

Performance Criteria:

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

Performance Criterion	Evidence Check: The student can demonstrate
CVE.U1.E4.PC1	The student is able to identify and define the security threats (both cyber and physical security threats) and to document all these threats.
CVE.U1.E4.PC2	The student knows how to develop simple security solutions for cyber attacks.
CVE.U1.E4.PC3	The student is able to develop a simple security architecture

Table 4: Performance Criteria for the Element CVE.U1.E4

3.4 UNIT CVE.U2 IN-VEHICLE COMMUNICATIONS

Acronym: CVE.U2

Title: In-vehicle communications

Description:

The communications applied in transports have two main components: in-vehicle communications (on-board) and inter-vehicles communications (vehicular comm). All communications solutions installed on the board of vehicles are in-vehicle communications.

3.4.1 Unit CVE.U2 - Element 1: Controllers

Acronym: CVE.U2.E1

Element Title: Controllers

Element Note:

On the board of vehicles there is a network of controllers and the controllers are the main source as well as the destination of data transmitted on-board.

Performance Criteria:

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

Performance Criterion	Evidence Check: The student can demonstrate
CVE.U2.E1.PC1	The student is able to define on-board functions and the controllers needed to provide these functions.
CVE.U2.E1.PC2	The student understands the functionality of different types of controllers.
CVE.U2.E1.PC3	The student is able to elaborate a simple architecture of a network of on-board controllers.

Table 5: Performance Criteria for the Element CVE.U2.E1

3.4.2 Unit CVE.U2 - Element 2: CAN

Acronym: CVE.U2.E2

Element Title: CAN

Element Note:

The most used technology in developing a network of controllers is CAN (Controller Area Network) and this technology is able to connect all on-board controllers.

Performance Criteria:

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

Performance Criterion	Evidence Check: The student can demonstrate
CVE.U2.E2.PC1	The student understands the role and the main principles of CAN
CVE.U2.E2.PC2	The student is able to develop a simple CAN architecture.
CVE.U2.E2.PC3	The student knows the content of a CAN message and the way to transmit this kind of messages.

Table 6: Performance Criteria for the Element CVE.U2.E2

3.4.3 Unit CVE.U2 - Element 3: Data transmission

Acronym: CVE.U2.E3

Element Title: Data transmission

Element Note:

The network of controllers is built to transmit data between controllers and the main issue is to understand the way of transmitting data.

Performance Criteria:

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

Performance Criterion	Evidence Check: The student can demonstrate
CVE.U2.E3.PC1	The student is able to define the main principle of data transmission
CVE.U2.E3.PC2	The student knows how to transmit messages between controllers.
CVE.U2.E3.PC3	The student understands the signals used in the transmission of data and can measure these signals

Table 7: Performance Criteria for the Element CVE.U2.E3

3.4.4 Unit CVE.U2 - Element 4: Security in CAN

Acronym: CVE.U2.E4

Element Title: Security

Element Note:

The data security is important for data transmitted on the board of vehicles, especially for messages which are vital for the safety of the vehicle.

Performance Criteria:

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

Performance Criterion	Evidence Check: The student can demonstrate
CVE.U2.E4.PC1	The student is able to classify messages between controllers in terms of providing a level of safety
CVE.U2.E4.PC2	The student knows how to secure a data transmission
CVE.U2.E4.PC3	The student knows the main actions he/she needs to secure a communication link

Table 8: Performance Criteria for the Element CVE.U2.E4

3.5 UNIT CVE.U3 VEHICLE TO VEHICLE COMMUNICATIONS

Acronym: CVE.U3

Title: Vehicle to vehicle communications

Description:

The most useful communications technologies in developing the ITS or autonomous applications are v2v communications. There are two main aspects related to v2v communications: the both terminals are mobile, and the communications environment is dynamic.

3.5.1 Unit CVE.U3 - Element 1: Fundamentals of radio communications

Acronym: CVE.U3.E1

Element Title: Fundamentals of radio communications

Element Note:

The radio communications are mainly the most used communications today and the understanding of this type of communication is mandatory in v2v communication applications.

Performance Criteria:

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

Performance Criterion	Evidence Check: The student can demonstrate
CVE.U3.E1.PC1	The student is able to define a solution for radio communications (general technical specifications)

Performance Criterion	Evidence Check: The student can demonstrate
CVE.U3.E1.PC2	The student understands the main principles of radio communications
CVE.U3.E1.PC3	The student knows how to develop a general architecture for radio communications.

Table 9: Performance Criteria for the Element CVE.U3.E1

3.5.2 Unit CVE.U3 - Element 2: Communication techniques

Acronym: CVE.U3.E2

Element Title: Communication techniques

Element Note:

Communication techniques are important because the needs for communication are not the same for all system. Every system needs a customised communications system.

Performance Criteria:

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

Performance Criterion	Evidence Check: The student can demonstrate
CVE.U3.E2.PC1	The student is able to define and to understand the main communication techniques: modulation, amplification/attenuation, filtering and so on
CVE.U3.E2.PC2	The student knows the main digital modulation techniques
CVE.U3.E2.PC3	The student knows the modern radio technologies (ex. MIMO)

Table 10: Performance Criteria for the Element CVE.U3.E2

3.5.3 Unit CVE.U3 - Element 3: Coding and Error Control

Acronym: CVE.U3.E3

Element Title: Coding and Error Control

Element Note:

The control of errors in data transmission is very important especially for transmission which is related with safety.

Performance Criteria:

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

Performance Criterion	Evidence Check: The student can demonstrate
CVE.U3.E3.PC1	The student understands the different techniques of codding and the role of codes
CVE.U3.E3.PC2	The student is able to use some codes to control the errors in data transmission
CVE.U3.E3.PC3	The student knows types of errors and codding solutions to control the number of errors (on bit or frame)

Table 11: Performance Criteria for the Element CVE.U3.E3

3.5.4 Unit CVE.U3 - Element 4: Transmission Channels

Acronym: CVE.U3.E4

Element Title: Transmission Channels

Element Note:

The link between a terminal which is able to transmit data and another terminal which is able to receive data is provided by a transmission channel. The transmission channel is more complex in urban environment where the connected vehicles technology will demonstrate the most numerous applications.

Performance Criteria:

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

Performance Criterion	Evidence Check: The student can demonstrate
CVE.U3.E4.PC1	The student is able to define the most important parameters of a transmission channel
CVE.U3.E4.PC2	The student knows how to model a transmission channel using software platform (ex. MatLab or Octave)
CVE.U3.E4.PC3	The student is able to define a type of a transmission channel based on simple observation

Table 12: Performance Criteria for the Element CVE.U3.E4

3.6 UNIT CVE.U4 EMBEDDED SOFTWARE

Acronym: CVE.U4

Title: Embedded software

Description:

The controllers installed on the board of vehicles need software to fulfil the functionalities for that they have been designed. The controller has embedded software to decrease the complexity of the software installed and to eliminate the logic implemented with hardware (to reduce the hardware complexity).

3.6.1 Unit CVE.U4 - Element 1: Fundamentals of embedded software

Acronym: CVE.U4.E1

Element Title: Fundamentals of embedded software

Element Note:

The controller and the software which is embedded in the controller form the intelligent unit on the board of vehicle. The software embedded in the hardware is sometime used only for the specific hardware.

Performance Criteria:

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

Performance Criterion	Evidence Check: The student can demonstrate
CVE.U4.E1.PC1	The student is able to develop simple programs using embedded software and dedicated platforms.
CVE.U4.E1.PC2	The student knows debugging and testing methods
CVE.U4.E1.PC3	The student understands the main principle of embedded
Etc.	Etc.

Table 13: Performance Criteria for the Element CVE.U4.E1

3.6.2 Unit CVE.U4 - Element 2: Platforms for embedded software

Acronym: CVE.U4.E2

Element Title: Platforms for embedded software

Element Note:

All software designed and tested for this type of controllers or hardware need a software platform to be develop, compile and transfer to the hardware.

Performance Criteria:

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

Performance Criterion	Evidence Check: The student can demonstrate
CVE.U4.E2.PC1	The student is able to use a software platform to develop programs for embedded devices.
CVE.U4.E2.PC2	The student is able to use debugging tools to provide a syntax error free software
CVE.U4.E2.PC3	The student knows to transfer the program from the software platform to the hardware

Table 14: Performance Criteria for the Element CVE.U4.E2

3.6.3 Unit CVE.U4 - Element 3: Algorithms

Acronym: CVE.U4.E3

Element Title: Algorithms

Element Note:

Behind the programs and the programming language is the logic or the algorithms needed to implement the logic.

Performance Criteria:

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

Performance Criterion	Evidence Check: The student can demonstrate
CVE.U4.E3.PC1	The student is able to use well known algorithms in terms of processing data
CVE.U4.E3.PC2	The student is able to develop a logical diagram for a simple software
CVE.U4.E3.PC3	The student is able to test algorithms and to correct logical errors in simple software

Table 15: Performance Criteria for the Element CVE.U4.E3

3.6.4 Unit CVE.U4 - Element 4: Debugging and testing

Acronym: CVE.U4.E4

Element Title: Debugging and testing

Element Note:

The main characteristics of a software is the robustness and the reliability. To be in line with these two main characteristics is important to eliminate the software errors which are the main cause of the software failure.

Performance Criteria:

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

Performance Criterion	Evidence Check: The student can demonstrate
CVE.U4.E4.PC1	The student is able to use debugging tools and methods for embedded software
CVE.U4.E4.PC2	The student knows how to test a simple software and to elaborate a procedure for testing
CVE.U4.E4.PC3	The student knows to check the functionalities of the software and to correct possible errors.

Table 16: Performance Criteria for the Element CVE.U4.E4

3.7 UNIT CVE.U5 CONNECTED VEHICLES APPLICATIONS

Acronym: CVE.U5

Title: Connected vehicles applications

Description:

The communications established between terminals are needed to support the development of applications in the field of ITS. An important aspect is the application of connected vehicles in freight transport (one example is the platooning system).

3.7.1 Unit CVE.U5 - Element 1: Urban Mobility Applications

Acronym: CVE.U5.E1

Element Title: Urban Mobility Applications

Element Note:

The main challenging domain of transport and mobility is the urban mobility. The connected vehicles technologies are mainly designed for this urban environment.

Performance Criteria:

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

Performance Criterion	Evidence Check: The student can demonstrate
CVE.U5.E1.PC1	The student is able to identify the significant urban mobility applications where the connected vehicles solutions could be applied.
CVE.U5.E1.PC2	The student is able to define functionalities of connected vehicles solutions and the effect on urban mobility
CVE.U5.E1.PC3	The student understands and can define the technical requirements for connected vehicles application in urban mobility.
Etc.	Etc.

Table 17: Performance Criteria for the Element CVE.U5.E1

3.7.2 Unit CVE.U5 - Element 2: Multi-modal and freight applications

Acronym: CVE.U5.E2

Element Title: Autonomous vehicles

Element Note:

Another important direction of connected vehicles applications is the multi-modal transport especially for freight transport. Here is covered also the connectivity between trucks in providing platooning facilities.

Performance Criteria:

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

Performance Criterion	Evidence Check: The student can demonstrate
CVE.U5.E2.PC1	The student is able to identify the significant multi-modal and freight applications where the connected vehicles solutions could be applied.

Performance Criterion	Evidence Check: The student can demonstrate
CVE.U5.E2.PC2	The student is able to define functionalities of connected vehicles solutions and the effect on multi-modal and freight transport
CVE.U5.E2.PC3	The student understands and can define the technical requirements for connected vehicles application in multi-modal and freight transport.

Table 18: Performance Criteria for the Element CVE.U5.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.

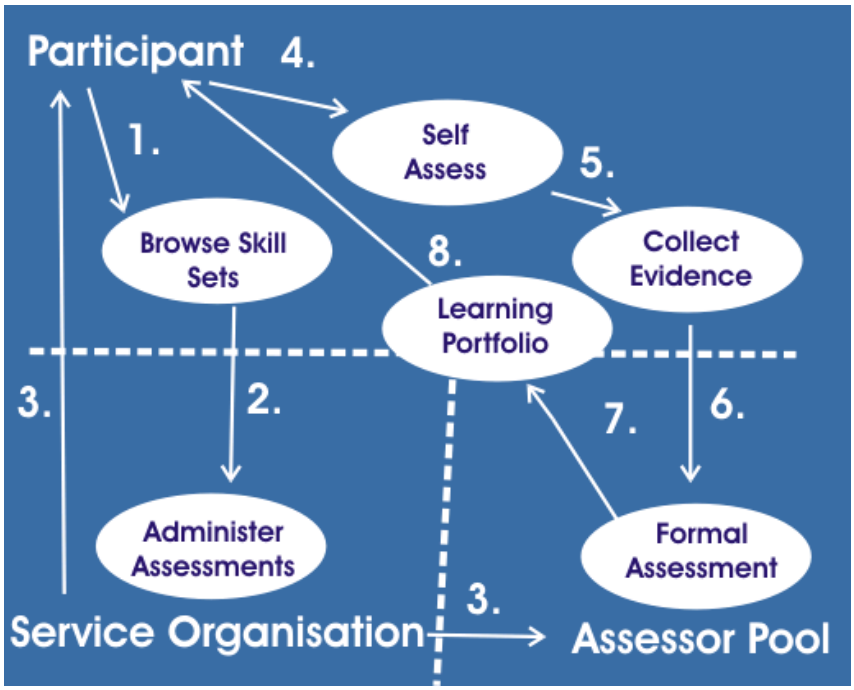
In a previous project CREDIT (Accreditation of Skills via the Internet) [1] in which some of the project partners were involved such an Internet based skills assessment system has been built. Therefore another possible scenario of the future is that representative educational bodies per country in Europe 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.



Picture 1: 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

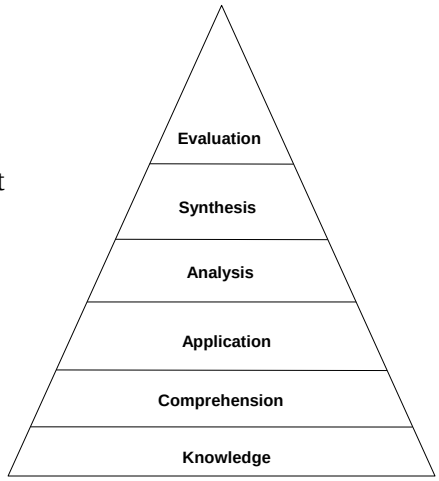
In most cases the same job role can be offered on different levels. e.g. IT Security Manager Basic Level (NVQ level 2), IT Security Manager Advanced level (NVQ Level 3), and IT Security Manager Expert Level (NVQ Levels 4 and 5).

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)



Picture 3: 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 • Critical awareness of knowledge issues in a field and at the interface between different fields	Six Sigma Black Belt

Level	Knowledge	Example
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

Picture 4 : 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

Picture 5 : 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

Picture 6 : 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

Picture 7 : 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.

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