DRIVES

Development and Research on Innovative Vocational Education Skills

Machine Learning Engineer

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 Machine Learning 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.

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2 ECQA SKILLS DEFINITION MODEL

A skills definition contains the following items (see Fig. 1):

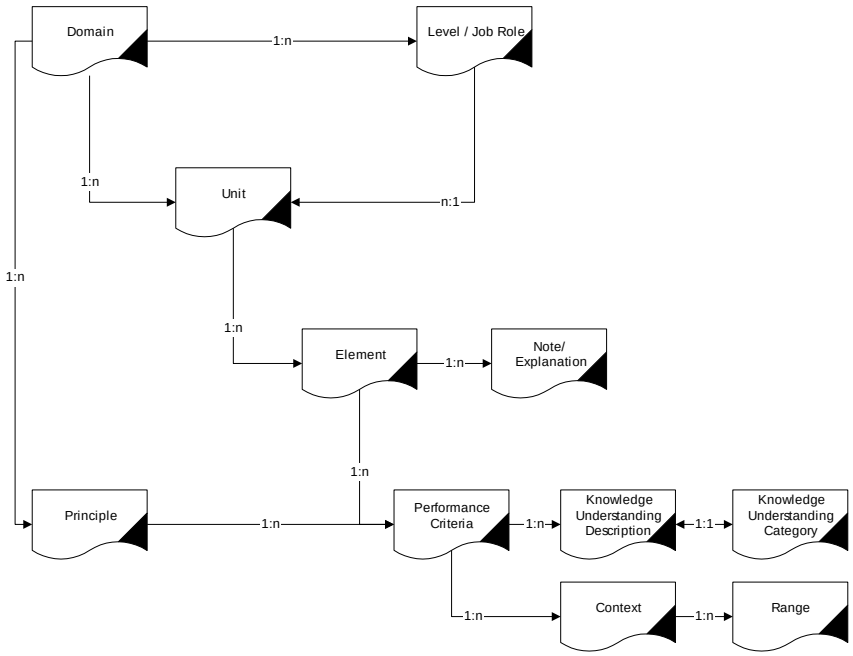


Figure 1 The Skill Definition Model (1:n = one to many relationship)

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 "Machine Learning 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 "Machine Learning Engineer" has been designed.

Unit ID	Unit Name	Element ID	Element Name
MLE.U1	Introduction to Artificial Intelligence	MLE.U1.E1	What is Artificial Intelligence (AI)?
		MLE.U1.E2	AI Applications, Use Cases and Real-Life Examples
MLE.U2	Machine Learning Overview	MLE.U2.E1	What is Machine Learning?
		MLE.U2.E2	Machine Learning and Recommendation Systems
		MLE.U2.E3	Machine Learning Applications, Use Cases and Real-Life Examples
MLE.U3	Machine Learning Algorithms	MLE.U3.E1	Machine Learning Models
		MLE.U3.E2	Supervised Models
		MLE.U3.E3	Unsupervised Models
		MLE.U3.E4	Semi-Supervised Models
		MLE.U3.E5	Reinforcement Learning Models
MLE.U4	Machine Learning in Practice	MLE.U4.E1	Solving Typical Machine Learning Problems

Table 1 : The Skills Set for ECQA Certified Machine Learning Engineer

3.2 THE SKILLS DESCRIPTIONS – JOB ROLE MACHINE LEARNING ENGINEER

Domain Acronym: Engineering

Domain title: Artificial Intelligence in Automotive

Domain Description:

The field of Artificial Intelligence aims to design computer programs and/or machines which simulate intelligence to mimic human cognitive abilities. Artificial Intelligence is a broad science which includes thinking models, cognitive and knowledge-based systems, problem solving, and decision making. In

the automotive industry, the upcoming fully autonomous vehicles will rely heavily on Artificial Intelligence to perceive its environment, reduce the reaction time, and perform the better action according to a rigorous assessment of the consequences of each action and the projection of the different scenarios possible in order to maximize the safety of all interveners, including the driver and passengers inside the car, other human beings in another cars, pedestrians and animals. Artificial Intelligence can also be used to enhance the experience inside the car, enabling a more comfortable, and pleasant ride experience according to user preferences.

Job Role Acronym: MLE

Job Role Title: Machine Learning Engineer

Description:

The Skill card comprises the following thematic learning units

Unit 1 – Introduction to Artificial Intelligence

Unit 2 – Machine Learning Overview

Unit 3 – Machine Learning Algorithms

Unit 4 – Machine Learning in Practice

3.3 UNIT MLE.U1 INTRODUCTION TO ARTIFICIAL INTELLIGENCE

Acronym: MLE.U1

Title: Introduction to Artificial Intelligence

Description:

The first unit is an introduction to artificial intelligence that provides learners a detailed description of AI and its main particularities. It consists of the following learning elements:

E1 – What is Artificial Intelligence?

E1.1 – Artificial Intelligence Overview.

E1.2 – The Progress and History of Artificial Intelligence

E1.3 – The Philosophical Problems Surrounding Artificial Intelligence: Issues, Concerns and Ethical Considerations

E2 – Artificial Intelligence Applications, Use Cases and Real-Life Examples

3.3.1 Unit MLE.U1 - Element 1: What is artificial intelligence?

Acronym: MLE.U1.E1

Element Title: What is Artificial Intelligence?

Element Note:

This learning element describes the concept of Artificial Intelligence based on its definition, origin, evolution over the years, contributions and, also, constraints.

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
MLE.U1.E1.PC1	The student is able to define artificial intelligence.
MLE.U1.E1.PC2	The student understands the need, purpose and impacts of artificial intelligence.
MLE.U1.E1.PC3	The student understands the differences between data, information, knowledge, understanding/insight and wisdom.
MLE.U1.E1.PC4	The student is able to deduce how to gain strategic advantage through the use of different kinds of intelligence.
MLE.U1.E1.PC5	The student understands the origin and evolution of artificial intelligence over the years.
MLE.U1.E1.PC6	The student recognizes and critically understands the issues and ethical concerns surrounding artificial intelligence.

Table 2: Performance Criteria for the Element MLE.U1.E1

3.3.2 Unit MLE.U1 - Element 2: Artificial Intelligence Applications, Use Cases and Real-Life Examples

Acronym: MLE.U1.E2

Element Title: Artificial Intelligence Applications, Use Cases and Real-Life Examples

Element Note:

This learning element focus on the applicability of Artificial Intelligence, offering an elaborated overview of the main areas of knowledge and applications of AI through real-life examples and use cases.

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
MLE.U1.E2.PC1	The student knows the different application domains of artificial intelligence.
MLE.U1.E2.PC2	The student is able to analyse and discuss several examples and applications of artificial intelligence.
MLE.U1.E2.PC3	The student recognizes the challenges surrounding artificial intelligence approaches.
MLE.U1.E2.PC4	The student can assess the impact of artificial intelligence on the future of work and society.
MLE.U1.E2.PC5	The student is able to reflect about the future of artificial intelligence.

Table 3: Performance Criteria for the Element MLE.U1.E2

3.4 UNIT MLE.U2 MACHINE LEARNING OVERVIEW

Acronym: MLE.U2

Title: Machine Learning Overview

Description:

The second unit of this job role is an introduction to machine learning, a particular branch of artificial intelligence, that provides learners a detailed description of Machine Learning and its main characteristics, also referring to recommendation systems. It consists of the following learning elements:

E1 – What is Machine Learning?

E2 – Machine Learning and Recommendation Systems

E3 – Machine Learning Applications, Use Cases and Real-Life Examples

3.4.1 Unit MLE.U2 - Element 1: What is Machine Learning?

Acronym: MLE.U2.E1

Element Title: What is Machine Learning?

Element Note:

This learning element describes the concept of Machine Learning based on its definition and contributions.

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
MLE.U2.E1.PC1	The student knows and understands the definition of machine learning.
MLE.U2.E1.PC2	The student understands the need, purpose and impacts of machine learning.
MLE.U2.E1.PC3	The student is able to recognize the connection between artificial intelligence and machine learning.
MLE.U2.E1.PC4	The student understands how machine learning fits into artificial intelligence.

Table 4: Performance Criteria for the Element MLE.U2.E1

3.4.2 Unit MLE.U2 - Element 2: Machine Learning and Recommendation Systems

Acronym: MLE.U2.E2

Element Title: Machine Learning and Recommendation Systems

Element Note:

This learning element provides insights on recommendation systems and their connection with Machine Learning algorithms.

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
MLE.U2.E2.PC1	The student knows how to define recommendation systems.
MLE.U2.E2.PC2	The student understands the operation and logic behind recommendation systems.
MLE.U2.E2.PC3	The student understands the role of machine learning in recommendation systems.

Table 5: Performance Criteria for the Element MLE.U2.E2

3.4.3 Unit MLE.U2 - Element 3: Machine Learning Applications, Use Cases and Real-Life Examples

Acronym: MLE.U2.E3

Element Title: Machine Learning Applications, Use Cases and Real-Life Examples

Element Note:

This learning element focus on the applicability of Machine Learning, offering an elaborated overview of its main areas of knowledge and applications through real-life examples and use cases.

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
MLE.U2.E3.PC1	The student knows the different application domains of machine learning.
MLE.U2.E3.PC2	The student is able to analyse and discuss several examples and applications of machine learning.
MLE.U2.E3.PC3	The student is able to recognize the growing importance of machine learning techniques in today's society.

Table 6: Performance Criteria for the Element MLE.U2.E3

3.5 UNIT MLE.U3 MACHINE LEARNING ALGORITHMS

Acronym: MLE.U3

Title: Machine Learning Algorithms

Description:

The third unit of this job role provides a comprehensive description of the different Machine Learning algorithms. It consists of the following learning elements:

E1 – Machine Learning Models

E2 – Supervised Models

E3 – Unsupervised Models

E4 – Semi-supervised Models

E5 – Reinforcement Learning Models

3.5.1 Unit MLE.U3 - Element 1: Machine Learning Models

Acronym: MLE.U3.E1

Element Title: Machine Learning Models

Element Note:

This learning element describes the different types of machine learning algorithms focusing on their characteristics and main differences.

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
MLE.U3.E1.PC1	The student is able to list the different types of machine learning models.
MLE.U3.E1.PC2	The student understands each type of learning model and its particularities.
MLE.U3.E1.PC3	The student is able to recognize and understand the differences between the machine learning models.

Table 7: Performance Criteria for the Element MLE.U3.E1

3.5.2 Unit MLE.U3 - Element 2: Supervised Models

Acronym: MLE.U3.E2

Element Title: Supervised Models

Element Note:

This learning element provides a description of supervised learning models focusing on its definition, its application domain and its different categories. In addition, this element explains the particularities of regression, classification and probability estimation models.

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
MLE.U3.E2.PC1	The student is able to define and understand supervised learning.
MLE.U3.E2.PC2	The student understands the differences between regression models, classification models and probability estimation models.
MLE.U3.E2.PC3	The student knows some of the most commonly used algorithms in supervised learning.
MLE.U3.E2.PC4	The student is able to categorize each algorithm within the regression, classification and probability estimation domain.
MLE.U3.E2.PC5	The student knows the domain applications of supervised models.

Table 8: Performance Criteria for the Element MLE.U3.E2

3.5.3 Unit MLE.U3 - Element 3: Unsupervised Models

Acronym: MLE.U3.E3

Element Title: Unsupervised Models

Element Note:

This learning element provides a description of unsupervised learning models focusing on its definition and application domain as well as in the most commonly used algorithms and in the different types of clustering.

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
MLE.U3.E3.PC1	The student is able to define and explain unsupervised learning.
MLE.U3.E3.PC2	The student knows some of the most commonly used algorithms in unsupervised learning.
MLE.U3.E3.PC3	The student knows the domain application of unsupervised models.

Table 9: Performance Criteria for the Element MLE.U3.E3

3.5.4 Unit MLE.U3 - Element 4: Semi-Supervised Models

Acronym: MLE.U3.E4

Element Title: Semi-Supervised Models

Element Note:

This learning element provides a description of semi-supervised learning models focusing on its definition and application domain as well as in its most commonly used algorithms.

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
MLE.U3.E4.PC1	The student is able to define and understand semi-supervised learning.

Performance Criterion	Evidence Check: The student can demonstrate
MLE.U3.E4.PC2	The student knows some of the most commonly used algorithms in semi-supervised learning.
MLE.U3.E4.PC3	The student knows the domain application of semi-supervised models.

Table 10: Performance Criteria for the Element MLE.U3.E4

3.5.5 Unit MLE.U3 - Element 5: Reinforcement Learning Models

Acronym: MLE.U3.E5

Element Title: Reinforcement Learning Models

Element Note:

This learning element provides a description of reinforcement learning models focusing on its definition and application domain as well as in its most commonly used algorithms. In addition, this element shows some common terminologies used in the field of reinforcement learning. Furthermore, this element provides insights about policy optimization methods, Q-learning methods and hybrid methods. Finally, the element explains the differences between model-based reinforcement learning and model-free reinforcement learning, as well as, the distinct approaches of model-based reinforcement learning, namely, learn the model and learn given the model.

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
MLE.U3.E5.PC1	The student is able to define and understand reinforcement learning.
MLE.U3.E5.PC2	The student knows common terminologies used in the field of reinforcement learning.
MLE.U3.E5.PC3	The student knows some of the most commonly used algorithms in reinforcement learning.
MLE.U3.E5.PC4	The student understands model-based reinforcement learning and model-free reinforcement learning as well as their differences.
MLE.U3.E5.PC5	The student understands policy optimization methods, Q-learning methods and hybrid methods as well as list some algorithms for each category.

Performance Criterion	Evidence Check: The student can demonstrate
MLE.U3.E5.PC6	The student understands the different approaches of model-based reinforcement learning: learn the model and learn given the model.
MLE.U3.E5.PC7	The student knows the domain application of reinforcement learning models.

Table 11: Performance Criteria's for the Element MLE.U3.E5

3.6 UNIT MLE.U4 MACHINE LEARNING IN PRACTICE

Acronym: MLE.U4

Title: Machine Learning in Practice

Description:

The last unit of this job role provides a broad description of the different Machine Learning problems and application domains through the analysis of some examples of resolution of typical machine learning problems and through a practical exercise that allows apprentices to apply all the knowledge and skills acquired until know. It consists of the following learning elements:

E1 – Solving Typical Machine Learning Problems

3.6.1 Unit MLE.U4 - Element 1: Solving Typical Machine Learning Problems

Acronym: MLE.U4.E1

Element Title: Solving Typical Machine Learning Problems

Element Note:

This learning element describes the typical machine learning problems and areas of intervention. In addition, this element provides insights on the key stages of the resolution approach that typically applies to those problems through an exhaustive analysis and discussion of the resolution of some machine learning problems. The main steps involved include data understanding, data cleaning and transformation, selection of the machine learning model that best fits this specific problem, training and assessment of the learning model. By doing so, this element also gives awareness to the main challenges surrounding machine learning approaches.

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
MLE.U4.E1.PC1	The student is able to recognize typical machine learning problems and its areas of intervention.
MLE.U4.E1.PC2	The student knows and understands the steps of the resolution approach that typically apply to machine learning problems.
MLE.U4.E1.PC3	The student is able to explore and understand the dataset as well as the main goal of the project.
MLE.U4.E1.PC4	The student is able to perform data cleaning, pre-processing and transformation.
MLE.U4.E1.PC5	The student knows which machine learning model to use.
MLE.U4.E1.PC6	The student is able to explore and interpret the results as well as evaluate the performance of the model.
MLE.U4.E1.PC7	The student is able to analyse and explore step by step the resolution of some machine learning problems.
MLE.U4.E1.PC8	The student is able to discuss the approach taken as well as the results obtained.
MLE.U4.E1.PC9	The student is able to recognize the challenges surrounding machine learning approaches.

Table 12: Performance Criteria's for the Element MLE.U4.E1

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.

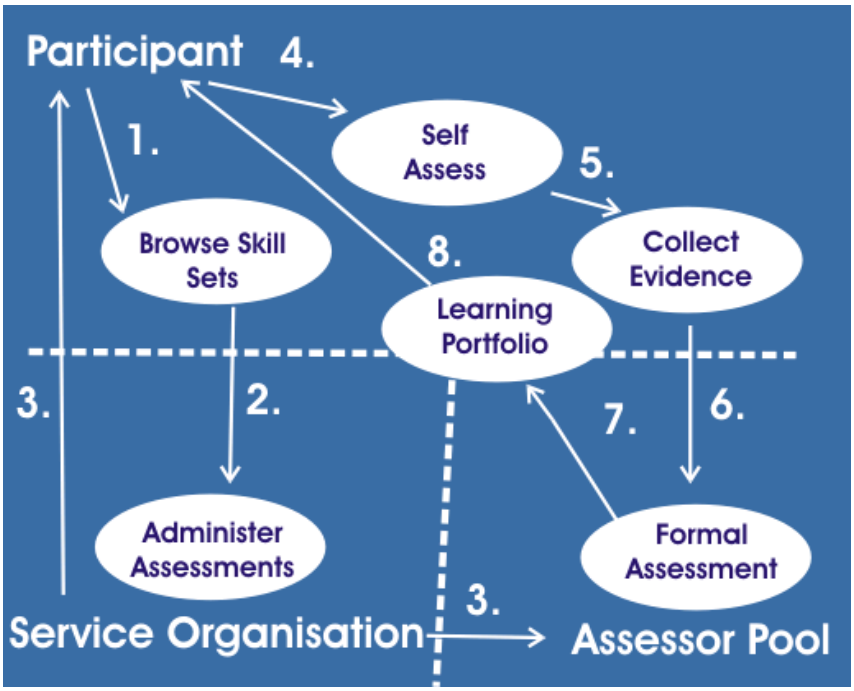
In a previous project CREDIT (Accreditation of Skills via the Internet) [1] in which some of the project partners were involved such an Internet based skills assessment system has been built. Therefore another possible scenario of the future is that representative educational bodies per country in Europe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

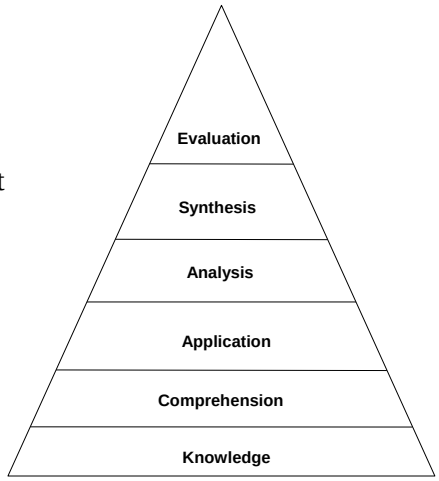
In most cases the same job role can be offered on different levels. e.g. IT Security Manager Basic Level (NVQ level 2), IT Security Manager Advanced level (NVQ Level 3), and IT Security Manager Expert Level (NVQ Levels 4 and 5).

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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