AQUA

Skill Card – Knowledge Alliance for Training Quality and Excellence in Automotive

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Project Partners

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Path

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Version	Revision	Date	Pages	Author	Modification
0.1	1	17.1.2014	All	ALL Partners	Integrating partner contributions to a consolidated skill card
1.0	2	25.2.2014	All	R. Messnarz, C. Kreiner	Update based on integrated Excel version

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Project partners
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Quality System References

ISO 9001 compliant planning and review processes are applied.

NQA 2.5 (Network based Quality Assurance Documentation System)

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1 Introduction

1.1 Objective

The objective of this deliverable is to provide an introduction to European skill cards strategies, to describe the applied skills definition model, and to apply this model to describe the job role of an EU Internal Financial Control Assessor.

1.2 Purpose of the Deliverable

The WP5 Deliverable describes

- What are skill cards
- What is a skills definition model
- What is a typical skills assessment process
- How does this apply for the AQUA Skills Assessment
- The skills definition for the job role AQUA
- What are the special skills necessary for Automotive quality managers with AQUA skills in the field of Automotive industry
- How are the to be developed courses related with the skills definitions

1.3 Scope of the Deliverable

The deliverable contains

- A chapter about skill cards, skills definitions
- A chapter per job role – Automotive Quality Manager with AQUA skills
- A chapter about the demand analysis and how the courses to be developed are derived from the skills definitions

The deliverable does not cover:

- Already course development, as this was done in parallel to the skills definitions (each skills element is related to a specific course unit).

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1.4 Acronyms and Definitions Used

Acronym	Description
CREDIT	Capabilities Registration, Evaluation, Diagnosis & advice through Internet Technology
DTI	Department of Trade and Industry (UK)
EU	European Union
EC	European Commission
ISO	International Organization for Standardization
NVQ	National Vocational Qualification
PC	Performance criteria

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1.5 References

[1] ECQA, European Certification and Qualification Association, www.ecqa.org

[2] R. Messnarz, D. Ekert, M. Reiner. M.A. Sicilia, **Europe wide Industry Certification Using Standard Procedures based on ISO 17024**, in: Proceedings of the TAEE Conference, Vigo, Spain, June 2012, IEEE Computer Society Press

[3] DTI - Department of Trade and Industry UK, British Standards for Occupational Qualification, National Vocational Qualification Standards and Levels

[4] ECQA Standard for Job Role Certification - http://www.ecqa.org/fileadmin/documents/Job_Role_Committee/ECQA-job-role-certification.pdf

[5] R. Messnarz, Ist die Komplexität beherrschbar?, Automotive Cluster Austria, AC Quarterly Magazine, 02-2012

[6] Andreas Riel, Ovi Bachmann, Klaudia Dussa-Zieger, Christian Kreiner, Richard Messnarz, Risto Nevalainen, Bernhard Sechser, and Serge Tichkiewitch (2012) EU Project SafEUr - Competence Requirements for Functional Safety Managers, in Dietmar Winkler, Rory V. O'Connor, Richard Messnarz (eds), Systems, Software and Services Process Improvement, Communications in Computer and Information Science, CCIS 301, Springer, 2012

[7] Richard Messnarz, Frank König, Ovi Bachmann (2012) Experiences with Trial Assessments Combining Automotive SPICE and Functional Safety Standards, in Dietmar Winkler, Rory V. O'Connor, Richard Messnarz (eds), Systems, Software and Services Process Improvement, Communications in Computer and Information Science, CCIS 301, Springer, 2012

[8] SOQRATES Safety Team, Richard Messnarz, Hans-Leo Ross, Stephan Habel, Frank König, Abdelhadi Koundoussi, Jürgen Unterrreitmayer, Damjan Ekert, Integrated Automotive SPICE and safety assessments (p 279-288), in Wiley SPIP, Volume 14 Issue 5, September 2009

[9] Christian Kreiner, Richard Messnarz, Andreas Riel, Damjan Ekert, Michael Langgner, Dick Theisens , Michael Reiner, Automotive Knowledge Alliance AQUA – Integrating Automotive SPICE, Six Sigma, and Functional Safety, in EuroSPI 2013 Proceedings, CCIS Series 364, Springer Verlag, June 2013

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1.6 Skill Card Strategy

Imagine that in the future Europeans will have a skill card 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, and e.g. companies in Italy employ project managers from Ireland, etc. European countries such as UK, The Netherlands, and France have already 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 EU Cert Campus (Accreditation of Skills via the Internet) 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.

1.7 Skills Definition Model

For developing the skill set of the Automotive Quality Managers with AQUA skills we base 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, and so we also base our work on these models [1], [2], [3], [4].

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

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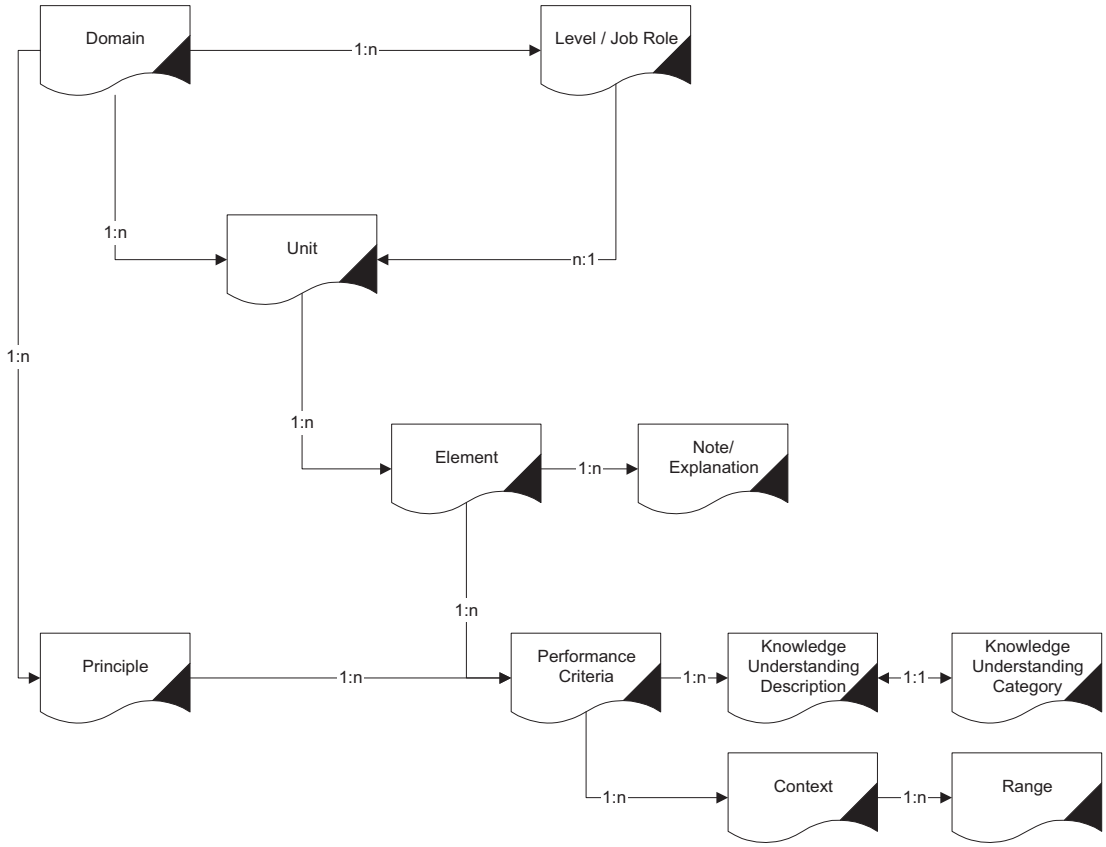

Figure 1: The Skill Definition Model (1:n = one to many relationship)

Context (UK standards): 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 (UK standards): 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 (UK standards): A category of knowledge and understanding descriptions.

Knowledge and understanding description (UK standards): 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.

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

Performance criterion (UK standards): 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 (UK standards): A statement of good intentions; it underpins all competent domain practice.

Range (UK standards): 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.

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

Job Role: A certain profession that covers part of the domain knowledge. E.g. domain = EC Project Management, job role = EC Project Quality Manager.

Unit (UK standards): 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.

1.8 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 AQUA project the registration will automatically assign the predefined set of QUA skills units.

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.

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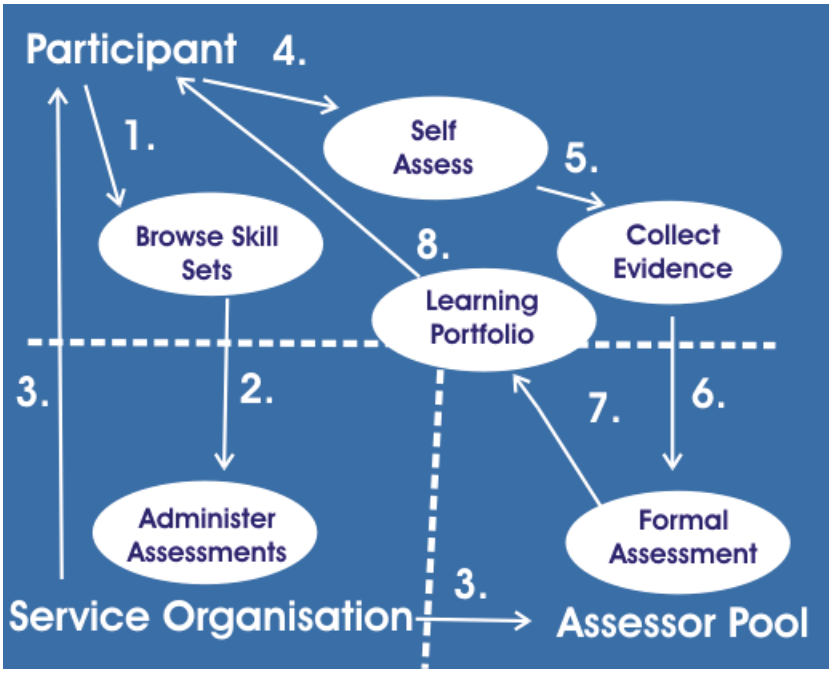

Figure 2: The Skills Assessment Model

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

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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).

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2 How Does This Apply / Demand Analysis

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

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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).

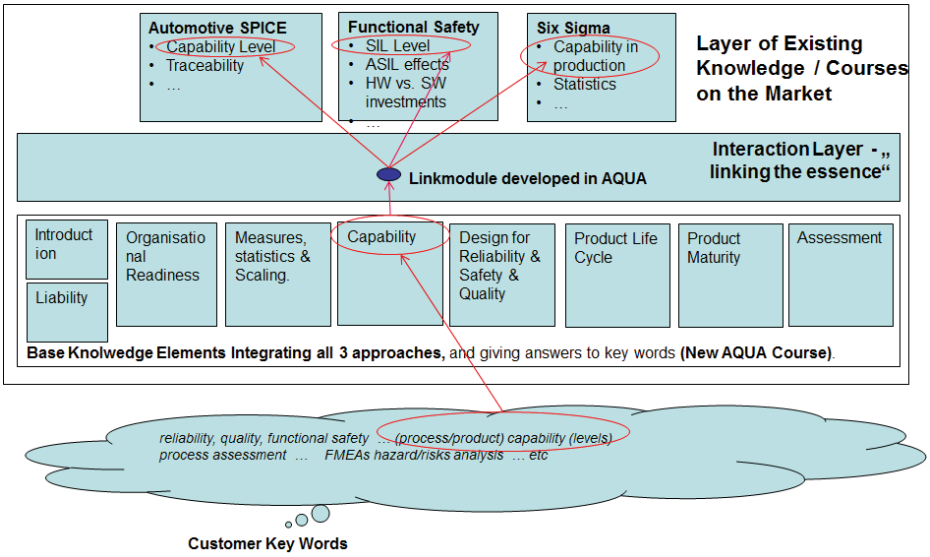

Figure 3: Integrated Base Modules Concept of AQUA and Linking Strategy

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.

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3 Skills Definition for the Job Role "Automotive Quality Manager with AQUA Skills"

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

UnitID	Unit Name	Element ID	Element Name
AQUA.U1	Introduction	AQUA.U1.E1	Integration view and general part
		AQUA.U1.E2	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: The Skills Card for AQUA

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.

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3.2 The Skills Descriptions – Job Role AQUA

Domain Acronym: AQ

Domain title: Automotive Quality

Domain Description:

In AQUA a "Baukasten" 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 Manager with AQUA Skills

Description:

The job role contains 4 major units:

1. AQUA.U1 Introduction
2. AQUA.U2 Product Development
3. AQUA.U3 Quality and Safety management
4. AQUA.U4 Measure

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3.2.1 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.

3.2.1.1 Element AQUA.U1.E1: Integration view and general part

Acronym: AQUA.U1.E1

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	• Understand how the Six Sigma, Automotive SPICE, and Functional Safety can be combined in the overall engineering process.
AQUA.U1.E1.PC2	• Describe the motivation and the architecture of Automotive SPICE.
AQUA.U1.E1.PC3	• Describe the motivation and the architecture of ISO 26262.
AQUA.U1.E1.PC4	• Understand the DMAIC methodology and tools & techniques according ISO 13053 and LSSA skill sets for Lean Six Sigma Belts.

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

3.2.1.2 Element AQUA.U1.E2: Organisational readiness

Acronym: AQUA.U1.E2

Element Title: Organisational readiness

Element Note:

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

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

3.2.2 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.

3.2.2.1 Element AQUA.U2.E1: Lifecycle

Acronym: AQUA.U2.E1

Element Title: Lifecycle

Element Note:

This element deals with the life cycle view and understanding according to 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):

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Performance Criterion	Evidence Check: The student can demonstrate -
AQUA.U2.E1.PC1	• Understand how the Six Sigma, Automotive SPICE, and Functional Safety can be combined in an integrated life cycle approach.
AQUA.U2.E1.PC2	• Describe the life cycle concepts underlying Automotive SPICE.
AQUA.U2.E1.PC3	• Describe the safety life cycle according to ISO 26262.
AQUA.U2.E1.PC4	• Understand 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 3: Performance Criteria for the Element AQUA.U2.E1

3.2.2.2 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	• Understand the complementary key roles of requirements management in the three expert domains.
AQUA.U2.E2.PC2	• Describe the requirements related processes and traceability concept in Automotive SPICE.
AQUA.U2.E2.PC3	• 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 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 4: Performance Criteria for the Element AQUA.U2.E2

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

Table 5: Performance Criteria for the Element AQUA.U2.E3

3.2.2.4 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	• Understand the complementary views on integration and testing in the three expert domains.

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Performance Criterion	Evidence Check: The student can demonstrate -
AQUA.U2.E4.PC2	• Describe the different levels of testing and the traceability concept in Automotive SPICE.
AQUA.U2.E4.PC3	• Describe the verification and validation concepts according to ISO 26262.
AQUA.U2.E4.PC4	• Understand which different types of tests can be used during product development.

Table 6: Performance Criteria for the Element AQUA.U2.E4

3.2.3 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.

3.2.3.1 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 understand 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	• Understand 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	• Describe the capability dimension in Automotive SPICE.
AQUA.U3.E1.PC3	• 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	• Understand the relationship between long-term and short-term capability. Define, select and calculate Cp and Cpk to assess

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Performance Criterion	Evidence Check: The student can demonstrate -
	process capability. Define, select and calculate Pp and Ppk to assess process performance.

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

3.2.3.2 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	• Understand the complementary views on hazard and risk management in the three expert domains.
AQUA.U3.E2.PC2	• Describe how Risk Management is implemented in Automotive SPICE.
AQUA.U3.E2.PC3	• 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 8: Performance Criteria for the Element AQUA.U3.E2

3.2.3.3 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:

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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	• Understand how the Automotive SPICE, Functional Safety, and Six Sigma assessment and audits methods form an integrated concept.
AQUA.U3.E3.PC2	• Describe the assessment method of Automotive SPICE.
AQUA.U3.E3.PC3	• Describe safety audit and assessment requirements according to ISO 26262.
AQUA.U3.E3.PC4	• Understand how to prepare for internal audits. Understand the audit process and different roles.

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

3.2.4 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.

3.2.4.1 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	• Understand how the Six Sigma, Automotive SPICE, and Functional Safety can be combined in the overall measurement system.
AQUA.U4.E1.PC2	• Describe the typical metrics and measurements expected by Automotive SPICE.
AQUA.U4.E1.PC3	• Describe key metrics used to measure risk in automotive

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Performance Criterion	Evidence Check: The student can demonstrate -
	functional safety.
AQUA.U4.E1.PC4	• 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. Understand the various factors that influence Measurement System Variation (accuracy (bias), precision (repeatability and reproducibility) and stability.

Table 10: Performance Criteria for the Element AQUA.U4.E1

3.2.4.2 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	• Understand the role of the reliability notion in an integrated development approach linking Six Sigma, Automotive SPICE, and Functional Safety.
AQUA.U4.E2.PC2	• Describe the connection of ASPICE with reliability.
AQUA.U4.E2.PC3	• 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	• Define reliability specifications and design tests to demonstrate these reliability specifications. Analyse failure data of life time tests.

Table 11: Performance Criteria for the Element AQUA.U4.E2

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Appendix – Metrics

3.3 Size of the Skill Card

The below table shall illustrate the size of the achievements made in Work Package 4

Job Role	Number Units	Number Elements	Number Performance Criteria
AQUA	4	11	44

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