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IQSIM2

New Innovative Simulator Tools for Quality Capacity Environmental Production Process Training in Education of Migrants

Erasmus+
Cooperation partnerships in adult education
Agreement no.: 2021-1-NO01-KA220-ADU-000033720

D2.1 Best practice guideline monitoring progress of teachers

Version:
Date: **18.03.2024**

Summary

EU directives, harmonized standards and guidelines targeting the expanding fabrication industry, create a strong demand for using efficient new learning technologies within the European mechanical industry environment that takes place.
Introduction of new technologies combined with highly automated processes and integration of IT technology, creates a new environment for the people in this business.
Outsourcing has helped companies in Europe to turn around their processes and become more competitive in the world markets. Manufacturing is the 2nd largest sector in outsourcing, with 150b Euros worth of contracts worldwide. In this environment, companies do not only sell products, but also know-how and processes. In the context of the virtual and modular enterprise, large companies need to transfer their internally developed know how to SMEs that are recipients of outsourcing contracts.
The need for understanding the processes and production flow becomes more and more important. The need to understand the national characteristics and the environment where the product is being used becomes vital.

EU directives, harmonized standards, and educational guidelines targeting the interplay with the expanding SME fabrication industry promote new production systems where knowledge-based production is frequently used as a convenient and necessary tool together with Product Based Learning (PBL).

Target audience.

This document is written for the participants in the project as a part of the project plan. The target audience in this project is people with background from mechanical engineering and with extensive experience from welding technology and industrial production.
This means the document contains a number of “trade specific” words and expressions that might be unknown for a casual reader.
It has been written however also with the background that people without any knowledge of this type of industry and production technology should be able to get a reasonable overview of the tasks.

Additionally, it is expected that the teachers are experienced teachers with background from mechanical industry. And, with background and experience from practical welding.
The comments in this Guideline are based on that they have this background.

The teacher’s role and current status.

A general problem for the VET schools and course providers are that the local teachers have little time to develop new courses, or Competence Units (CUs) by themselves. Additionally, the courses that are based on PBL and modeled according to the production flow, or fabrication flow, also requires that the teachers have a broad knowledge of that topic.
The status of most of the teachers are that they are employed based on their national local industry background.

But what are the local industry background?

National industry background.

Norway.

Most engineers needed in Norway are within mechanics & mechanical design, electricity (high voltage), steel structures, electronics/automation/instrumentation, and piping (for the Oil & Gas) Norway is an Oil & Gas nation, so most jobs are in Oil & Gas companies and companies that deliver to the Oil & Gas industry.

Hungary.

The main sectors of Hungarian industry are heavy industry (mining, metallurgy, machine and steel production), energy production, mechanical engineering, chemicals, food industry and automobile production.

Unfortunately, a number of teachers do not have the broad background which is required for following all the topics that can be raised through such courses.
The courses which contain a number of Competence Units, CUs, and these units follows the development of a product, from initial order phase through the different production steps until a product delivery to a client.

Romania.

In 2018 Romania enjoyed one of the largest world market shares in machine tools (5.3%). Romanian-based companies are well known throughout Europe. However, small- to medium-sized manufacturing firms still form bulk of the manufacturing sector. These firms employ two-thirds of the Romanian workforce.

Sweden

Welding personnel are always in demand in Sweden, with great pay and job opportunities. Sectors such as mechanical, civil, project and electrical engineering are considered among the top. The main reason behind this is Sweden's continuous efforts in investing in technology, and infrastructure. Mechanical engineering offers diverse career options in areas including the aeronautics and automotive industries, acoustics, biomechanics, manufacturing, minerals and energy technology, robotics, and construction.

Work Based Content

The course will clarify the welders` role in manufacturing where it begins well before welding starts, continues during the welding operation, involves action after welding is completed, and is finalized only when the results are properly reported.
The course will be work-based and follows the manufacturing process from the order is received until the welded product is ready for delivery. The welder is responsible for producing documents that verify the quality of the components and related manufacturing action throughout this process

that the welder has the responsibilities for.

However, if we look at the industry structure in the participants countries, it is obvious that the industry culture is different from offshore, through machine tools through to aeronautics.
In a project like iQSIM2 where the PBL follows a production flow, then course design as well as the design of the CUs will not follow the industry culture for some of the participants.

Learning methods and activities

The activities in this course are work-based and follows a product as it is being produced in the factory until it is ready for delivery. The manufacturing process has been divided in logical steps whereby the learning activity and learning content and tasks, are distributed according to the status of the manufacturing process.
Activities in the course will be both planning activities as well as practical tasks to be carried out in the workshop together with the mentor of the company.
The learning material will be distributed through a LMS (Learning Management System) system provided for this course.
Learning methods will be a mixture of solving planning and reporting tasks through the classroom or through the LMS (Learning Management System) system and practical hands-on training in the workshop.
The CUs will follow the work-based production process. Each CU will either be a part of the work preparation activities or a part of the production activities.

Harmonization of the work content and production flows.

Based on the national industry background, it is pretty obvious that the quality requirements for the products they are producing in the different countries for their main industry, will be different.

The quality requirements and documentation needs for a pressure boiler in Hungary operating at 10 bar will be different from the quality requirements and documentation for a subsea Christmas tree operating at 1200 meter water depth.
The same will be with the quality documentation for the aerospace industry in Sweden, like for the Gripen Fighter plane.

This means that the practical consequences are that the teachers background will be different. Their experience, their know-how and their competence will vary based on their industrial background and the industrial culture.

When the project is developing a common course structure with a common content, then it was pretty obvious when developing D1.1 that it would be easy to develop the course structure, but we would struggle with the teacher's background for teaching the different CUs in accordance with the CU requirements.

Based on the development of the course, and the CUs, it turned out that in different CUs the project used words, terminology and examples that could be outside the current national teacher's experience.
A training course or a checklist of important terms, expressions and so on, had to be developed to

allow the teachers to see if their current experience would be enough to teach the new course developed through the project.
Such a teacher checklist is given in D2.3 as the first draft example.
The teacher's checklist that follows in D2.3 lists a number of problem areas and topics that will pop-up through a PBL based course following the fabrication process.

The idea behind the checklist is that the teacher can evaluate the topics and problem areas in the CUs and for the course and see if he/she has a sound background for teaching the course and to evaluate if additional knowledge, and competence must be obtained before the teaching activities starts.

At a later project a guide for the different topics and problem areas may be developed.

Semantic Interoperability

The project has developed a course which will be used in different countries spanning a range of different languages. The project language will be English, and the courses will be developed in that language. However, the target user audience will require that the learning material must be in their native language, which consequently require the teacher or the course provider to translate the course material, either partly or in full.
A direct word-for word translation will be easy although time consuming. However, such a translation will reflect the knowledge level of the translator and the personnel giving the translation their consent. The translator will have a different reference background and a different competence level than the target student group and this may lead to a differentiation in the textual context that may give the phrases different content or meaning of the content.
It is assumed that this is a minor problem for ordinary text, but text related to welding will often describe technical items and relations that are related to different technological levels and experience. This experience and technological levels may often use the same words and phrases that others with different background also are using.

Example:
What does an acceptable quality joint mean? In the above picture we see that the welder has inserted a piece of the welding rod to compensate for wrong fit-up and dimensional control. This

joint would very often be acceptable in shipbuilding or also in steel construction. In offshore such joints will not be acceptable and it will require a costly repair procedure.

The knowledge space and the competence are crucial factor in defining the content of the word and the sentences. In welding, like in many related technical areas several technical phrases have been used over decades without any change and this may very well create problems within the education itself.

Example:

Acceptable quality	Again an expression that covers a wide variety of practical results. The phrase will contain quite different elements if you are coming from the shipbuilding industry compared with offshore industry. The expression does not say anything that can be used for identifying the quality or which standards or definitions that shall be implied in the expression.

The other dimension in this discussion is the vocabulary has changed over the years with new words describing new methods and new technology, which is quite naturally. However, the older vocabulary has partly changed content because of knowledge and competence obtained by the stakeholders involved in the development of the fabrication process itself. This is a continuous process following the development of the industry in the different countries.
The result of such process may have a dramatic effect on the communication between the partners involved in this process. The sender will utilize a word or a phrase with a certain content where the knowledge and competence of the sender implicit defines the volume or extent of the content and the receiver will have a different perception of the word or phrase received because the level of knowledge and competence may vary.

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Erasmus+
Cooperation partnerships in adult education
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D2.2 Guideline monitoring progress of teachers based on the pilot courses.

Version:
Date: **18.03.2024**

Summary

Based on D1.1, D1.3 and D1.4 and D2.1 and with discussions with teachers both in the project and with teachers outside the project but working with the same type of education, it became obvious that the course CUs would contain tasks for the students that might be solved in different ways with different complexity depending on the industrial background and experience that the teacher had.

To get the standardized course to be interpreted and executed in a harmonized way, it would be an advantage to create a teacher checklist of topics, cases, and statements where the teacher could reflect on their knowledge and competence.

Target audience.

This document is written for the participants in the project as a part of the project plan. The target audience in this project is people with background from mechanical engineering and with extensive experience from welding technology and industrial production.
This means the document contains several “trade specific” words and expressions that might be unknown for a casual reader.
It has been written however also with the background that people without any knowledge of this type of industry and production technology should be able to get a reasonable overview of the tasks.

Additionally, it is expected that the teachers are experienced teachers with background from mechanical industry. And, with background and experience from practical welding.
The comments in this Guideline are based on that they have this background.

The teacher’s role and status.

A general problem for the VET schools and course providers are that the local teachers have little time to develop new courses, or Competence Units (CUs) by themselves. Additionally, the courses that are based on PBL and modeled according to the production flow, or fabrication flow, also requires that the teachers have a broad knowledge of that topic.
The status of most of the teachers are that they are employed based on their local industry background.

But what are the local industry background?

National industry background.

Norway.

Most engineers needed in Norway are within mechanics & mechanical design, electricity (high voltage), steel structures, electronics/automation/instrumentation, and piping (for the Oil & Gas) Norway is an Oil & Gas nation, so most jobs are in Oil & Gas companies and companies that deliver to the Oil & Gas industry.

Expected teacher’s background.

Working language: English
Product type: Offshore steel structure with the main supplier or together with a sub-suplier
Quality requirements: ISO 3834 Comprehensive level combined with ISO 9001 and EN 1090-1 combined with FPC (Factory Production Control). Additional standards will be NORSOK M-501:2022

Hungary.

The main sectors of Hungarian industry are heavy industry (mining, metallurgy, machine, and steel production), energy production, mechanical engineering, chemicals, food industry and automobile production.

Unfortunately, several teachers do not have the broad background which is required for following all the topics that can be raised through such courses.
The courses which contain several Competence Units, CUs, and these units follows the development of a product, from initial order phase through the different production steps until a product delivery to a client.

Expected teacher’s background.

Working language: Hungarian
Product type: Heavy industry with the main supplier or together with a sub-suplier
Quality requirements: ISO 3834 Standard level combined with ISO 9001 and EN 1090-1

Romania.

In 2018 Romania enjoyed one of the largest world market shares in machine tools (5.3%). Romanian-based companies are well known throughout Europe. However, small- to medium-sized manufacturing firms still form bulk of the manufacturing sector. These firms employ two-thirds of the Romanian workforce.

Expected teacher’s background.

Working language: Romanian
Product type: Steel structure with the main supplier.
Quality requirements: ISO 3834 Elementary level combined with ISO 9001

Sweden

Welding personnel are always in demand in Sweden, with great pay and job opportunities. Sectors such as mechanical, civil, project and electrical engineering are considered among the top. The main reason behind this is Sweden's continuous efforts in investing in technology, and

infrastructure. Mechanical engineering offers diverse career options in areas including the aeronautics and automotive industries, acoustics, biomechanics, manufacturing, minerals and energy technology, robotics, and construction.

Expected teacher's background.

Working language: English
Product type: Steel structure with the main supplier or together with a sub-suplier
Quality requirements: ISO 3834 Comprehensive level combined with ISO 9001

Work Based Content

The course will clarify the welders` role in manufacturing where it begins well before welding starts, continues during the welding operation, involves action after welding is completed, and is finalized only when the results are properly reported.
The course will be work-based and follows the manufacturing process from the order is received until the welded product is ready for delivery. The welder is responsible for producing documents that verify the quality of the components and related manufacturing action throughout this process that the welder has the responsibilities for.

However, if we look at the industry structure in the participants countries, it is obvious that the industry culture is different from offshore, through machine tools through to aeronautics.
In a project like iQSIM2 where the PBL follows a production flow, then course design as well as the design of the CUs will not follow the industry culture for some of the participants.

Based on the observations about the industry culture and the teachers background a teacher's checklist will be developed in D2.3

Learning methods and activities

The activities in this course are work-based and follows a product as it is being produced in the factory until it is ready for delivery. The manufacturing process has been divided in logical steps whereby the learning activity and learning content and tasks, are distributed according to the status of the manufacturing process.
Activities in the course will be both planning activities as well as practical tasks to be carried out in the workshop together with the mentor of the company.
The learning material will be distributed through a LMS (Learning Management System) system provided for this course.
Learning methods will be a mixture of solving planning and reporting tasks through the classroom or through the LMS (Learning Management System) system and practical hands-on training in the workshop.
The CUs will follow the work-based production process. Each CU will either be a part of the work preparation activities or a part of the production activities.

Harmonization of the work content and production flows.

Based on the national industry background, it is obvious that the quality requirements for the products they are producing in the different countries for their main industry, will be different.

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This means that the practical consequences are that the teachers background will be different. Their experience, their know-how and their competence will vary based on their industrial background and the industrial culture.

When the project is developing a common course structure with a common content, then it was obvious when developing D1.1 that it would be easy to develop the course structure, but we would struggle with the teacher's background for teaching the different CUs in accordance with the CU requirements.

Based on the development of the course, and the CUs, it turned out that in different CUs the project used words, terminology and examples that could be outside the current national teacher's experience.
A training course or a checklist of important terms, expressions and so on, had to be developed to allow the teachers to see if their current experience would be enough to teach the new course developed through the project.
Such a teacher checklist is given in D2.3 as the first draft example.
The teacher's checklist that follows in D2.3 lists several problem areas and topics that will pop-up through a PBL based course following the fabrication process.

The idea behind the checklist is that the teacher can evaluate the topics and problem areas in the CUs and for the course and see if he/she has a sound background for teaching the course and to evaluate if additional knowledge, and competence must be obtained before the teaching activities starts.
The checklist, or questions, can also be used as students tasks in the CUs.

At a later project a guide for the different topics and problem areas may be developed.

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New Innovative Simulator Tools for Quality Capacity Environmental Production Process Training in Education of Migrants

Erasmus+
Cooperation partnerships in adult education
Agreement no.: 2021-1-NO01-KA220-ADU-000033720

D2.3-1 Best practice Guideline based on the initial pilot courses

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Version: **Final**
Date: **21.02.2024**

Introduction.
This summary contains the educational and the results from the pilot course.
The summary and most of the data shown here have been generated in the start up phase of the pilot courses and during the initial discussions of the content of the course as well as through the discussion of how t present the cases.
This summary contains the observations from the different countries and some of the ideas coming out of the pilots

Background.
What has been observed in the CUs with work-based content we are working with knowledge, skills and competence. We assume that the teachers have the required background experience to transfer knowledge and skills and maybe also competence.
However what has been seen is that due to their different cultural background and their industrial background, their knowledge may vary and in some cases additional up-skilling may be required.

Fig: Millers pyramid of competence, where performance in practice represents competence in work-based education and training, where Performance in practice also includes attitudes and ability to cooperate

Problem Based Learning and Product Based Learning.

The IQSIM2 project course contains both Product Based Learning as well as Problem Based Learning.

Product Based Learning is an educational approach where the students learn by building or creating a product. In the IQSIM2 project this product will be an industrial product were one of the key fabrication technologies are welding.
The students are actively involving in all steps in the development of the real product, from initial approval of the design through the preparation and planning stage followed by production and handover of the product to a possible client.
An important factor in this education is that it will involve teamwork and collaboration and cooperation between the students in order to manage the product development.

Problem Based Learning means that the students will identify their learning needs based on the problems that are presented them through the production of the product. The problems given to the students to solve will be real world complex problems that may allow the students to seek out

relevant information. The problem Based Learning will foster critical thinking and creative problem solving as well as collaboration between the students and stimulate to active learning to solve the given problems.

To each of the CUs in the IQSIM2 course, a two sets of direct questions focusing on a problem area has been developed.
The first set of questions are generic and the second set of questions are more specific and can relate directly to the product that will be used as a product case through the course.

Aim.
The aim is therefore to develop a framework as a tool to envisage that the teachers can follow in order to ensure that they have the right knowledge, skills and competence for education and training of students for the respective CUs.

Questions.
The method consists of the following elements:
a. An overview of the general and specific learning outcomes and the competence requirements for the CU.
b. A set of generic questions related to the content in the CU and a common discussion of the questions and answers given through this discussion.
c. A set of specific Product Oriented Questions related to the product that has been selected for the training course. Note that these questions have been specified for each CU in the course.

Training methods.

Again the training method contains three stages:

A) Activities before start of the teacher course.
B) Activities during the teacher course.
C) Activities after the teacher course.

A) Activities before start of the teacher course.

A) A set of generic questions are submitted to the course participants. The participants will answer these questions and submit the answers back to course organizer.
At the first course meetings the answers will be published, anonymously for discussions about the possible alternative answers.
Dependent on the size of the class, this can be taken in one or two steps. Either as a general open discussion in the whole group or it can be done in sub-groups and the result from the sub-group meetings are then discussed in plenum.
Through this discussion a consensus for each of the problem areas have to be met. This consensus will be summarized by the course teacher.

B) Based on the consensus from A, then the Specific Product Oriented questions will be raised. These questions should be raised when the product is known and when the teachers have the product specifications and other relevant documentation of the product, available for the CU that is relevant.

Dependent on the size of the class, this can be taken in one or two steps. Either as a general open discussion in the whole group or it can be done in sub-groups and the result from the sub-group meetings are then discussed in plenum.

The Specific Oriented Questions should be discussed from two perspectives:
* That the question assumes that the Product documentation are correct. And what is the consequences of the questions. And what is the consequences of the questions.
* That the questions assumes that the Product documentation is not correct. And what is the consequences of the questions.

The course teacher should then ensure that a consensus is agreed upon for each of the questions.

Based on the teacher groups initial validation of the results under A, and B, actions can be taken to develop possible missing knowledge or addressing missing competence.

C. Preparing the course for the students. The course and the CUs have a Product Based and also a Problem Based frame.
Based on the selected product a set of questions and tasks have to be developed for the students for each CU. These questions and tasks can be:
* Positive, that means that the students have to solve a task according a specific requirement.
* Negative, that means a problem has occurred and has been defined. The students tasks will be to solve that problem and consequently create a correct solution to the problem.

Again these questions might be of a generic nature and they also can be of a specific nature related to the product selected for the course

Conclusion.

When a Product has been selected for a course or a CU, then a detailed set of tasks for the students and questions can be developed by the teachers.
Based on the results a more general action plan for each CU can be tailored to fill the knowledge and competence gap.

Mapping the students knowledge and competence before start of the course.

Before the start of a course, or start of a CU, a mapping of the students previous knowledge and competence are mapped.
The questions for the mapping will be developed based on the product that will be the reference in the course or the CU. Example if the product is based on piping the questions will differ if the product is based on structural steel.
The questions will be submitted to the students a week before the training will start. Through these questions the students will evaluate their knowledge and competence before the course starts.
In addition a set of Multiple Choice Questions will also be available for more in depth evaluation of their knowledge.
The answers are anonymous.
Based on these answers the teacher can map the status of the class and can through this give a priority to different themes and tasks to be done.
The activities in the class consists of the following:
1. Individual type work
2. Group based work were collaboration and cooperation is stimulated and where the tasks could be both “Positive” or “Negative”.

3. Open discussions in the class.
4. Summary and consensus for the solution organized by the teacher.

Example.

This example is taken from the CU-2 Evaluating a work order.

Relevant generic questions to the teachers for CU-2:

1. Which welding standards are used as basis for creating Welders Certificates?
2. What is the difference between an IIW Welding Diploma and a Welders Certificate?
3. What is a Welder Documentation?
4. What is a Weld Record and what shall be the content of such a record?
5. In what different ways can you maintain a Welders Certificate?
6. How do you ensure that a WPS is used correct in production?
7. What part of ISO 3834 would you recommend to be used for the product in this course?

Relevant Specific questions related to the Product

No	
1	Are all welders and welding operators approved by an appropriate test according to the appropriate part of EN ISO-9606 or other equivalent code/standard?
2	Are all records of approval maintained up to date?
3	Are the tests performed by qualified laboratories?
4	Do you have access to and understanding of ISO 6520 ?
5	Does the welding coordination personnel supply the welding personnel with WPS or Work Instructions, to ensure that all activities can be properly performed and documented?
6	Does the manufacturer prepare WPS in accordance with the appropriate part of ISO 15614 or contract specification?
7	Are there arrangements to ensure that the WPS's are correctly used in production?

CU-2	**Title: Evaluating a work order**

	Content. Through this CU the students will face the following situation: A work order has been released. The welder will get appropriate drawings and Welding Procedures to be used during his/her work. The student will evaluate the work order to see if all relevant information's are available **General Learning outcomes:** ***** Understand the basic terms of welding * Know the range of welder's certificate * Know the basic requirements for a welder's test for certificate **Specific Learning Outcomes.** * Understand the validity of a welder's certificate * Understand the range of approval and the requirements for renewal of certificates * Understand which regulations will be required for the HES **Competence.** The student will know how to: * Follow up the validity of the welder's certificate according to ISO 9606 * Understand which standards that will be important for the job * Understand his/hers responsibility for reporting according ISO 6520 **Use of iQSim software tool:** Not foreseen in this CU Basic: A1 + A9-ref IIW Guideline International Welder

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D2.3-2Pedagogical Guideline Identifying teachers competence

Version:
Date: **21.02.2024**

Summary.

Based on D1.3 and D1.4, D2.1 and D2.2 a Teacher Guideline for identifying their knowledge and competence is required due to the differences in experience and industry culture fabrication process requirements. It became obvious that the course CUs would contain tasks for the students that might be solved in different ways with different complexity depending on the industrial background and experience that the teacher had.

In order to get the standardized course to be interpreted and executed in a harmonized way, this document has been developed in order to identify tasks and topics that will be relevant for the different CUs.

Target audience.

This document is written for the participants in the project as a part of the project plan. The target audience in this project is people with background from mechanical engineering and with extensive experience from welding technology and industrial production.
This means the document contains several “trade specific” words and expressions that might be unknown for a casual reader.
It has been written however also with the background that people without any knowledge of this type of industry and production technology should be able to get a reasonable overview of the tasks.

Additionally, it is expected that the teachers are experienced teachers with background from mechanical industry. And, with background and experience from practical welding.
The comments in this Guideline are based on that they have this background.

The teacher’s current status.

Norway.
Expected teacher’s background.

Working language: English
Product type: Offshore steel structure with the main supplier or together with a sub-suplier
Quality requirements: ISO 3834 Comprehensive level combined with ISO 9001 and EN 1090-1 combined with FPC (Factory Production Control). Additional standards will be NORSOK M-501:2022

Hungary.
Expected teacher’s background.

Working language: Hungarian
Product type: Heavy industry with the main supplier or together with a sub-suplier
Quality requirements: ISO 3834 Standard level combined with ISO 9001 and also EN 1090-1

Romania.
Expected teacher’s background.

Working language: Romanian

Product type: Steel structure with the main supplier.
Quality requirements: ISO 3834 Elementary level combined with ISO 9001

Sweden

Expected teacher's background.

Working language: English
Product type: Steel structure with the main supplier or together with a sub-suplier
Quality requirements: ISO 3834 Comprehensive level combined with ISO 9001

Harmonization of the work content and production flows.

Based on the national industry background, it is obvious that the quality requirements for the products they are producing in the different countries for their main industry, will be different.

This means that the practical consequences are that the teachers background will be different. Their experience, their know-how and their competence will vary based on their industrial background and the industrial culture.

When the project is developing a common course structure with a common content, then it was obvious when developing D1.1 that it would be easy to develop the course structure, but we would struggle with the teacher's background for teaching the different CUs in accordance with the CU requirements.

Such a set of teachers questions as well as teacher self-evaluation are given in D2.3 as the first draft example. The teachers' questions that follow in D2.3 lists a number of problem areas and topics that will pop-up through a PBL based course following the fabrication process.

However, during the discussion of implementing a set of questions as well as self-evaluation, it was argued that what really was needed was a set of questions targeting the teachers in front of each CU for allowing the teachers to discuss important topics of the CU.
By implementing these questions, the teachers could also discuss the interpretations of different technical topics.
Additionally, the CUs are following the production flow in a company. That means that if all CUs are taken, then the production processes are covered as well, which requires an understanding of the production process.
Additional topics will then be necessary to understand, the interconnection between different groups of personnel and their ability to cooperate in the product development.

The idea behind the questions are therefore that the teachers can evaluate the topics and problem areas in the CUs and before the course starts and see if he/she has a sound background for teaching the course and to evaluate if additional knowledge, and competence has to be obtained before the teaching activities starts.

At a later project a guide for the different topics and problem areas may be developed.

Course with Competence Units---CU`s

NOTE: This is the overview of each CU in the course.

NOTE: The course title: European Fillet Welder is the pilot course in this project. **However, the theoretical content will be the same for all Welders courses.** That means if we alter welding processes or product, that does not influence the comments to each CU.

Course	**Title: European Fillet Welder for plate to plate and plate to tube** If the student passes the examination according EWF ANB requirements then the candidates will be granted an EWF European Fillet Welder Diploma. Additionally the student may also take an ISO 9606-1 Welding Certificate for the material and welding process used in the course.

T**he course consists of the following 10 CUs:**

Relevant generic questions for CU-1:

1. Have you been using a Learning Management System (LMS) for teaching students at this level before (work-based learning)?
2. Have you been teaching with a system where the teaching will follow the production process of a product before? If so then how was this solved?
3. Have you been using a video communication system like Zoom, Teams or similar for communication with the students?

Relevant specific questions for CU-1:

No	
1	I have extensive experience form using an LMS in my teaching activities in distributing tasks and content to the students.
2	I have extensive experience in using an LMS as the communication tool with the students.
3	I have experience from using Zoom video communication tools.

CU-1	**Title: Introduction, ICT**
	Content In this CU the students will get an introduction to the course, containing the following topics where they will learn to know each other and the teacher. A presentation of the course and the education methods for this course will be presented. The data tools in this course, Its Learning and ZOOM will be presented, and the students will be familiarized in how to use them for getting information, delivering reports and for communication purposes. A presentation of the education structure and methodology with emphasis on work-based training

	and how this will be implemented in the course will be presented and explained. **General Learning outcomes** * Learn the EWF Guideline for International Welder * Be able to navigate through the available welding standards and select the right standard for a task * Get an overview of the welding standards * Be able to evaluate which other standards and procedures that shall be met during work * Be able to evaluate the HES requirements for å job **Specific Learning Outcomes.** * Know the basics responsibility for own work as a fillet welder * Identify the welders' responsibilities in fabrication * Understand the HES responsibilities of the welder **Competence.** The student will know how to: * Use the data tools needed for e-learning sessions. * Use an LMS (its Learning) tool for extracting learning materials. * Use an LMS tool for submitting tasks and solve multiple choice questions. * Work in groups through using modern data tools, used in the course. * Use Zoom, or similar, video communication tool to communicate with the teacher and other students **Use of iQSim software tool:** Not foreseen in this CU

Relevant generic questions for CU-2:

1. Which welding standards are used as basis for creating Welders Certificates?
2. What is the difference between an IIW Welding Diploma and a Welders Certificate?
3. What is a Welder Documentation?
4. What is a Weld Record and what shall be the content of such a record?
5. In what different ways can you maintain a Welders Certificate?
6. How do you ensure that a WPS is used correct in production?
7. What part of ISO 3834 would you recommend being used for the product in this course?

Relevant specific questions related to the Product.

No	

1	Are all welders and welding operators approved by an appropriate test according to the appropriate part of EN ISO-9606 or other equivalent code/standard?
2	Are all records of approval maintained up to date?
3	Are the tests performed by qualified laboratories?
4	Do you have access to and understanding of ISO 6520 ?
5	Does the welding coordination personnel supply the welding personnel with WPS or Work Instructions, to ensure that all activities can be properly performed and documented?
6	Does the manufacturer prepare WPS in accordance with the appropriate part of ISO 15614 or contract specification?
7	Are there arrangements to ensure that the WPS's are correctly used in production?

CU-2	**Title: Evaluating a work order**
	Content. Through this CU the students will face the following situation: A work order has been released. The welder will get appropriate drawings and Welding Procedures to be used during his/her work. The student will evaluate the work order to see if all relevant information's are available. **General Learning outcomes:** * Understand the basic terms of welding * Know the range of welder's certificate * Know the basic requirements for a welder's test for certificate **Specific Learning Outcomes.** * Understand the validity of a welder's certificate * Understand the range of approval and the requirements for renewal of certificates * Understand which regulations will be required for the HES **Competence.** The student will know how to: * Follow up the validity of the welder's certificate according to ISO 9606 * Understand which standards that will be important for the job * Understand his/hers responsibility for reporting according ISO 6520 **Use of iQSim software tool:** Not foreseen in this CU Basic: A1 + A9

Relevant generic questions to for CU-3:

1. What type of requirements should a fabricator evaluate before the fabrication starts and are these requirements regulated through any standards? If so, then which?
2. When planning for a production, which considerations should be taken related to the design?
3. What will be important for a welder to be aware of when he/she see the design drawings?
4. What considerations should the welder be aware of when he/she gets the first drawings and descriptions?

Relevant specific questions related to the Product.

No	
1	Does the manufacturer have to consider the following contractual requirements:
	* post weld heat treatment requirements?
	* inspection and testing requirements?
	* technical requirements to be met by the specification of welding procedure, non-destructive testing procedures and heat treatment procedures?
	* the approach to be used for welding procedure approval?
	* the approval of personnel?
	* selection, identification and/or traceability (e.g. materials, welders, welds)?
	* quality control arrangements, including any involvement of an independent inspection body?
	* other welding requirements (e.g. batch testing of consumables, ferrite content of weld metal, ageing, hydrogen content)?
	* environmental conditions relevant to welding on site (e.g. very low temperature ambient conditions or any necessity to provide protection against adverse weather conditions)?
2	Does the manufacturer have to consider the following design requirements:
	* location, accessibility and sequence of all welds?
	* surface finish and weld profile?
	* parent metal(s) specification and welded joint properties?
	* permanent backing?
	* welds which are to be made in the workshop, or elsewhere?
	* dimensions and details of joint preparation and completed joint?
	* use of special methods (e.g. to achieve full penetration without backing when welded from one side only)?

	* quality and acceptance requirements for welds?
	* other special requirements (e.g. Acceptability of peening, heat treatment)?
3	Are the following items of equipment available, when necessary:
	equipment for preheating and post-weld heat treatment, including temperature indicators?
	jigs and fixtures?
	cranes and handling equipment used for welding production?
4	suitability and validity of welder's approval certificates (see appropriate part of ISO 9606 or ISO 14732 or other equivalent code/standard)?

CU-3	**Title: Planning for starting the work order**
	Content: Through this CU the students will carry out planning activities for the work-order that has been given. This will include both the welding equipment for the job as well as the welding parameters and how to define any defects because of the work. **General Learning outcomes:** * Basic knowledge of welding on steel structures and piping * Identifying materials according to ISO/TR 20172 * Define imperfections according to ISO 6520-1 * Learn the welding symbols according to ISO 2553 **Specific Learning Outcomes.** * The effect of welding parameters on the weld geometry * How to avoid magnetic arc blow * Know the different types of imperfections according to ISO 6520-1 * Describe the major components of the welding equipment **Competence.** The student will know how to: * Define imperfections according to ISO 6520-1 * Report defects and imperfections according to ISO 6520-1 * Identify and verify materials according to ISO/TR 20172 * Read welding drawings and understand the meaning of welding symbols **Use of iQSim software tool.** Will be used in this CU Material related questions and discussions Basic: A2, A7, A8

Relevant generic questions for CU-4:

1. Which dangerous situations can occur for a welder related to health and safety?
2. Which environmental considerations must a welder take into consideration before starting the work?
3. Is it required to have any plans or procedures related to HES?
4. Has occurrences to be registered and documented related to HES?
5. Who is responsible for any HES deviations?

Relevant Specific questions related to the product:

No	
1	Are the following items of equipment available, when necessary: Personnel protective equipment and other safety equipment, directly associated with welding?
2	Has the manufacturer documented plans for the maintenance of equipment, ensuring checks of those items which control essential variables in the welding procedure specification, eg:
	Condition of guides in equipment for thermal cutting, mechanized welding fixtures, etc.?
	Condition of ampere meters, voltmeters and flow meters used for the operation of the welding machines?
	Condition of cable, hoses, connectors, etc.?
	Condition of control system in mechanized and or automatic welding equipment?
	Condition of thermocouples and other temperature measurement instruments?
	condition of wire feeders and conduits?
	Action to be taken to avoid the use of defective equipment?
3	Suitability of working and environmental conditions for welding?
	Suitability and condition of equipment?

CU-4	**Title: Verification of HES (Health, Environment and Safety) before starting the work**
	Content: Through this CU the students will be able to verify the requirements for HES on a personal level as well as the influence of the HES for the working environment. The student should be aware of the HES requirements for personal protection equipment, but also the need for protection of the workplace to ensure that the other employees are not affected by the work. **General Learning outcomes:** * Know the dangerous situations that can arise from the use of the welding equipment * Know how to ensure that the workplace is safe with the necessary marking for escape routes and so forth

	* How to ensure that the other employees have a safe working environment based on the welding activities * Know how to work in confined spaces **Specific Learning Outcomes.** * Know the specific hazards in the working shop * Know the needs for ventilation * Know the measures to prevent noise hazards * Know how to prevent fire du to hot work * Know how to handle gas cylinders **Competence.** The student will know how to: * Understand the hazards and basic safety regulations when welding * Perform welding operations in the workshop in a safe manner * Use personal protection equipment **Use of iQSim software tool** Will not be used in this CU Basic: A3, A4
4.1	**Practical tasks** Test the different personal protection equipment. Test ventilation system. Test other HES equipment to be used during the welding operation

Relevant generic questions for CU-5:

1. Are there any difference between ISO and ASME welding positions?
2. When can you assume to see ASME welding positions on a drawing?
3. How do you specify the different surface finish on a weld?
4. What do you recommend for welding maintenance?
5. How do you want to handle gas equipment from a safety point of view?
6. Can you use grease on gas regulators threads?
7. How do you carry out batch testing?

Relevant Specific questions related to the Product:

No	
1	Are the following items of equipment available, when necessary:
	* welding power sources and other machines?
	* equipment for joint preparation and cutting, including thermal cutting?
2	Has the manufacturer a written procedure for identification, control, maintenance and calibration (where relevant) of all production equipment?

	* Does this procedure include the designated responsible individuals?
	* Does this procedure include arrangements to prevent production use of defective equipment?
3	Number of welding power sources for each welding process?
4	Has the manufacturer specified responsibilities and procedures for the control of welding consumables?
	* Batch testing
	* If required in the contract, is batch testing of welding consumables carried out?
	* Does the manufacturer implement procedures for storage, handling and use of consumables which avoid moisture pick-up, oxidation, damage, etc.?
	* Are these procedures in accordance with the supplier's recommendations, if any?

CU- 5	**Title: Preparing the welding equipment and filler**
	Content The students will learn how the basic functions of the welding equipment as well as how to handle the welding consumables. This includes how to dry and store consumables in a correct way according to the manufacturer's Guideline. Learn to work with a WPS and the influence of the welding parameters to the results of the weld pool. **General Learning outcomes:** * Know the use, types and function of the welding consumables * Know the different welding positions according to ISO 6947 * Know the different joints and the surface finish **Specific Learning Outcomes.** * Identify the fillet welds and its size and shapes * Identify undercut and overlap in fillet welds * Daily maintenance of the welding equipment * Handling of gas bottles **Competence.** The student will know how to: * Use a WPS in production * Perform welding operations in the workshop and to adjust the welding parameters * Maintain the welding equipment and report deviations * Handle gas bottles and safety procedures for gas equipment **Use of iQSim software tool** Will be used in this CU Weld and joint details Basic: A5, A2
5.1	**Practical tasks**

	Handling and secure gas bottles and regulators. Handle and storage of filler

Relevant generic questions for CU-6:

1. Can you create and document a production plan for the assembly?
2. How would you define a welding sequence for the assembly in order to minimize heat influence in the product?
3. Do you have any plan for inspection before, during and after welding?

Relevant Specific questions related to the Product:

No	
1	Can the manufacturer show that he employs sufficient and competent personnel for the planning, performing, and supervising of the welding production according to the specified requirements?
2	Is the equipment used adequate for the application concerned?
	If specified in the contract is the welding and heating equipment subject to approval?
3	Does the manufacturer carry out an adequate production plan compatible with the production and testing facilities to be used in the manufacture of the product?
	Does such a plan include at least the following points as relevant:
	Specification of the sequence by which the product shall be manufactured (e.g. as a single parts of sub-assemblies and the sequence of subsequent final assembly)?
	Identification of the individual processes required?
	Reference to the appropriate specifications for welding and allied processes?
	Sequence in which the welds are to be made, if applicable?
	Order and timing in which the individual processes are to be performed?
	Specifications for inspection and testing, including the involvement of any independent inspection body?
	Provision for protection from environment conditions (e.g. protection from wind and rain)?
	Item identification by batches, components, or parts?

CU- 6	**Title: Assembly and tack welding**
	Content The CU covers the topic of assembling the material and tack weld before final welding operations. The importance of correct assembly according to drawings and learn the consequences of a bad assembly will be covered. **General Learning outcomes:** * Have the basic knowledge of welding consumables for MIG/MAG tack welding * Know the typical parameters for MIG/MAG * Know the basic safety requirements for MIG/MAG

	Specific Learning Outcomes. * Learn to know the different types of power sources and guns, earth cables and clamps * Learn to know the application of different wire sizes and gas * Selection of shielding gases * Verify that the tack weld has the same quality as the main weld **Competence.** The student will know how to: * Assemble the materials in a correct manner and learn the consequences of a bad fit-up * Perform tack welding operations in the workshop * Evaluate the safety procedures for the tack welding * Apply the correct HES measures when tack welding **Use of iQSim software tool** Will be used in this CU Weld and joint details Basic SM-1, SM-2, SM-3
6.1	**Practical task** Assemble test plates for the different welding positions. Ensure that the plates are assembled according to drawing. Tack weld the plates to be used for CU-7 and verify that the tack weld has the same quality as the main weld Assemble tube to test plates for the different welding positions. Ensure that the plates are assembled according to drawing. Tack weld the plates to be used for CU-8 and verify that the tack weld has the same quality as the main weld

Relevant generic questions for CU-7:

1. What is the difference between a WPS and a WI (Welding Instruction) and are there any documentation requirements?
2. Which tools can be used for Visual Inspection?
3. Are there any requirement for the person carrying out Visual Inspection?
4. Are there any requirement for traceability of the weld?
5. How do you document traceability?

Relevant Specific questions related to the Product:

No	
1	Has the manufacturer at his disposal sufficient and competent personnel for planning and performing, supervising, inspecting, testing and examining the welding production according to the specified requirements?

2	Are the WPS approved prior to any production welding?
	Are the tests performed by qualified laboratories?
	Is the method of approval in accordance with the relevant application standards or as stated in the contract?
3	Does the manufacturer use the WPS, or dedicated work instructions, directly in the workshop?
	Are the dedicated work instructions prepared from an approved WPS?
4	Is the cut surfaces according specifications, ISO 9013
	Suitability of WPS (see appropriate part of ISO 9606 or another equivalent code/standard)?
	Identity of parent material?
	Identity of welding consumables?
	Joint preparation (e.g. shape and dimensions) see EN ISO 9692 or equivalent code/standards)?
	Fit-up, jigging and tacking?

CU-7	**Title: Welding in position PA, PB, PG**
	Content The CU covers fillet weld on plates in position PA, PB, PD, PF and PG. This CU covers mainly practical tests and examinations on small plates in order to build competence in the welding process. **General Learning outcomes:** * Adjust the welding parameters according fillet weld in different positions * Create sound fillet welds with the appropriate characteristics specified in the WPS * Create both single run and multi-run fillet welds * Carry out visual inspection on the welds **Specific Learning Outcomes.** * Learn how the adjust the welding parameters to obtain the fillet weld profile * Learn how to measure the fillet weld to ensure it complies with the WPS requirements **Competence.** The student will know how to: * To carry out fillet welds on plates in the specified welding positions. * Carry out single pass as well as multi-pass fillet welds * Take appropriate actions if the fillet weld is not correct * Adjust the welding parameters according to the welding positions **Use of iQSim software tool** Will be used in this CU Weld and joint details Basic SM-4 M-2
7.1	**Practical task**

	Weld the plates for this task. Carry out all necessary repairs before the final report is made

Relevant generic questions for CU-8:

1. What corrective actions will you take if the weld is not correct?
2. What is a cold lap and how can you correct it?
3. What will be the correct handling of filler metal?
4. What can the welder do if the plate and pipe material is not produced according to the drawings?

Relevant Specific questions related to the Product:

No	
1	Are the following items checked, during welding, when necessary, as required by the inspection plan and procedures:
	Essential welding parameters (e.g. welding current, arc voltage, travel speed)?
	Preheating/interpass temperature (see ISO 13916 or another equivalent code/standard)?
	Cleaning and shape of runs and layers of weld metal?
	Back gouging?
	Welding sequence?
	Correct use and handling control of consumables?
	Control of distortion?
	Any intermediate examination (e.g. Checking dimensions)?
2	Are the following inspections carried out, after welding, when necessary, in accordance with the contract requirements:
	Visual inspection?
	Other non-destructive testing?
	Destructive testing?
	Evaluation of the form, shape and dimensions of the welded construction?
	Evaluation of the results and records of post weld operations (e.g. grinding, post-weld heat treatment, ageing)?

CU-8	**Title: Welding in position PD, and tube to plate PB and PH**
	Content The CU covers fillet weld on tube to plates in position PB, PH and PD. The CU covers both single pass as well as multi-pass fillet weld Through this CU the students will get basic welding knowledge in tube to plate welding.

	General Learning outcomes: * Adjust the welding parameters according fillet weld in different positions * Create sound fillet welds with the appropriate characteristics specified in the WPS * Create both single run and multi-run fillet welds * Carry out visual inspection on the welds **Specific Learning Outcomes.** * Learn how the adjust the welding parameters to obtain the fillet weld profile * Learn how to measure the fillet weld to ensure it complies with the WPS requirements **Competence** The student will know how to: * To carry out fillet welds on plates in the specified welding positions. * Carry out single pass as well as multi-pass fillet welds * Adjust the welding parameters according to the welding positions * Take appropriate actions if the fillet weld is not correct **Use of iQSim software tool** Will be used in this CU. Weld and joint details. Basic M-3, A7, B8, B9
8.1	**Practical task** Weld tube to plate for this task. Verify that the tack weld has the same quality as the main weld

Relevant questions for CU-9:

1. How do you document the result of Visual Inspection?
2. What is “positive” reporting technique?
3. What is “negative” reporting technique?
4. What is a defect?
5. What is a non-conformance?
6. What is a deviation?
7. What information should be included in a traceability report?

Relevant Specific questions related to the Product:

No	
1	Are measures taken as appropriate to indicate the status of inspection and test of the product

	during manufacturing?
2	Inspection and test techniques:
	Positive technique?
	Negative testing technique?
3	Are measures implemented for controlling components or items which do not conform to specified requirements, in order to prevent their inadvertent use?
	When repair and/or rectification is undertaken by the manufacturer are appropriate procedures available at repair workstations?
	When repair and/or rectification is carried out are the items reinspected, tested and examined in accordance with the original requirements?
	Does the manufacture have procedures or arrangements to identify and remedy any conditions that could adversely affect the quality of the product or production processes?
4	Where appropriate, is identification maintained throughout the manufacturing process?
	Where appropriate, is traceability maintained throughout the manufacturing process?

CU- 9	**Title: Visual Inspection and Documentation before delivery**
	Content The students will be able to visually inspect the fillet welds and report their own work and to document any deviations. They will be able to use the most common tools for visual inspection and verification of the fillet welds. Implications of failure and the product reliability will be highlighted. **General Learning outcomes:** * Know why a weld will fail * Know the consequences of a failed weld * Know how to visually inspect a fillet weld **Specific Learning Outcomes.** * Create visual inspection of the welds * Document the results of visual inspection * Learn to use the tools for visual inspection * Implication of failure and product liability **Competence** The student will know how to: * Carry out visual inspection on single-pass and multi-pass fillet welds * Create a visual report as well as non-conformance report of fillet welds Basic C3
9.1	**Practical task** Visual inspection of own welds, both single-pass and multi-pass welds. Create a short report for the visual inspection.

	Verify that the tack weld has the same quality as the main weld

Relevant generic questions for CU-10:

1. What should be included in a documentation of own work?
2. How shall the examination according EWF requirements be?
3. How shall the tasks for obtaining an ISO welding certificate be?

Relevant Specific questions related to the Product:

No	
1	Do the quality records include, according to the contract requirements and/or when necessary, the following:
	Contract/design review?
	Materials certificates?
	Consumables certificates?
	WPS?
	WPAR?
	Welder or welding operator approval certificates?
	Non-destructive testing personnel certificates?
	Heat treatments and procedure specification?
	Non-destructive and destructive testing procedures and reports?
	Dimensional reports?
	Repairs and non-conformity reports?

CU-10	**Title: Course summary, examination**
	Content Product delivery and acceptance This part of the course will be focusing on delivery of the product to the next production step It also focuses on how to create non-conformance notice and corrective actions. It will be a summary of the course and for the preparation of final assessment of the course itself **General Learning outcomes:** * Understand the consequences of a product recall or reclamation. * Understand the knowledge and competence requirements for the final assessment

	Specific Learning Outcomes. * Be able to verify and document own work * Be able to report according to requirements in a work order **Competence.** The student will know how to: * Submit a set of welds according to specifications and drawings with the required quality * Create a set of documentation for own work Preparation for examination, both theoretical and practical tests Summary of course Examination according to EWF Guidelines. For students that want to get an ISO 9606 certificate, the examination will follow the requirements in ISO 9606.

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D2.3-3 Best practice Guideline based on the EWF VET training systems

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Requirements for the Welding Inspector

The nature of such a job emphasizes a physical, technical, and ethical qualities. Any weaknesses in these areas can reduce the effectiveness of the individual's performance.

1 Inspector definition

There are many types of welding inspection activities, depending upon technical requirements for a particular fabrication process or other processes. Those processes may include non-destructive/destructive testing specialists, Code/Directive required inspection activities, military inspections, and client's representative inspectors. All the above may consider themselves as being welding inspectors because they do inspect welded joints.

The fact that welding inspectors work in many different industries performing so many quality-related tasks make it difficult to describe clearly and concisely what a welding inspector is and how that job function is specifically performed.

In such cases, an individual can perform one or many functions. (e.g., welding procedure qualification, welder qualification, in - process and final visual examination, non-destructive/ destructive testing). However, it is also common that an individual involved in welding inspection acts in the frame of one of those tasks (e.g. non-destructive testing).

Another important difference relates to the inspector's employer. The inspector may be directly employed by the manufacturer, the customer, the customer's representative, or an independent agency. While this should not affect the technical application of the individual's inspection skills, it may to some degree influence the logistics of that activity.

Each specific job will depend upon the relevant requirements, duties, and responsibilities of each inspector.

The following are important factors that a company should take into consideration when selecting a person for the job of welding inspector.

2 Attributes of a Welding Inspector

The welding inspector job carries a huge responsibility. Selection of the right person should be based on consideration of four critical attributes:

(1) Physical
(2) Technical
(3) Ethical
(4) Personal

2.1 Physical

2.1.1 Physical Condition. To perform duties in the most effective manner, the welding inspector should be in good physical condition. Since the primary job involves visual inspection, it is obvious that the welding inspector should have good vision (natural or corrected). For instance, if colour or contrast is important to the inspection process being employed (liquid penetrate, magnetic particle, or colour coded parts) then an individual should be tested for the ability to detect those colours.

Another aspect of physical conditioning involves the size of some welded structures. Since welds could be located anywhere on a very large structure, the inspector must be capable of reaching the weld at any location, to make an evaluation. The inspector must comply with safety regulations when performing these duties.

The ability of the welding inspector to reach the work may be reduced if the inspection is not performed immediately after welding. For example, aids for the welder as ladders and scaffolding may be removed, making access difficult or dangerous. Within safety guidelines/rules, the welding inspector should not be prevented from performing proper inspection because of a physical condition.

2.1.2 Technical Ability. While there may be no specific level of education and training required for welding inspectors, the job may involve interpretation of results. Therefore, an individual must have at least a minimum level of technical knowledge to perform well as an inspector. In order to perform

welding inspection, the individual will continually be asked to make judgments based on visual observations of physical characteristics of welds and weldments and their comparison with drawings or standards.

If an individual is unable to understand some written requirement, it will be difficult to make a judgment as to a weld's acceptability in accordance with that standard. There is more to an evaluation than just reading the specifications. Once read, the inspector must interpret its meaning. Even then, some requirement of a code or specification may appear very clear and straightforward when initially read; however, comparison of this written requirement with an existing physical condition may still prove to be extremely difficult. Technical ability is also necessary in order for the welding inspector to effectively express ideas or inspection findings. In addition, once an inspection has been performed, the inspector must be capable of describing the methods used and subsequent results with sufficient accuracy to adequately communicate to others familiar with the work being performed.

2.2 *Technical*

2.2.1 Interpretation of Drawings and Specifications. Another quality which the welding inspector should develop is an ability to understand and apply the various documents describing weld requirements. These include, in part: drawings, codes, and specifications. These documents provide most of the information regarding what, when, where, and how the inspection is to be performed. In fact, these documents literally constitute the rules under which the welding inspector must perform. They also state the requirements by which the welding inspector will judge the weld quality. Obviously, such documents must be reviewed prior to the start of any work, because the welding inspector should be aware of the job requirements before any production. Often this technical review will reveal required inspections "hold points", welding procedure and welder qualification requirements, and special processing steps or design deficiencies such as weld inaccessibility during fabrication.

The welding inspector should be thorough in reviewing documents. These are considered as reference documents and should be readily available at any time in the fabrication process. Generally, the inspector is the individual most familiar with all of these documents. The inspector may be called upon by others for information and interpretation regarding the welding requirements.

2.2.2 Inspection Experience. Having actual on-the-job inspection experience is very important. Textbooks and classroom studies do not provide all of the things needed to inspect effectively. Experience will aid the welding inspector in becoming more efficient. In time, better ways of thinking and working will develop.

On-the-job experience will also help the inspector develop the proper attitude and point of view regarding job assignment. After working with various codes and specifications, the inspector's effectiveness will improve because of an improved understanding of welding requirements. To emphasize the need for inspection experience, it is commonplace to see a novice inspector paired with an experienced one so that proper techniques can be passed along. Most inspector certification programs require some minimum level of actual inspection experience.

2.2.3 Knowledge of Welding. Another desirable quality for a welding inspector is a basic knowledge of welding and related processes. Because of their background, welders are sometimes chosen as welding inspector trainees. Such a person is certainly better prepared as an inspector to understand many problems that the welder may encounter. This knowledge helps the inspector in gaining respect and cooperation from the welders. Further, this understanding helps the welding inspector predict what weld discontinuities may be encountered in a specific situation. The welding inspector can then monitor critical welding variables to help prevent these welding problems. When the inspector is experienced in welding processes and understands their advantages and limitations, possible problems can be more easily identified and prevented.

2.2.4 Knowledge of Examination Methods. Knowledge of various DT/NDT methods should be helpful to the welding inspector. Although the inspector may not perform these tests, from time to time it may be necessary to review test results. As with welding processes, the welding inspector is

aided by a basic understanding of testing methods. It is important that the inspector be aware of alternate methods which could be applied to enhance visual inspection.

2.3 Ethical. To safeguard public health and to maintain integrity and high standards of skills, practice, and conduct in the occupation of welding inspection, the inspector must render decisions promptly while remaining impartial and tolerant of the opinions of others.

2.3.1 Integrity. The welding inspector must act with complete integrity (honesty) in professional matters and be forthright and candid with respect to matters pertaining to welding inspector qualification requirements.

2.3.2 Responsibility to the Public. The welding inspector is obligated to preserve the health and well-being of the public by performing the duties required of weld inspection in a conscientious and impartial manner to the full extent of the inspector's moral and civic responsibilities and qualifications. Accordingly, the welding inspector shall:

a. Undertake and perform assignments only when qualified by training, experience, and capability,
b. Present credentials upon request,
c. Neither falsely represents status nor seek to misrepresent certification level or modification of certification documents or false verbal or written testimony of current level or status,
d. Be completely objective, thorough, and factual in any written report, statement or testimony of the work and include all relevant or pertinent testimony in such communiques or testimonials,
e. Sign only for work that the inspector has inspected, or for work over which the inspector has personal knowledge through direct supervision, and
f. Neither associate with nor knowingly participate in a fraudulent or dishonest venture.

2.3.3 Public Statements. The welding inspector will issue no statements, criticisms, or arguments on weld inspection matters connected with public policy which are inspired or paid for by an interested party, or parties, without first identifying the party, the speaker, and disclosing any possible pecuniary interest.

The welding inspector will not publicly express any opinion on a weld inspection subject unless it is founded upon adequate knowledge of the facts in issue, upon a background of technical competence pertinent to the subject, and upon honest conviction of the accuracy and propriety of the statement.

2.3.4 Conflict of Interest. The welding inspector shall avoid conflict of interest with the employer or client and will disclose any business association, or circumstances that might be so considered.

The welding inspector shall not accept compensation, financial or otherwise, from more than one party for services on the same project, or for services pertaining to the same project, unless the circumstances are fully disclosed and agreed to by all interested parties or their authorized agents.

The welding inspector shall not solicit or accept gratuities, directly or indirectly, from any party, or parties, dealing with the client or employer in connection with the Inspector's work.

The welding inspector shall, while serving in the capacity of an elected, retained, or employed public official, neither inspect, review, nor approve work as welding inspector on projects also subject to the inspector's administrative jurisdiction as a public official, unless this practice is expressly dictated by a job description, specification, or both, and all affected parties to the action are in agreement.

2.3.5 Solicitation of Employment. The welding inspector shall neither pay, solicit, or offer, directly or indirectly, any bribe or commission for professional employment with the exception of the usual commission required from licensed employment agencies.

The welding inspector shall neither falsify, exaggerate, nor indulge in the miss interpretation of personal academic and professional qualifications, past assignments, accomplishments, and responsibilities, or those of the inspector's associates. Misrepresentation of current certification

status at the time of, or after submission of requested employment information, or in the solicitation of business contracts wherein current certification is either required or inherently beneficial (advertisements for training courses, consulting services, etc.) are a violation of this section.

2.4 Personal

2.4.1 Professional Attitude. The first, and perhaps the most important personal quality, is a professional attitude. This is a real key to the success of the welding inspector because it will determine the degree of respect and cooperation the inspector will receive from others during the performance of inspection duties. Included in this category is the ability of the welding inspector to make decisions based on facts so that they are fair, impartial, and consistent. If an inspector's decisions show partiality or inconsistency, they will undermine the inspector's reliability.

In keeping with this professional attitude, the welding inspector's decision should be consistent with job requirements so that decisions are neither too critical nor too lenient. For example, it is a mistake to have preconceived ideas as to a component's acceptability. The inspector should review the facts and make decisions based solely on those facts. This need for professionalism also extends into a person's dress and manner, and language used when dealing with others. If these characteristics become offensive to others, they may well, by themselves, reduce an inspector's effectiveness.

The inspector should develop a positive attitude. The goal is to assure that the welding has been done properly, rather than to try and find something wrong. Every attempt should be made to be cooperative and helpful. When decisions are being formulated, the welding inspector should genuinely consider all opinions and recommendations. Only after carefully listening to input from other involved parties and combining that information with all the facts and requirements, can the welding inspector make a truly sound judgment.

2.4.2 Learning Potential. Individuals are often hired as welding inspectors primarily because of their learning potential. The inspector can perform the job more effectively after being trained extensively in a variety of subjects. In fact, because the job of welding inspector involves so many different aspects, it is virtually impossible to gain all the necessary information through experience alone. Personal and professional experience must be supplemented by additional training.

2.4.3 Completing and Maintaining Inspection Records. A final attribute is the welding inspector's ability to complete and maintain inspection records. The welding inspector must be capable of accurately communicating all aspects of the inspection, including the results. The records should be legible and understandable to anyone familiar with the work; therefore, neatness is important. The welding inspector should also consider these records as protection should questions later arise. Reports should contain sufficient information regarding how the inspection was performed so that similar results can be obtained later by someone else.

Once records have been developed, the welding inspector should be capable of maintaining all necessary information in an orderly fashion to facilitate easy retrieval.

Records should be completed in chemical; if incorrect entries are noted, they can be lined out and corrected. This corrective action should then be initiated and dated for explanation.

Next, the report should accurately and completely state the job name and inspection location in addition to specific test information. The use of sketches and pictures may also help to convey information regarding the inspection results. Finally, the completed report shall be signed and dated by the inspector who performed the work.