DRIVES

Development and Research on Innovative Vocational Education Skills

Automotive Quality Engineer

Job Role Skill Set

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www.project-drives.eu

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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 Automotive Quality 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 Fig.1):

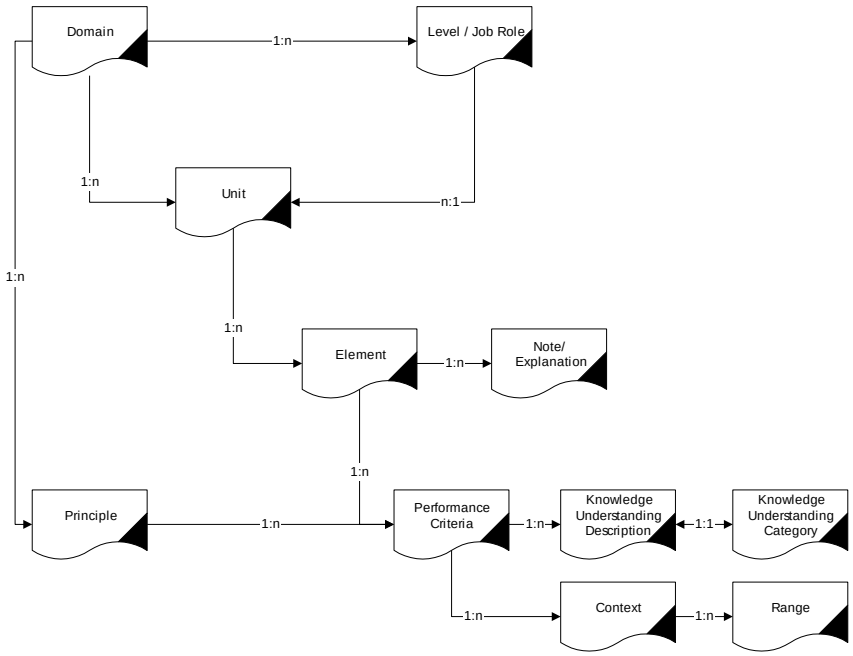


Figure 1: The Skill Definition Model (1:n = one to many relationship)

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 "AUTOMOTIVE QUALITY ENGINEER"

3.1 BACKGROUND

Electronics and software control 70% of modern cars' functionality; studies predict 90% and more tomorrow. The induced system complexity makes it increasingly difficult for automotive companies to master interdisciplinary, horizontal issues such as quality, reliability, and functional safety.

Moreover, the ISO 26262 reference standard for road vehicles has been released only very recently. Consequently, existing knowledge is rare, and highly specialised on teaching the standard rather than its practical implementation. This is where competition is happening in automotive worldwide, and where Europe can create a competitive advantage.

In the Automotive Cluster Austria they currently discuss "Can we still manage the complexity of software and electronics in cars?" [5], and come to the conclusion that such integrated automotive and safety engineering best practices are needed.

Key Notes about Functional Safety at EuroSPI 2012 illustrated that functional safety is increasingly important for the success on the market:

The EuroSPI 2012 key note from the KTM quality head stated: "It is important to show a way of effective integration of the process and the methods of functional safety for a medium-sized business based on pilot projects. The principle of these projects is to acquire expert knowledge via practical execution of the work products and simultaneous training."

The EuroSPI 2012 key note from a Magna program manager of a highly safety critical product line states that "for Tier 1 suppliers of mechatronic systems it is inevitable today to comply with standards like Automotive SPICE and ISO 26262 (Functional Safety for Road Vehicles). This can lead to substantial on-top costs and a lot of additional effort if especially requirements management is not implemented in a smart way."

A group of industry partners from Automotive and medical device industry joined a workshop series at EuroSPI and collaborate in task forces since 2003 which was kick-off financed for one year by the Bavarian software initiative. This group published a number of papers about their integration of Automotive SPICE and Functional Safety in an integrated approach [6], [7], [8].

The Lean Six Sigma Academy published papers about EuroSPI emphasising the implementation of Lean Six Sigma in Europe applying the Toyota success story in Europe. They presented different levels of six sigma experts (yellow, orange, green, black belt) and contributed examples of success stories.

Automotive SPICE, Functional Safety standards, and Lean Six Sigma in a way form the quality backbone of the automotive industry. Only such common standards enable highly integrated supply chains as we

find them in automotive industry. For a participating company this means competence and ability in all these areas is a priority.

Also the Automotive Clusters reported that - while there is a limited number of Tier 1 companies in the market - there are hundreds of Tier 2 and Tier 3 small and medium sized companies. They do not have the time to invest in each of the three approaches separately and they need an integrated compact view which can be implemented (as much as possible related to real practice).

The EU project AQUA proposes such a compact integration of core elements and will create training which is delivered through the Automotive Clusters.

We illustrate the AQUA architecture in the figure below. In AQUA a base layer of core modules will be established which allow an integrated and complementary view about the three approaches, including Automotive SPICE, Functional Safety, and Lean Six Sigma. Integrated means, the base layer modules extract and teach common paradigms and principles - "the essence" - from the latter, and the link layer expresses the mapping or translation to Automotive SPICE, Functional Safety, and Lean Six Sigma. In this way, the complexity of learning and mastering all three standards can be significantly reduced.

From the core modules AQUA also develops a linking layer which references the parts addressed in the existing and established approaches, such as Automotive SPICE, Functional Safety, and Lean Six Sigma. Also the AQUA project maps the key words which the partners in the Automotive clusters need to address onto the core modules which we propose in AQUA.

The Automotive Clusters stated that these core modules must contain enough best practice examples so that based on the core modules an implementation in the projects can be done. A selected set of experts in the company will be recommended to the full courses (see link to existing and established approaches and courses (= layer of existing courses on the market).

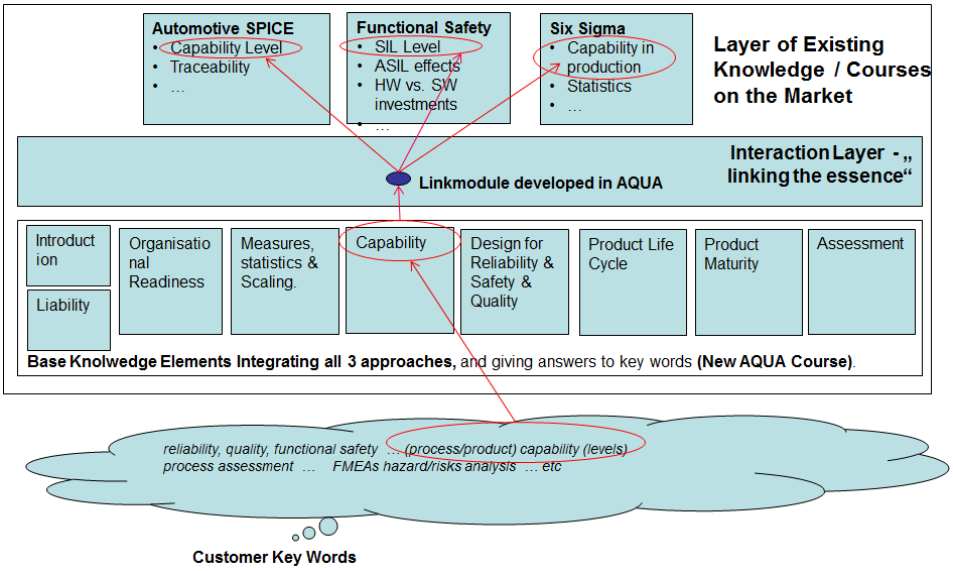


Figure 2 Integrated Base Modules Concept of AQUA and Linking Strategy

The functionality of this architecture in the above figure can be illustrated based on a key word based "signal" flow (see the arrows in above figure).

If you take the key word "capability" it has three different meanings although it is used by all three approaches. Thus in a core module the concept of capability is explained from the three perspectives [9]. In Automotive SPICE the capability levels are derived from process capability levels based on ISO 15504 (the capability of an engineering process such as ENG.5 Software Design). In ISO 26262 the Safety Integrity Levels ASIL-A to ASIL-D are originally derived from IEC 61508 and represent a specific redundant hardware design and hardware FIT rate (1 FIT is equal to a probability of 10-9 that an error occurs in an hour) and corresponding diagnostic coverage by software to avoid that failures of the electronic lead to hazardous situations for the driver. So this SIL is a kind of product maturity level. And in Six Sigma the capability relates to the production capability which means that by statistical quality control the number of faults in introduction is reduced to achieve 6-sigma deviation. This is also needed in Automotive because the contracts in Automotive mention ppms (Parts per Million Errors) which need to be achieved and contracts contain less than 100 ppm.

3.2 DIFFERENT SKILLS LEVELS AT UNIVERSITY TEACHING

The university program in e.g. Austria assigns the AQUA elements into a bachelor level, master level for system engineering, and master level for production engineering. The below figure describes the mapping of elements to bachelor and master level program.

AQUA Units and Elements Mapping to Skills Levels				
AQUA Units and Elments	Link Module / Integration View	ASPICE Module	Six Sigma Module	Safety Module
Unit 1 - Introduction				
U1.E1: Introduction	Bachelor	Bachelor	Production (Master)	Bachelor
U1.E2: Organisational Readiness	Bachelor	Bachelor	Production (Master)	Bachelor
Uni 2 - Product Development				
U2.E1 Life Cycle	Master	Master	Master	Master
U2.E2 Requirements	Master	Master	Master	Master
U2.E3 Design	Master	Master	Master	Master
U2.E4 Test and Integration	Master	Master	Master	Master
Unit 3 - Quality and Safety Management				
U3.E1: Capability	Bachelor	Bachelor	Production (Master)	Bachelor
U3.E2: Hazard and Risk Management	Bachelor	Bachelor	Bachelor	Bachelor
U3.E3 Assessment and Audit	Bachelor	Bachelor	Bachelor	Bachelor
Unit 4 - Measure				
U4.E1: Measurement	QM	QM	Production (Master)	QM
U4.E2: Reliability	QM	QM	Production (Master)	QM
Stages / Levels in the AQUA educational program				
Master level, 3 ECTS				
Bachelor Level, 2 ECTS				
Production & Master Level, 2 ECTS				

Figure 3 AQUA Levels of Skills – Bachelor versus Master Level

In general, first the bachelor related elements need to be trained and certified. And based on that knowledge the engineering elements of unit 2 can be taught.

In case of industry courses where experienced industry staff knows already the basics the master level course can be held without a prior bachelor level course.

3.3 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 "Automotive Quality Manager with AQUA Skills" has been designed.

UnitID	Unit Name	Element ID	Element Name
AQUA.U1	Introduction	AQUA.U1.E1	Introduction
		AQUA.U1.E2	Integration view and general part
		AQUA.U1.E3	Organisational readiness
AQUA.U2	Product Development	AQUA.U2.E1	Lifecycle
		AQUA.U2.E2	Requirements
		AQUA.U2.E3	Design
		AQUA.U2.E4	Integration and Testing
AQUA.U3	Quality and Safety management	AQUA.U3.E1	Capability
		AQUA.U3.E2	Hazard & Risk management

		AQUA.U3.E3	Assessment and audit
AQUA.U4	Measure	AQUA.U4.E1	Measurements
		AQUA.U4.E2	Reliability

Figure 4 AQUA Skills Hierarchy

For each element four views are developed:

1. From the integrated perspective
2. From the Automotive SPICE perspective
3. From the Functional Safety perspective
4. From the Six Sigma perspective

Therefore each element has 4 performance criteria.

3.4 THE SKILLS DESCRIPTIONS – JOB ROLE AUTOMOTIVE QUALITY ENGINEER

Domain Acronym: AQUA

Domain title: Automotive Quality

Domain Description:

In AQUA a modular set of learning elements has been built for the Automotive industry to apply a combined method of Six Sigma (production quality), functional safety (safety integrity level), and Automotive SPICE (capability level). In the skill card we integrate 4 performance criteria per element, covering an integrated view, Automotive SPICE, Functional Safety, and Six Sigma.

Job Role Acronym: AQUA

Job Role Title: Automotive Quality Engineer

Description:

The job role contains 4 major units:

- AQUA.U1 Introduction
- AQUA.U2 Product Development
- AQUA.U3 Quality and Safety management
- AQUA.U4 Measure

3.5 UNIT AQUA.U1: INTRODUCTION

Acronym: AQUA.U1

Title: Introduction

Description:
This unit gives an overview about the purpose and necessity of each expert domain with respect to quality and safety, as well as the need of an integrated approach. Both a technical and organisational viewpoint are elaborated.

3.5.1 Element AQUA.U1.E1: Introduction

Acronym: AQUA.U1.E1

Element Title: Integration view and general part

Element Note:

This element introduces the main principles of system engineering, the V-model the basics of Automotive SPICE®, ISO26262 and Six Sigma.

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 -
AQUA.U1.E1.PC1	The student understands the principles of System Engineering
AQUA.U1.E1.PC2	The student understands the V-Model and its processes
AQUA.U1.E1.PC3	The student understands the aims and purpose of Automotive SPICE®
AQUA.U1.E1.PC4	The student understands the purpose of the ISO 26262
AQUA.U1.E1.PC5	The student understands the origin and background of the Six Sigma methodology

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

3.5.2 Element AQUA.U1.E2: Integration view and general part

Acronym: AQUA.U1.E2

Element Title: Integration view and general part

Element Note:

This element introduces the essentials technical challenges of each AQUA expert domain, and provides an integrated view on them.

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 -
AQUA.U1.E1.PC1	The student understands how the Six Sigma, Automotive SPICE, and Functional Safety can be combined in the overall engineering process.
AQUA.U1.E1.PC2	The student can describe the motivation and the architecture of Automotive SPICE.

Performance Criterion	Evidence Check: The student can demonstrate -
AQUA.U1.E1.PC3	The student can describe the motivation and the architecture of ISO 26262.
AQUA.U1.E1.PC4	The student understands the DMAIC methodology and tools & techniques according ISO 13053 and LSSA skill sets for Lean Six Sigma Belts.

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

3.5.3 Element AQUA.U1.E3: Organisational readiness

Acronym: AQUA.U1.E2

Element Title: Organisational readiness

Element Note:

This element introduces the essentials organisational challenges of each AQUA expert domain, and provides an integrated view on them.

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 -
AQUA.U1.E2.PC1	The student understands the essential role of interdisciplinary teams to facilitate integration in the specific context of holistic quality engineering and management.
AQUA.U1.E2.PC2	The student can describe the organisational requirements to development teams and their competencies according to Automotive SPICE.
AQUA.U1.E2.PC3	The student can describe the organisational requirements for a good safety culture and successful safety management.
AQUA.U1.E2.PC4	The student can describe Lean Six Sigma levels of expertise: Master Black Belt, Black Belt, Green Belt, Orange Belt and Yellow Belt.

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

3.6 UNIT AQUA.U2: PRODUCT DEVELOPMENT

Acronym: AQUA.U2

Title: Product Development

Description:
This units investigates the domain expert and integrated views on the subject of product development. Based on the life cycle view, the principal subjects are requirements management, design, as well as integration and testing.

3.6.1 Element AQUA.U2.E1: Lifecycle

Acronym: AQUA.U2.E1

Element Title: Lifecycle

Element Note:

This element deals with the life cycle view and the student understands according to the three expert domains, as well as their integration.

Performance Criteria understanding

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

Performance Criterion	Evidence Check: The student can demonstrate -
AQUA.U2.E1.PC1	The student understands how the Six Sigma, Automotive SPICE, and Functional Safety can be combined in an integrated life cycle approach.
AQUA.U2.E1.PC2	The student can describe the life cycle concepts underlying Automotive SPICE.
AQUA.U2.E1.PC3	The student can describe the safety life cycle according to ISO 26262.
AQUA.U2.E1.PC4	The student understands and follow the Six Sigma DMADV and DMAIC roadmap. Identify and select the proper tools to use during the Process Improvement project and the design (DFSS) phase.

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

3.6.2 Element AQUA.U2.E2: Requirements

Acronym: AQUA.U2.E2

Element Title: Requirements

Element Note:

This element explains how requirements are managed in the three expert domains, as well as how an integrated approach looks like.

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 -
AQUA.U2.E2.PC1	The student understands the complementary key roles of requirements management in the three expert domains.
AQUA.U2.E2.PC2	The student can describe the requirements related processes and traceability concept in Automotive SPICE.

Performance Criterion	Evidence Check: The student can demonstrate -
AQUA.U2.E2.PC3	The student can describe the derivation of the safety requirements from the hazard analysis and risk assessment, as well as the integration of the safety requirements into the system requirements and the technical safety concept.
AQUA.U2.E2.PC4	Show how the project will impact customers. Identify internal and external customers. Define and The student can describe CTQ requirements (critical to quality) and the importance of aligning projects with those requirements. Translate Voice of the customer (VOC) requirements into project goals and objectives. Translate objectives into CTQ targets and specifications.

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

3.6.3 Element AQUA.U2.E3: Design

Acronym: AQUA.U2.E3

Element Title: Design

Element Note:

This element deals with the view on the design approach of the three expert domains, as well as their integration

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 -
AQUA.U2.E3.PC1	The student understands the complementary views on design in the three expert domains.
AQUA.U2.E3.PC2	The student can describe the different levels of design and the traceability concept in Automotive SPICE.
AQUA.U2.E3.PC3	The student can describe the different levels of the functional safety related design process.
AQUA.U2.E3.PC4	The student can describe and apply DOE principles and terms: Responses, Variables, Factors, Levels, Interactions, transfer function. The student understands the difference between full factorial experiments and fractional factorial experiments.

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

3.6.4 Element AQUA.U2.E4: Integration and Testing

Acronym: AQUA.U2.E4

Element Title: Integration and Testing

Element Note:

This element explains how integration and testing are managed in the three expert domains, as well as how an integrated approach looks like.

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 -
AQUA.U2.E4.PC1	The student understands the complementary views on integration and testing in the three expert domains.
AQUA.U2.E4.PC2	The student can describe the different levels of testing and the traceability concept in Automotive SPICE.
AQUA.U2.E4.PC3	The student can describe the verification and validation concepts according to ISO 26262.
AQUA.U2.E4.PC4	The student understands which different types of tests can be used during product development.

Table 7: Performance Criteria for the Element AQUA.U2.E4

3.7 UNIT AQUA.U3: QUALITY AND SAFETY MANAGEMENT

Acronym: AQUA.U3

Title: Quality and Safety management

Description:
This unit puts a focus on the program's essential aspects quality and safety management in terms of the transversal subjects Capability, Hazard and Risk Management, as well as Assessment and Audit. It explains the particular significance of these subjects in each expert domain, and why and how an integrated view can and should be adopted.

3.7.1 Element AQUA.U3.E1: Capability

Acronym: AQUA.U3.E1

Element Title: Capability

Element Note:

This element explains how the term Capability is understood in each of the three expert domains, and shows an integrated view allowing to The student understands capability holistically.

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 -
AQUA.U3.E1.PC1	The student understands how the Six Sigma, Automotive SPICE, and Functional Safety can lead to a more complete concept of capability of the development process, product, and production (P3 concept).
AQUA.U3.E1.PC2	The student can describe the capability dimension in Automotive SPICE.
AQUA.U3.E1.PC3	The student can describe the concept of automotive safety integrity levels (ASILs) as a principal requirement and measure of capability in automotive functional safety.
AQUA.U3.E1.PC4	The student understands the relationship between long-term and short-term capability. Define, select and calculate Cp and Cpk to assess process capability. Define, select and calculate Pp and Ppk to assess process performance.

Table 8: Performance Criteria for the Element AQUA.U3.E1

3.7.2 Element AQUA.U3.E2: Hazard & Risk management

Acronym: AQUA.U3.E2

Element Title: Hazard & Risk management

Element Note:

This element deals with the management of hazards and risks from the three expert areas' points of view, and explains an integrated approach.

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 -
AQUA.U3.E2.PC1	The student understands the complementary views on hazard and risk management in the three expert domains.
AQUA.U3.E2.PC2	The student can describe how Risk Management is implemented in Automotive SPICE.
AQUA.U3.E2.PC3	The student can describe the Hazard Analysis and Risk Assessment and Management concept according to ISO 26262.
AQUA.U3.E2.PC4	Define and document the key functions of a design, the primary potential failure modes relative to each function and the potential causes of each failure mode.

Table 9: Performance Criteria for the Element AQUA.U3.E2

3.7.3 Element AQUA.U3.E3: Assessment and audit

Acronym: AQUA.U3.E3

Element Title: Assessment and audit

Element Note:

This elements explains the essential role of assessments and audits in all the expert areas, as well as an integrated approach to these activities.

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 -
AQUA.U3.E3.PC1	The student understands how the Automotive SPICE, Functional Safety, and Six Sigma assessment and audits methods form an integrated concept.
AQUA.U3.E3.PC2	The student can describe the assessment method of Automotive SPICE.
AQUA.U3.E3.PC3	The student can describe safety audit and assessment requirements according to ISO 26262.
AQUA.U3.E3.PC4	The student understands how to prepare for internal audits. The student understands the audit process and different roles.

Table 10: Performance Criteria for the Element AQUA.U3.E3

3.8 UNIT AQUA.U4: MEASURE

Acronym: AQUA.U4

Title: Measure

Description:
This unit deals with measurements and reliability in the context of the three expert domains and their integration.

3.8.1 Element AQUA.U4.E1: Measurements

Acronym: AQUA.U4.E1

Element Title: Measurements

Element Note:

This element investigates the role of measurements in the three experts, as well as the integrated view on it.

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 -
AQUA.U4.E1.PC1	The student understands how the Six Sigma, Automotive SPICE, and Functional Safety can be combined in the overall measurement system.
AQUA.U4.E1.PC2	The student can describe the typical metrics and measurements expected by Automotive SPICE.
AQUA.U4.E1.PC3	The student can describe key metrics used to measure risk in automotive functional safety.
AQUA.U4.E1.PC4	The student can calculate process performance metrics such parts per million (PPM), defects per million opportunities (DPMO), defects per unit (DPU), process yield and First Time Right (FTR) yield. The student understands the various factors that influence Measurement System Variation (accuracy (bias), precision (repeatability and reproducibility) and stability.

Table 11: Performance Criteria for the Element AQUA.U4.E1

3.8.2 Element AQUA.U4.E2: Reliability

Acronym: AQUA.U4.E2

Element Title: Reliability

Element Note:

This element explains the significance of reliability in the three expert domains, as well as in an integrated view.

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 -
AQUA.U4.E2.PC1	The student understands the role of the reliability notion in an integrated development approach linking Six Sigma, Automotive SPICE, and Functional Safety.
AQUA.U4.E2.PC2	The student can describe the connection of ASPICE with reliability.
AQUA.U4.E2.PC3	The student can describe the key role of reliability measures, in particular FIT rates, for the achievement of the overall functional safety integrity level achievement.
AQUA.U4.E2.PC4	The student can define reliability specifications and design tests to demonstrate these reliability specifications. Analyse failure data of life time tests.

Table 12: Performance Criteria for the Element AQUA.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 The student can 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 The student can 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 The student can 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.

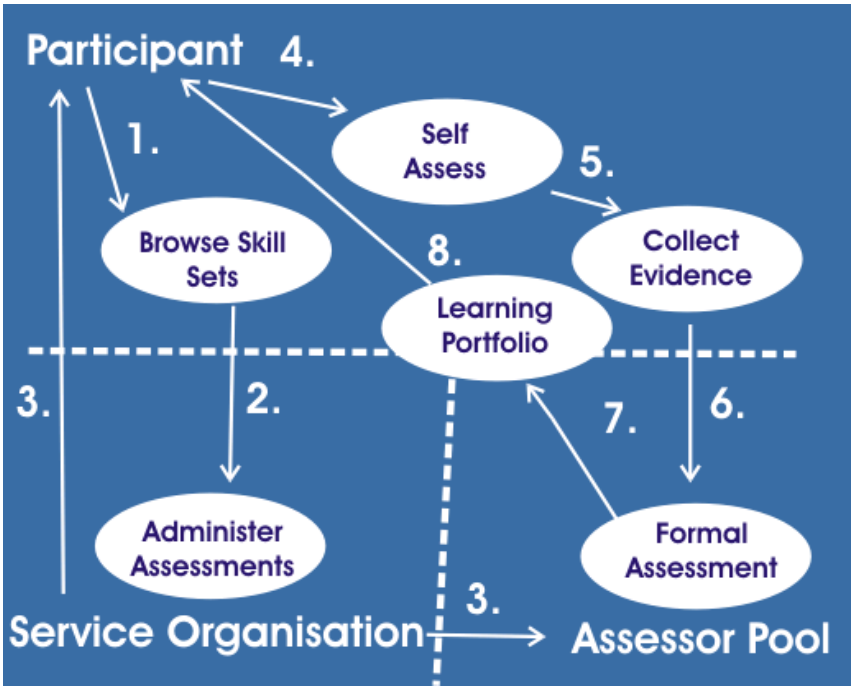
ECQA SKILLS ASSESSMENT MODEL

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

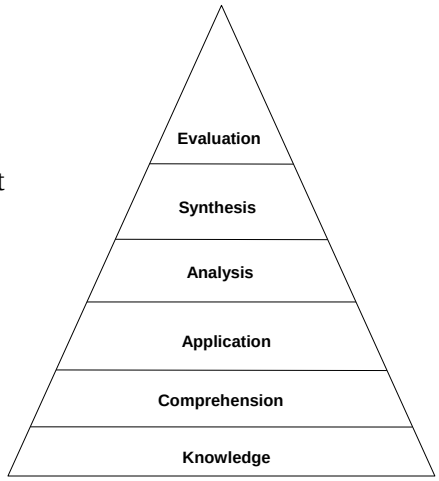
In most cases the same job role can be offered on different levels. e.g. IT Security Manager Basic Level (NVQ level 2), IT Security Manager Advanced level (NVQ Level 3), and IT Security Manager Expert Level (NVQ Levels 4 and 5).

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 The student understandsing 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 The student can describes standard processes for the examination and certification of people. Some of the basic principles The student can 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.

ANNEX D REFERENCES

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