DIGIWELD

DIGITAL EDUCATION AND TRAINING IN WELDING

Innovative digital tool for training in the field of welding

Project Number: 2018-1-RO01-KA202-049218

Needs analysis report for the European Welders Curricula

Responsible partner: EWF
Contributors: ASR, ATS, CNT, CESOL, IIS

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1. Executive summary

Intellectual Output one (I01) addressed **the Update of the European Welder (EW) Training Guideline** to incorporate the newly developed digital training tool in the training, learning and assessment strategies. The objective of the revision of the curriculum in the context of digital tools is to boost the digital skills of trainers, both youngsters (i-VET) and older personnel seeking further training (C-VET), thus targeting the greater attractiveness of VET and innovativeness of the learning programmes.

The proposals for the update of the EW Curriculum has been leaded by the European Federation for Welding Joining and Cutting (EWF, www.ewf.be), in collaboration with the remaining project partners, Asociatia de Sudura din Romania, Asociacion Española de Soldadura Y Tecnologias de Unión, IIS Progress s.r.l, Augmented Training Services, S.L., Colegiul Tehnic "Domnul Tudor", during a period of 6 months.

EWF is a European umbrella organisation, representing the manufacturing community in Europe - along with its 31 European members, the National Welding Institutes. EWF manages the EW harmonised training, ensuring that trainees gain minimum knowledge of the appropriate welding processes and the materials behaviour. The EW training guideline and professional profile is recognised by the European industry and relevant stakeholders worldwide.

2. Introduction

The European Education and Training of Welders is addressed by the IAB-089 guideline (latest version), which is a document prepared, evaluated and formulated by Members of the Committee for Education and Training of the EWF. The guideline seeks to achieve harmonization in training, examination and qualification testing of welders in the world. Therefore, it has been designed to provide the minimum core education in the field of welding and the assessment of both theoretical knowledge and practical skills. The latter being linked to the requirements of ISO 9606 (or equivalent standard).

The EW Guideline gives methods for both theoretical and practical education at three levels for Fillet, Plate and Tube Welders.

The update of the European Welder (EW) Profile has been identified as a need to encompass new technologies and teaching methods for trainers/teachers and improve the education and training process by focusing on the apprentices' needs. The introduction of new open and innovative learning digital tools will allow the reduction of time and cost in training. It will also make training closer to native digital skills of the new generation of apprentices.

The proposal to update the EW curriculum consists in introducing welding simulators in practical training. The work was developed based on the four tasks identified in the Intellectual Output One (IO1):

- Identification of complementary conditions for the trainees to access the courses,
- Assessment on the need of a new theoretical model in Computer and Simulation,
- Definition of workload and examination for practical training,
- Review of the curriculum.

An internal survey was developed to encompass all the tasks previously mentioned and acquired inputs from the project's partners. The acquired answers will be used to support the proposal to change the EW curriculum.

An external survey was also developed in all the partners languages (EN, RO, PT, IT, ES). The survey was addressed to people in the field of welding training, who are in direct contact with apprentices and equipment. The inputs from the external survey provided valuable information regarding the usage of simulators in the welders' training and will also be used to support the changes.

The results for the proposal are detailed in the next pages.

3. Internal Survey

In order to collect valuable information from the project partners, in the scope of IO1, an internal survey was developed encompassing the 4 tasks associated to this Intellectual Output. The survey has 3 sections: 1 - Access conditions; 2 - New theorical topic related to Computer & Simulation and 3 - Practical training.

The inputs from all partners were gathered and are presented below.

3.1. Internal Survey Answers

1. Access conditions

1.1. Should digital tools knowledge be considered as condition for accessing the course?

EWF	ATS	ASR	CESOL	CNT	IIS
No	Yes	Yes	No	Yes	Yes

1.1.1. What level of know-how should the apprentice have in digital tools to access the course? (*fill with "X"*)

EWF	ATS	ASR	CESOL	CNT	IIS
-	Basic	Basic	Basic	Basic	Basic

1.1.2. Name which digital skills should be considered to access the course? (*e.g. navigate the internet, reproduce and manipulate digital information, use mobile devices, etc.*)

EWF	-
ATS	Communicating: Communicate, collaborate, and share online Handling information and content: Find, manage and store digital information and content securely Problem Solving: Find solutions to problems using digital tools and online services
ASR	Reproduce and manipulate digital information Share online, cloud, mobile devices, basic hardware skills
CESOL	User level: navigate the internet, use mobile devices, etc.
CNT	Reproduce and manipulate digital information Share online, cloud, mobile devices, basic hardware skills
IIS	Use of mobile devices

1.1.3. Based on the guideline access conditions (Figure 1), give a suggestion on how you would modify it to consider digital tools knowledge? *(e.g. In case the Authorized Training Body is providing training with a welding simulation system, the apprentice must have/own…*)

EWF	-
ATS	In case the Authorized Training Body is providing training with a welding simulation system, the apprentice must have a basic level of digital skills
ASR	In case the Authorized Training Body is providing training with a welding simulation system, the apprentice must have a basic level of digital skills
CESOL	The candidate wouldn´t have to demonstrate any digital tools knowledge. The ATB should give a specific training about how to use the simulator which will be used in the training course.
CNT	In case the Authorized Training Body is providing training with a welding simulation system, the apprentice must have a basic level of digital skills
IIS	As relates to digital tools knowledge, no formal requirement applies. It is up to the ATB to check that the participant has appropriate skills.

2. New theoretical topic related to Computer & Simulation

2.1. Is the creation of a new learning unit regarding Computer and Simulation needed?

EWF		ATS	ASR	CESOL	CNT	IIS
Yes		Yes	Yes	No	Yes	No

2.1.1.What is expected for the apprentice to know and do after completing the learning unit?

EWF	Understand how simulators work, and what digital tools can support him in his/her job.
ATS	- Knowledge of the Learning Management System (LMS) - Know the advantages of the use of augmented reality applied to welding compared to traditional methods - Properly handle the augmented reality simulator - Begin to practice while studying the theoretical contents
ASR	- To know how to access the digital information on device - To know how to use a LMS - To be able to set up the simulator for theoretical and practical training - To be able to connect the simulator on LAN - To know the differences between simulated welding and real welding
CESOL	NA
CNT	- To know how to access the digital information on device - To know how to use a LMS - To be able to set up the simulator for theoretical and practical training - To be able to connect the simulator on LAN - To know the differences between simulated welding and real welding
IIS	NA

2.1.2. How many contact hours should be allocated to this new learning unit?

EWF	ATS	ASR	CESOL	CNT	IIS
4 hours	4 hours	2 hours	-	2 hours	-

2.1.3. Should this new learning unit be considered in an already existing module/sub-module of the guideline?

EWF	ATS	ASR	CESOL	CNT	IIS
No	No	Yes	-	Yes	-

2.1.4. Where would you place the new topic in the theoretical section of the guideline index?

EWF	As a new module.
ATS	We propose to create a new general module called "Module 0. Digital tools" formed by - at least - two units: use of the LMS and use of the simulator.
ASR	The new topic should be added to module A as A.10 (2h)
CESOL	-
CNT	The new topic should be added to module A as A.10 (2h)
IIS	-

3. Practical Training

3.1. What is the National Qualification Framework (NQF) level of the welder qualification?

EWF	ATS	ASR	CESOL	CNT	IIS
2	2	3	2	3	N.A. (in Italy EQF system is still not installed)

3.2. Is the Welder National Qualification aligned with the EWF/IIW guideline (Y/N)?

EWF	ATS	ASR	CESOL	CNT	IIS
Yes	Yes	No	No	No	N.A.

3.2.1.How is the welder qualification organized in your country?

EWF	ATS	ASR	CESOL	CNT	IIS
By process		By process By material By joint type	By process	By process By material By joint type	By joint type

3.3. Provide a description of the number of hours required in practical welding training sections by your national legislation considering the welding process, material(s), joint type and position(s):

EWF	https://bit.ly/2Uk7Jhe
ATS	In Spain there are two types of professional training in welding: one regulated within the traditional educational system (FP) and another within the professional training for employment (FPE). Each one has its own legal regulations at national and regional level. **Welding and Boiler Technician (FP) – CINE 3 – 2000 h** of which **530** are practical welding training: - Professional module: Welding in a natural atmosphere. 290 h - Professional module: Welding in a protected atmosphere. 240 h **Professional Qualification in Welding (FPE) – 1280 h** of which **600** are practical welding training: - Welding and thermal projection by oxygas (140 hours) - Arc welding under protective gas with consumable electrode (130 hours) - Arc welding under protective gas with non-consumable electrode (130 hours) - Welding with electric arc with coated electrodes (200 hours)
ASR	According to Romanian national laws, there can be 2 situations: 1. Practical training for formation of welders using two paths: through National Education System and through Welder National Qualification: a. National Education System: 930 hours divided by: i. MIG = 250 hours ii. MAG = 250 hours iii. TIG = 250 hours iv. MMA = 180 hours b. Welder National Qualification: 480 hours 2. Practical training for specialization in specific domain of welding: 80 hours
CESOL	2000 hours of attendance, divided into 2 courses, and including 410 hours of internships in companies
CNT	According to Romanian national laws, there can be 2 situations: 1. Practical training for formation of welders using two paths: through National Education System and through Welder National Qualification: a. National Education System: X hours divided by: i. MIG =250 hours ii. MAG = 250 hours iii. TIG = 250 hours iv. MMA = 180 hours b. Welder National Qualification: 480 hours Practical training for specialization in specific domain of welding: 80 hours
IIS	No specific requirement is given in the national legislation (as it may be applicable, it only refers to ISO 9606)

3.4. Fill the following tables addressing the percentage of hours you recommend to be considered on the training simulator:

(All partners allocated the same percentage to all modules.)

EWF	ATS	ASR	CESOL	CNT	IIS
60%	50 – 60 %	50 – 60 %	40 %	50 – 60 %	60 %

3.4.1. Provide a general justification regarding the modules you ***did not*** consider for the simulator training:

EWF	It was considered 60% of simulator training (provided that the positions are available in the simulator) to represent several repetitions with the welding simulator (since no special preparation of the materials and positioning in a jig is necessary, the student has more time to practice in a simulator) and afterwards make a final exercise in an actual welding machine.
ATS	All modules can be considered for the simulator training. However, it must be taken into account that some positions such as full penetration in butt joints cannot be carried out.
ASR	All modules can be considered, if it is possible to be simulated.
CESOL	NA
CNT	All modules can be considered, if it is possible to be simulated.
IIS	-

3.5. If new modules, on the simulator, should be created, describe them: process, material, position and time wise.

EWF	No new modules required. The ones that exist are enough.
ATS	-
ASR	-
CESOL	NA
CNT	-
IIS	Nothing specific has to be developed. As applicable, all training modules may be covered by use of the simulator in a percentage of 60%

3.6. In which way should the simulators exercises be implemented on the training guideline?

EWF	Before the real life welding modules	Training before welding with welding machine will allow the student to learn his/her positioning relative to the piece to weld depending welding position. Will also allow the learning of the torch, adjust the needed welding speed, and other operational variables related to the welders' job. So, the example of the apprentice to repeat all the exercises at least 2 times (or when the Trainer considers the student is ready, before moving to real life welding exercises) can be the way to go.
ATS	Others	We propose a new flexible process in which the theoretical training (LMS and classroom) alternates with the practices in the simulator and the real welding workshop. Students do not go on to practice in the real welding workshop until they have passed the practical exercises in the simulator and the teacher determines that they are prepared to do it in the workshop
ASR	Before the real life welding modules	The apprentice should exercise on simulator until he/she will reach at least: • 50 % score without any aid from simulator, before moving on real life welding. • 70 % score with some aid from simulator, before moving on real life welding. • 90 % score with total aid from simulator, before moving on real life welding.
CESOL	Before the real life welding modules	The apprentice should make all the exercise at least once.
CNT	Before the real life welding modules	The apprentice should exercise on simulator until he/she will reach at least: • 50 % score without any aid from simulator, before moving on real life welding. • 70 % score with some aid from simulator, before moving on real life welding. • 90 % score with total aid from simulator, before moving on real life welding.
IIS	In between real life welding modules	The apprentice should gain successful results on the simulator before moving to the use of real welding machines (acceptance, i.e. successful results, shall be defined and agreed in advance through properly setting the software).

3.6.1. Could the intermediate exams, between modules, be done using the welding simulator?

EWF	No
ATS	If we talk about welding exams, the answer is "yes", but if we refer to overcome the theoretical content, we would use the LMS.
ASR	Yes
CESOL	No
CNT	Yes
IIS	No

3.6.1.1. Which level of difficulty should be considered for the exam?

EWF	-
ATS	If we talk about welding exams, the answer is "yes", but if we refer to overcome the theoretical content, we would use the LMS.
ASR	Hard (no aid)
CESOL	-
CNT	Hard (no aid)
IIS	-

EWF Comment:

Related with this question, currently in all exercises the student is being evaluated by the Trainer and that evaluation could be considered as intermediate exam, i.e. in an exercise using the simulator and when the Trainer considers that the student is ready to try in real welding machines (by getting higher than the set threshold) could be considered as the intermediate evaluation. If this is the case, then the answer above is “yes”.

3.6.1.2. Foreseeing that the apprentice could not adapt to the welding simulator, could the welding instructor override the virtual evaluation and allow the apprentice to move to real life welding?

EWF	ATS	ASR	CESOL	CNT	IIS
Yes	No	Yes	Yes	Yes	Yes

4. External Survey

The external survey was created and targeted to people involved in the field of welding training who are in direct contact with apprentices and equipment, providing valuable information regarding the usage of simulator in the welders training.

A total of 61 answers were gathered and are shown in the following topic.

4.1. External survey answers

1- On a scale from 1 to 5, how relevant do you consider digital tools to be used in welding training? (being 1 not relevant and 5 very relevant)

	Total 61	
1	5	8,20%
2	2	3,28%
3	18	29,51%
4	11	18,03%
5	25	40,98%

2- Do you use digital tools in welding training?

	Total 61	
Yes	19	31,15%
No, but considering implementing them.	37	60,66%
No, and not considering implementing them.	5	8,20%

3- Identify the digital tools you consider to be or could be relevant for welding training:

	Total 99	
Online training platforms.	31	31,31%
Mobile applications.	12	12,12%
Welding simulators.	47	47,47%
Others.	9	9,09%

4- Considering the adoption of digital tools in welding training, should the apprentice have any level of know-how of digital tools to access the training course?

	Total 61	
Yes	48	78,69%
No	13	21,31%

5- Do you use simulators in welding training?

	Total 61	
Yes.	9	14,75%
No, but considering implementing them.	39	63,93%
No, and not considering implementing them.	13	21,31%

6- What advantages do you see in using simulators on welding training? *(Pick 3 more relevant)*

	Total 195	
Improvement of workmanship and productivity	14	7,18%
Promotion of faster learning	35	17,95%
Reduction of training costs	44	22,56%
Environmentally friendly	26	13,33%
Improvement of apprentice safety	30	15,38%
Increase of apprentice retention	3	1,54%
Expansion of training options	34	17,44%
Other	9	4,62%

7- Regarding the usage of welding simulators, do you consider that they are able to replace real life welding training?

	Total 61	
No, welding simulators can't be used in welding training.	9	14,75%
Yes, between: 1 and 10% of the training time.	10	16,39%
Yes, between: 10 and 30% of the training time.	18	29,51%
Yes, between:30 and 50% of the training time.	21	34,43%
Yes, between:50 and 70% of the training time.	3	4,92%
Yes, between: 70 and 90% of the training time.	0	0,00%

8- Considering the usage of welding simulators, should an intermediate evaluation be considered, for the apprentice to move from the simulation training towards real life welding?

	Total 61	
Yes	43	70,49%
No	18	29,51%

9- Eventually, if it was mandatory to have an intermediate evaluation, which level of difficulty should be considered:

	Total 61	
Easy (total aid from software*).	6	9,84%
Medium (some aid from software*).	39	63,93%
Hard (no aid from software*).	16	26,23%

10- In case it was mandatory to have an intermediate evaluation, and foreseeing that the apprentice could not adapt to the welding simulator, could the instructor override the result and allow the apprentice to move to real life welding?

	Total 61	
Yes	55	90,16%
No	6	9,84%

5. Proposal for Access to the course

The guideline states the minimal requirements to access the course, at Section 2 – Access to the course. In this section is also stated the requirements for the trainee to move upwards the different levels considered, and this is done through theoretical and practical examinations.

In the scope of the project, the integration of complementary conditions for the trainees to access the course, regarding minimal knowledge in digital tools, where assessed and it is not foreseen the update of these requirements.

Based on the results attained, the level of knowledge required in digital tools/simulator should not be considered as requirement to access the course. Moreover, in task 2, a new theoretical competence unit related to Computer & Simulation will be created. This new theoretical topic will address the knowledge gaps that the trainees may present regarding the usage of new training tools and enable them to use these on practical exercises and move forward with training.

6. Proposal for the updating of the curricula with new topic related to Computer & Simulation

The creation of a new competence unit related to Computer & Simulation is foreseen in the scope of the project. The implementation of Simulators and Learning Management Systems (LMS) in the EW training will require an introduction of the trainees to these new instruments. This competence unit is set as optional and will be applied to institutions that implement their training using Simulators and LMS. Based on the inputs received by the experts in the field, a new theoretical competence unit was developed and is presented hereafter.

D.1 – Introduction to Computer and Simulation	**CONTACT HOURS**
SUBJECT TITLE	
Training Digital Tools	1
Learning Management System (LMS)	1.5
Welding Simulators	1.5
Total	4
WORKLOAD	**8**

LEARNING OUTCOMES – Introduction to Computer and Simulation	
Qualification	**European Welder**
KNOWLEDGE	Elementary principles of: ▪ digital tools ▪ learning management system (LMS) ▪ augmented reality ▪ welding simulators
SKILLS	Use digital tools in welding training Use learning management systems (LMS) in welding training Identify the differences between simulated welding and real welding Use and setup the welding simulator on practical training

DETAILED KNOWLEDGE	
Qualification	**European Welder**
CONTACT HOURS	**4**
DEPTH*	**ELEMENTARY**
Training Digital Tools Digital tools in welding training Advantages and disadvantages of training digital tools Implications	1
Learning Management System (LMS) Virtual Learning Environments Definition and characteristics of LMS Functionalities of an LMS – plan, implement and assess LMS – challenges and advantages Available LMS tools	1.5
Welding Simulators Welding simulators systems Augmented Reality vs Virtual Reality Difference between simulator and real welding system Advantages and disadvantages of welding simulators Set-up of welding simulators	1.5

7. Proposal for updating of the number of hours related to the practical training.

The current guideline is divided in six practical modules (3 pairs) associated to the three levels of skill, fillet welder, plate welder and tube welder. A description of each module is available associated to each process. The minimum recommended hours, positions, material specifications and evaluation are described accordingly.

On the scope of the project it is foreseen the integration of a simulator on the practical training of the EW and a split of the hours between the real equipment and the simulator.

Based on the inputs gathered, the proposal is to split the minimum recommended hours to ***a minimum 40%*** in the real welding equipment.

The integration of the welding simulators will be done to all modules and processes described in the guideline:

- Process 111 (MMA-Welding)
- Process 135, 136, 138 (MAG-welding)
- Process 131 (MIG-Welding)
- Process 141 (TIG-welding)
- Process 311 (Gas-welding)

The usage of the welding simulator will be the first step of the practical training as the trainee must go through all the exercises of the module before moving to practice on the real welding equipment and environment.

During training on the simulator, the trainee can choose the level aid from the simulator but must be capable to attain a percentage of **at least 50 % score, in each exercise, without any aid from simulator** before moving to practical training in the real welding equipment. Moreover, the Trainer will evaluate the welding capabilities of the trainee and has the final decision if the trainee should move to the real equipment.

8. Conclusion/Observations

The proposal for updating the EW guideline was based on the analysis of the information gathered form the internal and external surveys and also from inputs from experts and people involved in the welding and training field. The proposal for the upgrade of the guideline will encompass results previously gathered, moreover, as the project is developed and as more information is gathered, it is expected that the final proposal changes within the time frame of the project.

The main results are:

1) ***No changes in the access conditions*** are needed as the required level in knowledge in digital tools is considered as too basic. Nevertheless, the new theoretical competence unit will encompass the gaps that the trainees might have.

2) The new theoretical topic, ***D1 – Introduction to Computer and Simulation***, of ***4 hours***, was developed to introduce the trainee to the digital tools used by the training provider.

3) The practical hours were assessed, and the proposal considered is to split the minimum recommended hours to ***a minimal of 40% in the real welding equipment***. This division might need to be evaluated individually by exercise, as there may be some cases, due to difficulty inherited to the process and position, where more time may be needed in the real welding equipment.

4) During the training on the welding simulator the trainee must go through all the exercises and should attain ***at least 50% in each exercise, without any aid from the simulator*** before moving to practical training in the real welding equipment and environment. The trainer will assess the welding capabilities and has the final decision if the trainer is moving towards training with the real welding equipment.

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Project Number: 2018-1-RO01-KA202-049218

IO1 – NEW CURRICULA OF GUIDELINE IAB-O89r5-14

[European Welder Guideline]

Responsible partner: EWF
Contributors: ASR, ATS, CNT, CESOL, IIS

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1. Executive Summary

Intellectual Output 1 (IO1) addresses the update of the European Welder Guideline (IAB-089r5-14) used for the qualification of Welders at European (and International) level.
This update focuses on the elaboration of a specific curricula for trainees from Secondary Education and Vocational Education and Training (VET) based on this Guideline, incorporating a welding simulator as a viable and innovative tool for the education and training of future welders, which constitutes a major step forward for new digitised teaching methods.

One of the reasons for this update is the enhancement of the attractiveness of this Qualification among youngsters, among experienced welding professionals who search for an upskilling in welding and the acquisition of ICT competences, as well as among unemployed adults or people with fewer opportunities, who can have a chance to discover and develop other skills which will bring them close to a job position in the welding sector.

The development of the activities and the update of the European Welder (EW) Curriculum has been led by the European Federation for Welding Joining and Cutting (EWF – Belgium), in close collaboration with the remaining DIGIWELD project partners: Asociatia de Sudura din Romania (ASR – Romania), Asociacion Española de Soldadura Y Tecnologias de Unión (CESOL- Spain), Istituto Italiano della Saldatura Progress s.r.l (IIS – Italy), Augmented Training Services, S.L. (ATS – Spain), Colegiul Tehnic “Domnul Tudor” (CNT- Romania).

EWF (www.ewf.be) is a European umbrella organisation, representing the manufacturing community in Europe - along with its 29 European members, the National Welding Institutes. EWF manages the EW harmonised training, ensuring that trainees gain minimum knowledge of the appropriate welding processes and the materials behaviour. The EW training Guideline and professional profile are recognised by the European industry and relevant stakeholders worldwide.

2. Introduction

The European Welder Guideline was developed by the European Federation for Welding, Joining and Cutting (EWF) and reflects the results from discussions on the basics of welding technology. It is divided in two parts: Part I (EWF-IAB[1]-089r45-14) refers to the standard scheme for educating welders; Part II is optional and details test objects and Welding Procedure Specification (WPS) to be used for test object examination.

DIGIWELD project focuses on Part I, which is a document prepared, evaluated and formulated by members of the Committee for Education, Training and Qualification working group. European Welder (EW) Guideline seeks to achieve harmonization in training, examination and qualification of welders in the world. Therefore, it has been designed to provide the minimum core education in the field of welding and the assessment of both theoretical knowledge and practical skills, being linked to the requirements of ISO 9606 (or equivalent standard).

The EW Guideline (course) provides methods for both theoretical and practical education and training at three levels: Fillet, Plate and Tube Welders.

The update of the EW Guideline/curriculum has been identified as an answer to the need to encompass new technologies and teaching methods for trainers/teachers and improve the education and training process by focusing on trainees' needs, providing them with the best learning materials, complying with the latest requirements.

By using digital technologies in training, trainees will acquire welding skills and digital competences in a practical way. The introduction of open and innovative learning digital tools in the EW Guideline will allow the reduction of time and cost in training. It will also make training closer to native digital skills of the new generation of apprentices.

The proposal to update the EW curriculum consists of ensuring a harmonised use of a welding simulator in the practical training, defining the criteria for its use in terms of assessing trainees' performance before moving to a real- life welding machines. This update also suggests the introduction of a new Competence Unit (CU) focusing on Computer and Simulator in order to allow trainees to acquire basic skills and knowledges in the use of digital tools and, therefore, prepare them not only for the use of the welding simulator, but also for the use of the Learning Management System (LMS), a digital platform dedicated to training, practice and assessment of trainees' skills and knowledges, to be developed in the framework of DIGIWELD project.

The work towards this update was developed based on four tasks identified for Intellectual Output One (IO1):

- Identification of complementary conditions for the trainees to access the course,
- Assessment on the need for a new theoretical module in Computer and Simulation,
- Definition of workload and examination for practical training,
- Review of the EW curriculum.

[1] IAB – International Authorization Board

An internal survey applied to DIGIWELD project partners was carried out to encompass all the tasks previously mentioned and acquire inputs used to support the proposal to update the EW curriculum.

An external survey was also developed in all the partners languages (EN, RO, PT, IT, ES), addressed to people in the field of welding training, who are in direct contact with trainees and training equipment. The inputs from this survey provided valuable information regarding the usage of simulators in the welders' training and will also be used to support the update.

The results for the proposal to update EW Guideline are detailed in the next pages.

3. Internal and External Surveys: Main Results

In order to collect inputs for the development of IO1, and Internal Survey was conducted aiming DIGIWELD partners, whose fields of expertise range from research, innovation and training in welding and development of new technologies.

Also, an External Survey was carried out, aiming at experts in the field of welding training and technological equipment.

The main results collected are presented below and were compiled in a document entitled "Needs Analysis Report for the European Welder Curricula", adjacent to IO1.

3.1 Internal Survey

This survey encompassed the tasks associated to this Intellectual Output in three different Sections. These are the main results/findings for Section 1 - Access conditions, Section 2 - New theorical topic related to Computer & Simulation and Section 3 - Practical training and are the reflex of the answers provided by the majority of participants.

Section 1 | Access conditions

According to most part of the answers provided, basic knowledge and skills in digital tools should be considered as access condition to EW course.

Most partners agreed that candidates need to know how to securely find, manage and store digital information/contents and use and handle digital tools and online services.

EW Guideline (Section 2) describes the access conditions to the EW course. Partners were unanimous to suggest that this description include the following sentence: *In case the Authorized Training Body is providing training with a welding simulation system, the apprentice must have basic digital skills.*

Section 2 | New theorical topic related to Computer & Simulation

The majority of DIGIWELD partners replied that there is a need for the creation of a new Competence Unit (CU) in Computer and Simulation, which is important for trainees to acquire the needed basic skills and knowledge for using digital tools (such as welding simulators) and the Leaning Management System (LMS) to be developed in the scope of the project.

After completing this CU, partners believe trainees will be able to:

- "Understand how simulators work and how digital tools can support in his/her job",
- Know about "Learning Management Systems (LMS)", and how to use them,
- "Know the advantages of the use of augmented reality applied to welding compared to traditional methods",
- "Know the differences between simulated welding and real welding".

It is the partners' opinion that this theoretical CU should have 4 contact hours.

Section 3 – Practical Training

For this section, a comparison between the countries from DIGIWELD consortium was carried out, focusing on the respective National Qualifications Framework (NQF) and their connection to the EWF-IIW[2] Guideline. It is important to mention that, even though EWF's headquarters are in Belgium, it is based in Portugal. Therefore, the results from EWF focus on the Portuguese reality.

Partners' replies to this section show that NQF levels for Welder Qualification range between 2 (Portugal and Spain) and 3 (Romania). The Italian partner (IIS Progress) provided no indication on the NQF level for this Qualification once this country is still working towards the alignment of the national qualifications with the European Qualifications Framework (EQF). In the Portuguese and in the Spanish VET systems, Welder Qualification is already included in the national VET qualifications catalogues.

As for NQFs' connection to the EWF-IIW Guideline, national qualifications' catalogues may confer a different qualification level from the one conferred by the EWF system. For example, the Welder Qualification is a level 2 qualification in the Portuguese National Qualifications Catalogue, while in the EWF system it can range from a level 2 to a level 4 qualification.

In Romania, there is no alignment between the Welder Qualification NQF level and the EWF system and in Spain the Tube Welder qualification (part of the Welder Qualification) does not exist in the Spanish National Qualifications Catalogue.

All countries organise the Welder Qualification by process, except for Italy which organises it only by joint type. In Romania, besides process, the Qualification is also organised by material and joint type, as showed in the table below:

***Table 1** – Organization of Welder Qualifications by Partner Country*

EWF (PT)	ATS (ES)	ASR (RO)	CESOL (ES)	CNT (RO)	IIS (IT)
By process	By process	By process By material By joint type	By process	By process By material By joint type	By joint type

The number of hours required in practical Welding training sections considering welding process, material(s) joint types and position(s) varies from country to country due to their respective national legislation. In the following table, it is possible to verify that, on average, training in welding have a total duration of 2000 hours and can be divided between regular and professional courses:

***Table 2** – Description of practical welding training sections by Partner Country*

Portugal (EWF)	Technological Training in Welding in Portugal is based on: A. **Pre-defined Short-Term Training Units** comprised in a total of 800 hours, which include: i. MAG = 250 hours ii. TIG = 100 hours iii. Work-based learning = 120 hours B. **Set of Short-Term Training Units**, comprised in a total of 1000 hours, which include: i. MAG = 275 hours ii. TIG = 450 hours

[2] IIW – International Institute of Welding, which has an agreement with EWF for issuing International Welder Diploma equivalent to the European Welder Diploma.

	iii. MIG = 250 hours This training has two education modalities (Adult Education and Training and Modular Training) and is provided to VET schools in a Training Referential managed by the National Qualification Agency Authority (ANQEP), in accordance with EWF/IIW Guidelines.
Spain (ATS/ CESOL)	In Spain there are two types of professional training in welding: one regulated within the traditional educational system (FP) and another within the professional training for employment (FPE). Each one has its own legal regulations at national and regional level. **Welding and Boiler Technician (FP) – CINE 3 – 2000 h** of which **530** are practical welding training: - Professional module: Welding in a natural atmosphere. 290 h - Professional module: Welding in a protected atmosphere. 240 h **Professional Qualification in Welding (FPE) – 1280 h** of which **600** are practical welding training: - Welding and thermal projection by oxygas (140 hours) - Arc welding under protective gas with consumable electrode (130 hours) - Arc welding under protective gas with non-consumable electrode (130 hours) - Welding with electric arc with coated electrodes (200 hours)
Romania (ASR/CNT)	According to Romanian national laws, there can be 2 situations: 1. Practical training for formation of welders using two paths: through National Education System and through Welder National Qualification: a. National Education System: 930 hours divided by: i. MIG = 250 hours ii. MAG = 250 hours iii. TIG = 250 hours iv. MMA = 180 hours b. Welder National Qualification: 480 hours 2. Practical training for specialization in specific domain of welding: 80 hours
Italy (IIS)	No specific requirement is given in the national legislation (as it may be applicable, it only refers to ISO 9606)

All EW theoretical and practical modules will be considered in the welding training simulator that will be used in EW practical training, provided that the welding positions taught are available in the simulator. However, it must be taken into account that not all positions will be carried out due to their specificities (e.g. full penetration in butt joints). Nevertheless, simulator training can represent several repetitions since no special preparation of the materials and position in a jig is necessary.

As previously mentioned, DIGIWELD project will promote the use of welding simulators on practical training of trainees who attend EW course. Partners were asked what the percentage of time used in the welding simulator for exercises should be, considering the average time recommended by the EW Guideline for the exercises in each module of the course. Partners were unanimous to recommend that **training/exercises in the simulator** should constitute 50 to 60 percent of the practical training hours in each module, and that there is no need to create a new module on the simulator itself. It means that, for example, 60% of the time recommended in EW Guideline for exercises on the Competence Unite/Module dedicated to TIG Welding should be carried out in the welding simulator.

Most DIGIWELD partners agree that the welding simulator exercises should be implemented before the use of real-life welding machines, once:

- "Training before welding using a welding machine will allow students to learn their positioning relative to the piece to weld depending of the welding position. Will also allow the learning of the torch, adjust the needed welding speed, and other operational

variables related to the welders' job. So, the example of the apprentice to repeat all the exercises at least 2 times (or when the Trainer considers the student is ready, before moving to real life welding exercises) can be the way to go.",

- "The apprentice should make all the exercise at least once.",
- "The apprentice should gain successful results on the simulator before moving to the use of real welding machines".

There was also an opinion that defended a flexible process in which the theoretical training carried out both in Learning Management System and in the classroom could alternate with practice in the simulator and real welding workshop, to which apprentices only go on if they have passed the practical exercises in the simulator and the teacher determines that they are prepared to do it in the workshop.

Practical training in simulator will have all these opinions in consideration, but mainly will be used before the real-life welding, to which trainees will only move when achieving a given score percentage, with or without aid from the simulator. According to ATS (DIGIWELD partner responsible for the welding simulator), it will allow to configure the level of help the exercises will provide. Depending on the EW module, there may be total, some or no aid.
Currently in the EW Guideline, trainees are evaluated by trainers in all exercises they carry out, and these evaluations can be considered as intermediate exams. Most partners agree that these intermediate exams should not be carried out using the welding simulator. However, if so, the level of difficulty to be considered for these exams should be "hard", with no aid from the simulator.

Two partners mentioned that trainees should exercise on the simulator until reaching, at least:

- 50 % score without any aid from simulator, before moving on real life welding.
- 70 % score with some aid from simulator, before moving on real life welding.
- 90 % score with total aid from simulator, before moving on real life welding.

Finally, in case the trainee would not adapt to the welding simulator, all partners agree that the welding instructor/trainer can override the virtual evaluation, allowing trainee to move to real-life welding.

3.2 External Survey

The External Survey was created and addressed to people involved in the field of welding training. Contacted by DIGIWELD partners, participants are in direct contact with trainees and equipment, thus providing valuable information regarding the usage and impact of simulators in the welders' training.

This survey was conducted in parallel with the Internal one, in January 2019, using the Survey Monkey platform and printed versions.

As it was done in the reporting of the Internal Survey results, the results presented for this survey are based on the answers provided by the majority of participants in each topic[3].

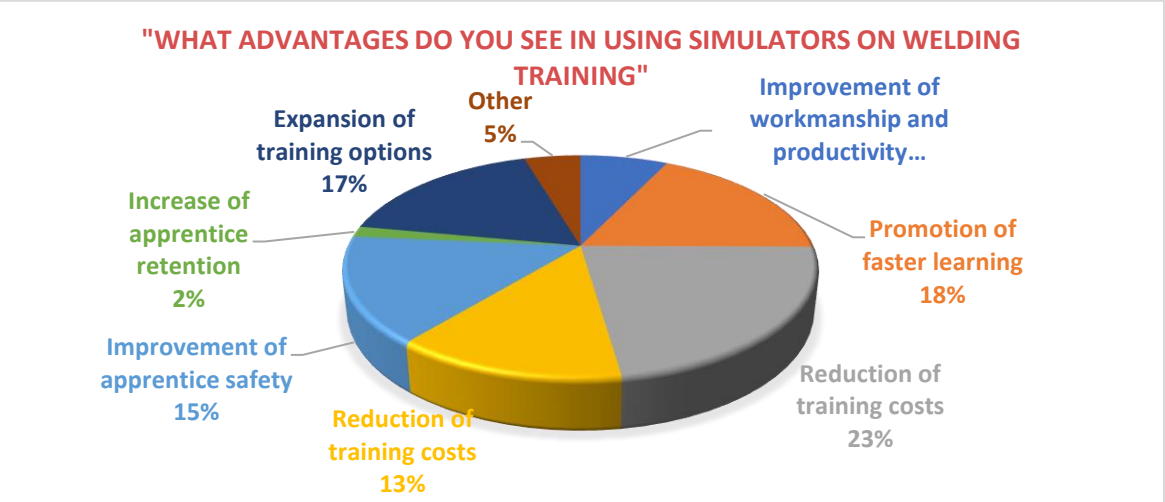
[3] Refer to IO1 – Needs Analysis Report

Result show that more than 40% of participants consider the use of digital tools to be very relevant in welding training, even though 61% of them do not use them (but are considering implementing them in their training, including welding simulators).

Online training platforms and welding simulators are viewed as the most relevant digital tools to be used in training, which causes trainees to need a certain level of know-how on digital tools to access the training course, according to participants.

When asked what the main advantages of using simulators are in the welding training, based on response options provided to participants, the answers were as showed in the graphic below:

Graphic 1 – *Advantages Participants of the External Survey see in the usage of Simulators in Welding Training*



Reduction of training costs, *promotion of faster learning*, *expansion of training options* and *improvement of apprentice safety* are the most chosen options by participants.

Regarding the replacement of real-life welding training by the usage of welding simulators in welding training, **35% of participants indicated to agree with a replacement between 30 to 50% of the training time** and 30% agrees with that replacement between 10 and 30% percent of the time.

From a total of 61 answers, 43 were that welding simulators can be used for intermediate evaluation to allow trainees to move from simulation training to real life welding. For participants, the level of difficulty of this intermediate evaluation should be **medium, with some aid from software**.

In case the trainee would not adapt to the welding simulator, 90% of participants agree that the welding instructor/trainer can override the virtual evaluation, allowing the apprentice to move to real-life welding.

4. Main Conclusions taken from the Needs Analysis Report

The main results achieved so far allow the DIGIWELD consortium to conclude that:

1) If using welding simulator for the practical training, the trainees must have basic knowledge and skills in digital tools.
2) The new theoretical Competence Unit to be created will be entitled *A.10/B.10/C.5 – Introduction to Computer and Simulation*, will have 4 contact hours and will be developed to introduce trainees to the digital tools used by the training provider (Approved Training Body, or ATB).
3) The practical hours of training were assessed, and the proposal considered is to split the minimum recommended hours to a minimal of 40% in the real welding equipment. This division might need to be evaluated individually by exercise, as there may be some cases, due to difficulty inherited to the process and position, where more time may be needed in the real welding equipment.
4) During the training on the welding simulator the apprentice must go through all the exercises and should attain at least 60% in each exercise, without any aid from the simulator before moving to practical training in the real welding equipment and environment. The trainer will assess the welding capabilities and has the final decision if the trainer is moving towards training with the real welding equipment.

The proposal for the EW Guideline's update encompasses the results gathered. Moreover, as the project is developed and as more information is gathered, it is expected that the final proposal changes within the time frame of the project, so it is a work under continuous development.

5. Current European Welder Qualification| Profile and Access Conditions

As previously mentioned, the European Welder Course comprises three levels of education and training: Fillet Welder, Plate Welder and Tube Welder. It consists of modules that are divided into theoretical education, practical training (practice in welding and test welding) and examination.

This course is part of the EWF Education, Training and Qualification System, which provides training guidelines that cover all professional levels in welding technology and related areas and is recognized worldwide. This System ensures that the transfer of knowledge process is developed in a harmonized way, meaning that EW Guideline (part of EWF System) is applied under the same conditions regardless of the country where it is utilized, in terms of theoretical and practical training and examination procedures.

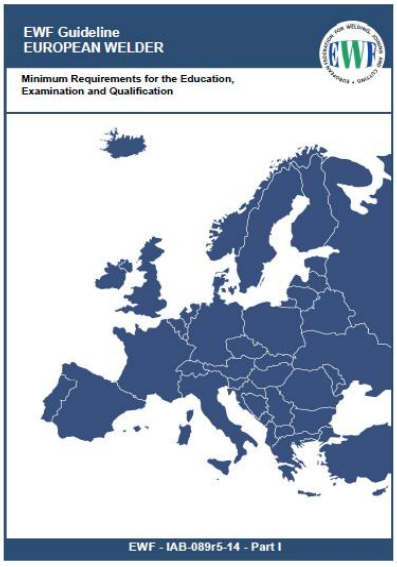


Fig. 1 – Cover of "EWF Guideline, European Welder"

The European Welder Course prepares trainees to meet the Welder profile. A Welder is a person who[4]:

- Is familiarized with fact principles related with the welding process,
- Has general concepts of the welding field and of activities related to joining and weld joint fit up,
- Can accomplish tasks and solve problems by applying welding process and related technologies,
- Can take responsibility to perform welding work in an autonomous way on construction sites and ensure the appliance of the proper welding practice.

In the EW Guideline, there are two distinct routes identified to access qualification.

[4] Refer to *General Description of the Welders Profile based on the EQF descriptors, in Annex.*

5.1 Access to Qualification | Standard Route

This is the route recommended by EWF as the fastest, most comprehensive way the training syllabus may be covered. Standard Route requires successful completion of this training syllabus, which is designed to meet all the requirements in the EW Guideline.

The Standard Route also allows a limited amount of prior learning to be taken into account, which needs to be approved by the Authorized Nominated Body (ANB).

Therefore, in order to access the course, the applicants must possess sufficient knowledge of, or education in, metalworking.

To access to Module 1, candidates must also have a level of health, and physical and mental capability to undergo the training for which they are applying. To access Module 2, candidates must demonstrate the required level of skills by passing the tests described in Module 1.

Successful completion of one module qualifies for participation in the next module, and this logic applies to all levels.

With existing knowledge and proven skills, the program may be available at higher level, provided that the candidate demonstrates a capability (practical and theoretical) to meet the entry requirements, as described below:

Table 3 *- Access requirements to the different EW Guideline Modules*

Access to Module 2	Demonstrate the required level of skill by passing the tests as described in Module 1
Access to Module 3	Demonstrate the required level of skill by passing the full examination as described in Module 2
Access to Module 4	Demonstrate the required level of skill by passing the full examination as described in module 2 and passing the tests as described in Module 3.
Access to Module 5	Demonstrate the required level of skill by passing the full examination as described in Module 2 and in Module 4.
Access to Module 6	Demonstrate the required level of skill by passing the full examination as described in Module 2 and in Module 4 and by passing the tests as described in Module 5.

Practical skills may be proven by adequate and valid ISO 9606 or equivalent certificates. At the discretion of the ANB, proof of practical skills at a lower level may be delivered after the completion of the training module involved but before awarding the corresponding diploma.

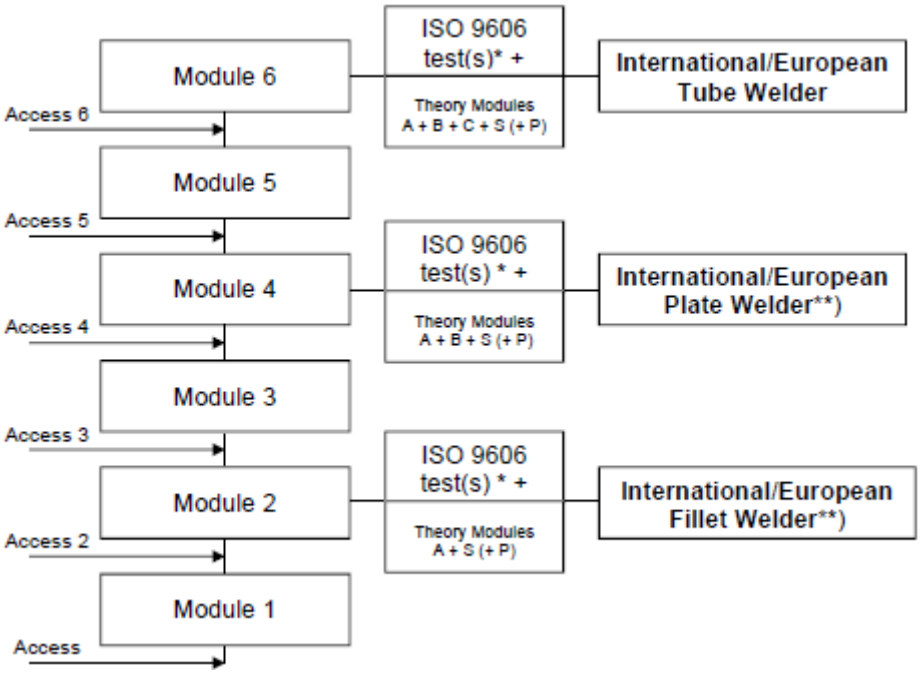


Fig. 2 - *The overall structure of the training and examination of the European Welder (EW)*

*) The modules 2, 4 and 6 may be completed either by comprehensive ISO 9606 tests or by less comprehensive ISO 9606 tests and test objects.

**) At the option of the Authorized Training Body (ATB) and in agreement with the ANB, it may not be necessary to issue intermediate certificates and diplomas.

5.2 Access to Qualification | Alternative Route

The Alternative Route is available for those who have previously gained the knowledge and expertise indicated in the instruction programme in EW Guideline, through informal and non-formal learning, and are able to demonstrate their capability in all respects, to proceed to examination without compulsory attendance at an ANB approved Training Course, as mentioned in the entry requirements.

5.2.1 Entry Requirements

Any candidate who can show a welder qualification (i.e. ISO 9606) valid under the scope for the Diploma he/she wants, or who has 3 years of experience as a welder, can access the Alternative Route.

5.2.2 Evaluation process

The evaluation process comprises several steps connected to theoretical and practical examinations, each with its own criteria.

Therefore, to perform the **theoretical examinations** related to the level of the EW Diploma that the candidate is seeking for:

- A candidate for Tube Welder Diploma must perform examinations for Modules/CUs A, B, C, Examination Process related (SX) and the Examination Material related (PSS or PAL).
- A candidate for Plate Welder Diploma, must perform examinations for Modules/CUs A, B, Examination Process related (SX) and the Examination Material related (PSS or PAL).
- A candidate for Fillet Welder Diploma must perform examinations for Modules/CUs A, Examination Process related (SX) and the Examination Material related (PSS or PAL).

To perform the **practical examinations** that are defined in the Guideline for the level of the EW Diploma that the candidate is applying for, including the lower levels examinations:

- A candidate for Tube Welder Diploma must perform practical examinations Mod. 2, 4, 5 and 6.
- A candidate for Plate Welder Diploma must perform practical examinations Mod. 2, 3 and 4.
- A candidate for Fillet Welder Diploma must perform practical examinations Mod. 1 and 2 (See Fig. 2).

In case the candidate fails on theoretical examination(s) or on the practical exam(s), he/she is able to perform a re-examination, under the following criteria:

- For theoretical examinations, candidates are allowed to have two more attempts (in total three attempts). In case of failure on the third attempt, the candidate must take the theoretical module(s) that he/she failed,
- For practical exams candidates, are allowed to have one more attempt. In case of failure on the second attempt, the candidate must take the practical module he/she has failed.

5.2.3 Awarding the EW Diploma

The EW Guideline states that if the candidate is successful in the theoretical and practical examinations, the EW Diploma shall be awarded.

6. European Welder Guideline: Structure and Purposes of the Course

The European Welder (EW) Course comprises three levels of education and training: Fillet Welder, Plate Welder and Tube Welder. It consists of Modules/CUs, which are divided into theoretical education, practical training and examination.

Thus, the education and training programme consist of **Theoretical Modules/CU A** (to the level of European Fillet Welder), **B** (to the level of European Plate Welder) and **C** (to the level of European Tube Welder), which provide basic knowledge in welding. Special requirements for each welding "**process"** are given in **Modules/CUs S** and special requirements per "**material**" (group) are described in **Modules/CUs P**. For each theoretical Module/CU, the EW Guideline defines its objective, scope and general Learning Outcomes (LOs).

The **Practical Modules 1 to 6** (organized in 3 pairs) correspond to the three levels of education. For each level, two alternative types of practical **examination** can be made, either ISO 9606 test only or a combination of ISO 9606 and test object.

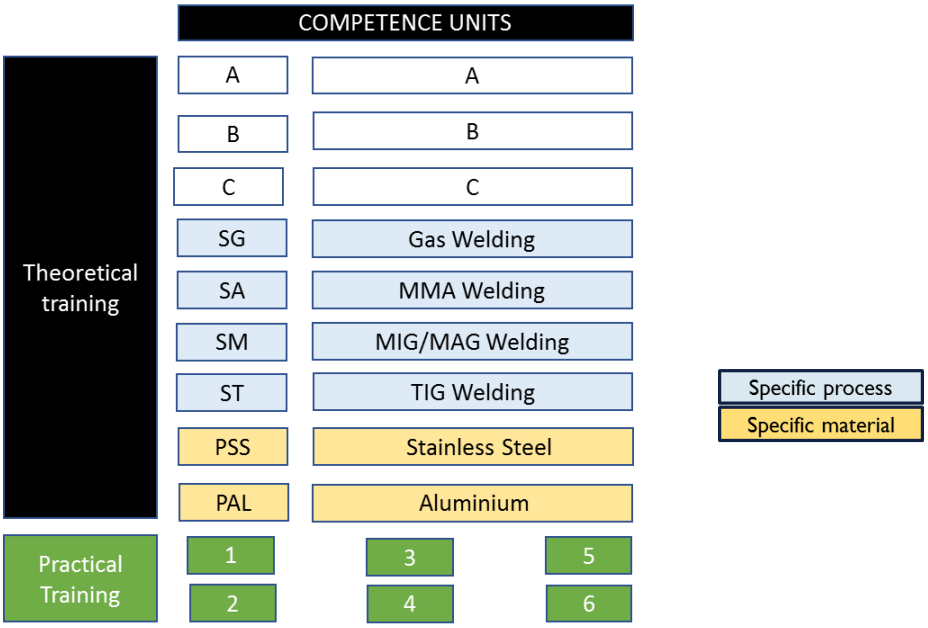


Fig. 3 – Structure of the European Welder Curriculum

The theoretical education provided to trainees aims at a basic understanding of the appropriate welding process and the materials' behaviour, including standards and safety regulations. The themes and keywords are given as "detailed knowledge" in the Competence Units' descriptions, together with the Learning Outcomes, which are defined in terms of knowledge and skills.

After each Competence Unit, a theoretical examination is performed.

The practical training advised in this Guideline brings to trainees a comprehensive skill, required for practical work in industry. This part of training should be done with the trainees individually. If a trainee demonstrates practical skills of welding different materials, it is possible to do the examination without prior practical training.

It is for the ANB to decide whether it is desirable to add knowledge on specific materials to the course. Such knowledge should be in addition to the basic knowledge, as specified in the Guideline.

There is a minimum number of compulsory contact hours for each Module/CU (A to C, P and S) as well as for their practical parts. A teaching hour will contain at least 50 minutes of direct teaching time. To avoid long periods of theoretical training and practical training, the introduction of an innovative learning method is recommended to help motivating and engaging trainees.

7. Updating the EW Guideline

The following proposals for the update of EW Guideline are based on the results from the Internal and External Surveys presented in section 3 of the present report, and include: the Access conditions to the EW course; the introduction of a new CU entitled "Computer & Simulation" and the procedures for the use of welding simulators on practical training of trainees.

7.1 Proposal to adjust the Access Conditions of EW Course to Welding Simulators

In EW Guideline, more specifically in its **Section 2 – *Access to the Course***, a description of the minimal requirements to access to EW course is provided. There are two routes to access to the course: a Standard Route and an Alternative one.

For the Standard Route Qualification Access, which indicates that "Applicants must possess sufficient knowledge of, or education in, metalworking to follow the course", DIGIWELD project proposes to add a sentence to this requirement, to be taken in to account by ATBs that use welding simulators for trainees' practical training: **If a welding simulator is used for the practical training, applicants must have basic knowledge and skills in digital tools.**

This basic knowledge and skills in digital tools will allow trainees to have a basic understanding of the subjects to be delivered by the new Competence Unit (CU) created in the scope of DIGIWELD, entitled Computer & Simulation, which will better prepare trainees for the usage of the welding simulator in practical training , and will be described moreover in this document.

This new theoretical CU will address the knowledge gaps that trainees may present regarding the usage of new training tools and enable trainees to use them on practical exercises and move forward with training. It will also focus on simulation systems in terms of sensors, interfaces, physical parts, augmented reality, etc.

7.2 European Welder Guideline: A new Competence Unit (CU)

The creation of a new Competence Unit (CU) related to Computer & Simulation is foreseen in the scope of DIGIWELD project for the update of the EW Guideline. The implementation of Simulators and Learning Management Systems (LMS) in the EW training requires an introduction of the trainees to these new instruments.

This new CU (or Module) is set as **optional** and will be applied to training institutions (i.e. ATBs) that implement their training using the Welder Simulator and LMS.

A.10/B.10/C.5 – Introduction to Computer and Simulations is the title attributed to this new CU. It may be considered as a transversal (cross-cutting) CU to all levels of Welders, meaning its Learning Outcomes (statement of what trainees will able to know and do after the completion of the CU, described in terms of Knowledge and Skills acquired by learners and written based on

the EW curriculum) are not directly linked to a specific job activity, so it might be mobilized in several job functions.

Also, the consortium decided to attribute a proficiency level to the new CU, which corresponds to an **Elementary depth** (comparable to Level 2 EQF), due to the fact that these contents provide trainees basic knowledge about the issue and basic cognitive and practical skills required to use the information in the development of tasks and problem solving.

The introduction of the created CU in the EW Guideline is showed in the figure below:

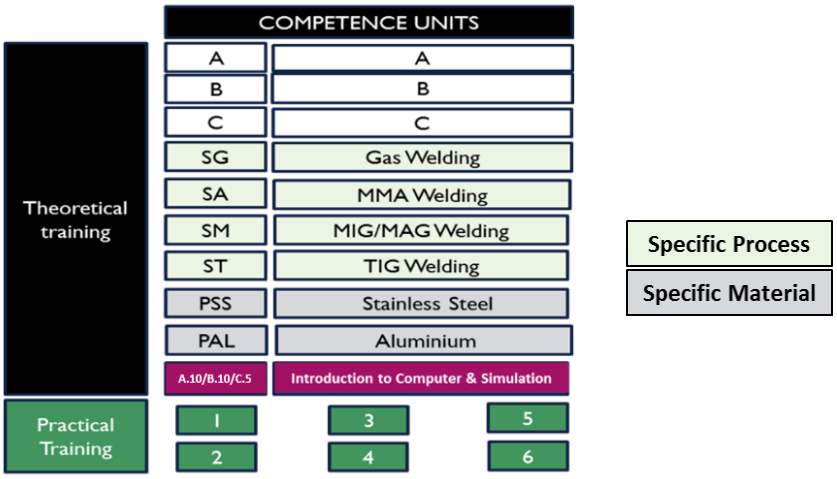


Fig.4 - Incorporation of the "Introduction Computer and Simulation" CU on the European Welder Curriculum

In case ATBs choose to use the developed welding simulator created for the EW practical training, this new CU will be taught to trainees in order to allow them to acquire the necessary knowledge and skills to use the simulator.

As this simulator will be based on all EW modules, it will allow trainees to apply the theoretical and practical contents and, therefore, to retain information about learning subjects (e.g. welding techniques), applying it to welding-related situations.

The detailed description of this CU, with the remaining EW theoretical Modules, and criteria for the use of the welding simulator will be shown in **Section 9 – Training Curriculum** of this report.

7.3 Proposal for updating the number of hours related to Practical Training – The use of Welding Simulator

7.3.1 Digital Tools in Learning Processes

Technological Evolution opened doors to a simpler and quicker access to information, having become essential for the development of all sectors of society, including education.

In the European Community, since 2000, all Member States have been developing programmes and actions that promote the integration of digital tools in education and training, which

translates into an effort made by all EU countries to equip schools, train teachers to use hardware and software and facilitate the production of digital content.

There are several benefits brought by digital tools' application in the learning process, namely:

a. **Cost-benefit:** costs involved in the acquisition of technology and equipment are compensated by the positive results presented by learners, with direct impact on the success of the training entities that make such investment.
b. **Learning reinforcement:** the use of platforms/websites allow learners to access additional information about the subjects taught in class by researching and downloading learning contents.
c. **Help informal learning:** which has greater impact on adult learners, as they can acquire knowledge and skills through the use of online platforms that promote self-learning and informal peer-learning (networks of interest or professions that provide and/or share information).
d. **Use of simulators:** the use of simulators provides a practical and immediate learning of a given subject, as well as immediate feedback and correction about the learners' performance, giving them autonomy to access the results obtained and giving teachers the possibility to use these results to adjust their teaching methods to the needs demonstrated by the learners. The use of simulators also allows them to perform exercises at their own pace, which promotes the enhancing of self-esteem in learners, including those not used to formal learning. It can also be seen as a medium to long term investment as it allows savings with welding consumables and base materials that are not used when simulation is used.

By integrating such tool in the EW curriculum, the DIGIWELD consortium aims to strengthen the link between theoretical and practical learning and to empower learners to acquire knowledge and digital skills through a practical and accessible tool adapted to the context of welding.

7.3.2 Practical Training and Tests - General

The EW Guideline applies mainly to ferritic steels (group 1, 2, 3 and 11 according to ISO/TR 15608), to stainless steels (group 8 and 10 according to ISO/TR 15608) and to aluminium alloys (group 21, 22 and 23 according to ISO/TR 15608) and may also be used as a basis for other materials not foreseen in the current EW Guideline.

The application of this programme to other materials than the ones given with the EW course exercises may require slight changes to the work pieces and/or the positions to be welded. It is important to refer that, in this case, the current EW Guideline does not provide for recognition through EW/IIW diplomas by an ANB, even though here may be another type of recognition by the organizations involved (diploma of the organizations themselves), but not by an ANB. Thus, these additions would have to be revised to be included in the EW Guideline.

In all practical Competence Units, the following Learning Outcomes apply:

1. Assemble and tacking the joint.
2. Take the necessary precautions to avoid distortion prior to, during and after welding.
3. Follow the welding symbols and the (p)WPS (related to the proposed weld).

4. Perform safe welding according to the (p)WPS (or welding instruction).
5. Select the appropriate type of consumable and the desired size according to the (p)WPS (or welding instruction).

The practical training and its contents, built in the scope of DIGIWELD project and described in the next section, will be part of the welding simulator.

7.3.3 Welding Simulator

The current EW Guideline states that there are many intelligent computer aided welding simulating systems available. If an existing welding simulation system is suitable to be used in welding training sessions for a special process, it needs to be approved by the ANB. In the case of an approved simulation system, the ATB is able to decide either to include it in training or not.

DIGIWELD consortium suggests the update of the EW Guideline's **Section 8/Sub-section 8.1 – Practical Training and Tests**, with a description of the terms for the application of the simulator in the EW course in terms of:

- Procedure for training (i.e. how to apply, number of hours, types of joints to address),
- Procedure for examinations (i.e. designing specific tests to prove trainees' skills and practical knowledges in order to start the practical training in real welding equipment).

There are minimum recommended training hours, positions, material specifications and evaluation, which are described accordingly in each practical module.
Once the welding simulator is integrated in the practical training of EW course, there is a need for a division between the hours dedicated to the use of the simulator and the use of real equipment. Thus, based on the inputs gathered by DIGIWELD consortium, the proposal is to devote ***a minimum of 40%*** of the recommended hours in the real welding equipment.
This division might need to be evaluated individually by exercise due to possible difficulty associated to the process and position, where more time may be needed in the real welding equipment.

The welding simulator will provide practical exercises related to all EW course modules (both theoretical and practical), offering the needed welding positions for trainees to practice and to be prepared for a final exercise with a real welding machine.

As mentioned before in this document, the use of the welding simulator by the A Training Bodies (ATBs) is optional, as well as the use of the Learning Management System (LMS) developed in the scope of DIGIWELD project. If ATBs decide to use it, Competence Unit (CU) "Introduction to Computer and Simulator" for EW Guideline needs to be included in the theoretical training of trainees to prepare them for use both, the simulator and LMS.

DIGIWELD consortium recommends that the use of the simulator for practical training constitutes 50% to 60% of the training hours in each module.

A. Access Condition

Before engaging in practical training with simulators, trainees need to attend and successfully accomplish Competence Unit (CU) "Introduction to Computer and Simulation". A written exam shall be carried out by the end of the CU. This CU allows trainees to acquire basic knowledge on digital tools and basic skills in the usage of digital tools, both LMS and welding simulator.

B. Using the Welding Simulator

As part of the practical training, the Welding Simulator will be used before the real-life welding modules, allowing trainees to:

- Learn their positioning in relation to the piece to weld,
- Learn to use the torch (angle and techniques),
- Adjust the needed welding speed.

It is recommended that trainees are given the opportunity to repeat all welding exercises two (2) times before moving to the real-life welding modules. In this way trainees have more time to practice in the simulator and make a final exercise in an actual welding machine. However, the final decision on the number of required repetition should be left for trainers' judgment, and therefore her/his assessment should prevail over the recommendation, meaning that the trainer may eventually decide that the trainee does not need to repeat the welding exercises.

The simulator allows the configuration of the level of aid the exercises will require. Depending on the EW module, there may be total, some or no aid at all. It is for the trainer to decide the level of aid to provide to trainees.
The level of aid provided to trainees to perform their simulation exercises impacts their probabilities to move to real-life modules: the more help they get, the more percentage is needed.
During training on the simulator, trainees can get aid from the simulator but must be capable to attain a percentage of **at least 60 % score, in each exercise, without any aid from simulator** before moving to practical training in the real welding equipment. Moreover, the trainer will evaluate the welding capabilities of the trainee and has the final decision on if he/she should move to the real equipment.

Thus, before moving to real-life welding, trainees should exercise on the welding simulator until they reach:

i. 60% score without aid from the simulator,
ii. 70% score with some aid from the simulator,
iii. 90% of the score with total aid from the simulator.

Trainers can assign the desired values to the different parameters. The range of tolerance will be higher or lower, depending on the level of difficulty chosen, which has three levels:

- Beginner
- Intermediate
- Advanced

Every single level is more restrictive than the other as the tolerance range varies in all parameters.

All three levels include **on-screen guides aids** that **can be deleted or customized** by the trainers. These visual aids provide corrective feedback to trainees during simulation in the Technique Parameters: work angle, travel (angle, direction and speed) and CTWD (contact tip to work distance).

These aids can also provide information of the manual skills based on the choice that the teacher make.

In case the trainee, for some reason, does not adapt to the use of the welding simulator, the trainer can override the virtual evaluation, allowing the trainee to move to real-life welding.

C. Intermediate Examination

Within the EW training course, trainees need to perform intermediate exams which are exercises carried out by the end of each practical module, based on the previously mentioned test pieces aligned with ISO 9606.
DIGIWELD consortium recommends that the welding simulator should not be used for the realization of this intermediate examination. However, if there is a chance in the future that welding simulator could be used for this purpose, the level of difficulty should be Advanced, with no aid from the simulator. Thus, trainers should set a threshold for intermediate examination, which can be based on the analysis of the simulated weld bead that comes out of the virtual equipment, since for the intermediate examination of each level a visual inspection of the trainer is sufficient. Trainees move to real welding machines when trainers consider their score get higher than that threshold.

D. Welding processes represented in the welding simulator

The welding simulator allows to practice the processes taught throughout the EW course, namely:

- Process 111 (MMA-Welding),
- Process 135, 136, 138 (MAG-welding),
- Process 131 (MIG-Welding),
- Process 141 (TIG-welding).

Even though Process 311 (Gas-welding) is also a process represented in the EW Guideline, given its specificities, it will not be considered in the welding simulator. For that reason, this process will only be covered in the theoretical module of the EW course.

8. Alignment between the EW Curriculum and the European Qualifications Framework (EQF)

The European Qualifications Framework (EQF) is a common reference framework that helps education and training entities, employers and individuals across Europe to compare qualifications in the different education and training systems, facilitating mobility of trainees and workers in the EU in the process. Thus, the adoption of EQF increases mobility of workers and trainees and contributes to the recognition of their qualifications outside their own countries.

The EQF tool is based on Learning Outcomes (LOs) whose main reference level descriptors are:

- Knowledge,
- Skills
- Autonomy and Responsibility (Attitudes).

In order to align the new CU created for DIGIWELD with EQF, the consortium wrote its LOs centered on learners' point of view (following a new LOs approach that focuses on defining precise and observable learning results).

8.1 EW Training Curriculum

In order to visualize the EW training curriculum, the contents of theoretical Modules/Competence Units A to C and S/P are presented, in terms of:

a. **Contact hours** –Minimum contact hours for each subject title.
b. **Subject title** – General curriculum content,
c. **Workload (WL)** – Is an estimation of the time learners typically need to achieve the defined learning outcomes. WL covers theoretical training and self-study, as well as the time devoted to practical training and examination (as explained in **Section 10. EW Qualification and its alignment with European tools**). The time needed for the completion of each Module/CU may vary individually, according to the capability of the trainee,
d. **ECVET** – European Credit System for Vocational Education and Training. Credit points are allocated to Modules/Competence Units, where 1 credit equals 25 to 30 hours of workload (refer to the explanation in **Section 10** as well).

The new CU "Introduction to Computer and Simulation" will not only be presented using the above-mentioned terms, but also:

e. **Learning Outcomes** – described in terms of knowledge and skills, as previously mentioned.
f. **Detailed Knowledge** – Description of the level of knowledge/Qualification each Module/CU addresses and of the contents of each subject title.
g. **Depth of the Qualification –** Based on the EQF descriptors for Welders' Profile and in the EWF Proficiency Levels (in Annex A), which is a sectorial framework developed by EWF.

Practical training of contents of EW Guideline and a table of recommended test pieces and positions for practical **examination** are also presented in this section.

9. Theoretical Training – European Welder Curricula

Module/Competence Unit A

Guideline - European Welder|EWF-IAB-089r5 – Part I] **Module A – Theoretical Education [Fillet Welder]**	**CONTACT HOURS**
SUBJECT TITLE	
Using electricity for arc welding	2
Welding equipment	2
Health and Safety	2
Safe working in the fabrication shop	2
Welding consumables	2
Welding practice (1)	4
Welding practice (2)	2
Introduction to steel	2
Qualification of welders	2
Total	**20**
WORKLOAD	**40**
ECVET	**1,5**

Module/Competence Unit B

Guideline - European Welder|EWF-IAB-089r5 – Part I] **Module B – Theoretical Education [Plate Welder]**	**CONTACT HOURS**
SUBJECT TITLE	
Methods of joint preparation for welding	2
Welded joints in plates	2
Weldability of steels	2
Shrinkage, residual stress, distortion	2
Weld imperfections	2
Overview of fusion welding processes	2
Safe working on site	2
Inspection and testing	2
Quality Assurance in welding (QA)	2
Total	**18**
WORKLOAD	**36**
ECVET	**1,25**

Module/Competence Unit C

Guideline - European Welder|EWF-IAB-089r5 – Part I] **Module C – Theoretical Education [Tube Welder]**	**CONTACT HOURS**
SUBJECT TITLE	
Welded joints in pipes	2
Materials other than non-alloy steel	2
Review and consequences of failures	2
International Welding Standards	1
Total	**7**
WORKLOAD	**14**
ECVET	**0,5**

Modules S (dedicated to one specific Welding Process)

These Modules are dedicated to one specific welding process to be taught **after on in parallel** to the theoretical modules per material required.

Module SG. Supplementary theoretical education for gas welding (311)

Guideline - European Welder|EWF-IAB-089r5 – Part I] **Module SG – Supplementary theoretical education for gas welding**	**CONTACT HOURS**
SUBJECT TITLE	
SG1. Construction and maintenance of gas welding equipment & typical welding parameters	3
SG2. Welding consumables	1
SG3. Health and Safety	1
Total	**5**

Module SA. Supplementary theoretical education for MMA welding (111)

Guideline - European Welder|EWF-IAB-089r5 – Part I] **Module SA – Supplementary theoretical education for MMA welding**	**CONTACT HOURS**
SUBJECT TITLE	
SA1. Construction and maintenance of MMA welding equipment & typical welding parameters	3
SA2. Covered electrodes	1
SA3. Health and Safety	1
Total	**5**

Module SM. Supplementary theoretical education for MIG/MAG welding (13)

Guideline - European Welder|EWF-IAB-089r5 – Part I] **Module SM – Supplementary theoretical education for MIG/MAG welding**	**CONTACT HOURS**
SUBJECT TITLE	
SM1. Construction and maintenance of MIG/MAG equipment	3
SM2. Welding consumables	1
SM3. Health and Safety	1
SM4. MIG/MAG welding characteristics and typical welding parameters	2
Total	**7**

Module ST. Supplementary theoretical education for TIG welding (141)

Guideline - European Welder|EWF-IAB-089r5 – Part I] **Module ST – Supplementary theoretical education for TIG welding**	**CONTACT HOURS**
SUBJECT TITLE	
ST1. Construction and maintenance of TIG welding equipment	3
ST2. Tungsten electrodes and welding consumables	1
ST3. Health and Safety	1
Total	**5**

Because all EW Guideline modules will be developed for DIGIWELD training course to be part of its digital training tools, the consortium discussed the possibility to adjust its level of language and terminology. For that reason, partners suggest adding to title of the theoretical **Module SM.**

Supplementary theoretical education for MIG/MAG welding (13), the term "Semi-Automatic Processes" to its title in order to tailor this terminology to candidates' language. Thus, the proposed name for this module is MIG/MAG and Semi-Automatic Processes", with no changes to its subject titles.

Modules P (dedicated to one specific Welding Material)

These Modules are dedicated to one specific material to be taught **after or in parallel** to theoretical modules, if the sought qualification is for stainless steel or aluminum.

Module PSS: Instruction items for supplemental theoretical education for stainless steel

Guideline - European Welder|EWF-IAB-089r5 – Part I] **Module PSS – Instruction items for supplemental theoretical education for stainless steel**	**CONTACT HOURS**
SUBJECT TITLE	
PSS1. Basics of stainless steel, welding processes and health aspects	2
PSS2. Weldability, welded joints and distortion of stainless steel	2
PSS3. Welding consumables for stainless steel	2
PSS4. Corrosion, post weld treatment	2
Total	**8**

Module PAL: Instruction items for supplemental theoretical education for aluminum

Guideline - European Welder|EWF-IAB-089r5 – Part I] Module PAL – Instruction items for supplemental theoretical education for aluminum	CONTACT HOURS
SUBJECT TITLE	
PAL1. Basics of aluminium, welding processes and health aspects	2
PAL2. Weldability and welding technique	2
PAL3. Welding consumables for aluminium welding	2
PAL4. Welding joints and distortion in aluminium alloys	2
Total	8

Competence Unit "Introduction to Computer and Simulation"

Competence Unit "Introduction to Computer and Simulation" (A.10/B.10/C.5)	CONTACT HOURS
SUBJECT TITLE	
Training Digital Tools and Methodology	1
Learning Management System (LMS)	1.5
Welding Simulators	1.5
Total	**4**
WORKLOAD	**8**
ECVET	**0,25**

LEARNING OUTCOMES – Introduction to Computer and Simulation	
Qualification	**European Welder**
KNOWLEDGE	Elementary principles of: ▪ Digital tools ▪ Learning management system (LMS) ▪ Augmented reality ▪ Welding simulators
SKILLS	Use learning management systems (LMS) for synchronous and asynchronous training Identify the differences between simulated welding and real welding Use welding simulator as practice for preparing to real welding contexts Identify additional welding digital tools used in training Use additional digital tools in the context of practical training in welding when applicable

DETAILED KNOWLEDGE	
QUALIFICATION	**European Welder**
CONTACT HOURS	**4**
DEPTH	**ELEMENTARY**
Training Digital Tools and Methodology Digital tools used in welding training Advantages and disadvantages of digital tools in training	1
Learning Management System (LMS) Virtual Learning Environments Definition and characteristics of LMS Settings and Functionalities of a LMS LMS – challenges and advantages Available LMS tools	1,5
Welding Simulators Welding simulators systems Augmented Reality Virtual Reality Difference between simulator and real welding system Advantages and disadvantages of welding simulators Set-up of welding simulators	1,5

10. EW Qualification and its alignment with European tools

In an interconnected world, harmonized training systems have become crucial to respond to the labour market needs and to link education to industrial environments and reality.

Mobility of labour and the recognition of qualifications and diplomas within Europe are enhanced when using common standards for training and examination or qualifications' awarding, based on European tools for transparency (like ECVET and EQF).

Implementation and recognition of Welder courses at European level should be based on EU policies and tools which, by principle, are key factors for enhancing transparency, comparability and portability of people's qualifications.

10.1 National and European Qualification Frameworks (NQF/EQF)

The Recommendation of the European Parliament and the Council of 23 April 2008 has established the European Qualifications Framework (EQF) for lifelong learning, which is a common reference framework of eight levels of qualifications, expressed as learning outcomes with increasing levels of proficiency. The EQF serves as a translation grid between different qualifications systems and their levels.

The new Council Recommendation on the EQF for lifelong learning (2017) has been approved, built on the achievements of the 2008 Recommendation, ensuring the continuity in the processes launched by individual countries to reference their qualifications frameworks and levels to the EQF.

Comparative analysis between National and European frameworks is required to understand qualifications and diplomas awarded in different countries. At this regard, the European Commission has developed a tool that compares Qualifications frameworks among different countries.

For a well establish international qualification, such as EWF Qualification System, with recognised training and Quality Assurance Systems in technical areas, a strategic approach is required when referencing EW Qualification to the EQF, which implies first a referencing process to the NQF, thus based on common procedures and criteria at national level.

10.2 EWF Sectoral Qualification Framework

EWF System assures harmonised knowledge, skills, autonomy and responsibility for any holder of a diploma in any region of the world, and comprises Education, Examination and Qualification Guidelines for different professional/proficiency levels.

For that purpose, EWF System has its own reference framework containing seven different proficiency levels, currently organized in statements of general descriptors defined in terms of knowledge, skills, autonomy and responsibility for each proficiency level that its qualification encompasses, enabling EWF's Qualifications transparency, recognition and linkage to both National and European Qualifications Frameworks.

While the EWF case is an example to follow, when it comes to establish a Sectoral Qualification Framework it is clear that, in order to be completely aligned with industry/sector requirements, he sector stakeholders have to be involved in defining Sectoral Qualification Framework at the European level, but with inputs from stakeholders from different countries with expertise in the process/technology/sector/industry. By doing this, it will be possible to ensure that the developed content/qualifications are aligned with the sector/industry requirements.

10.3 European Credit System for Vocational Education and Training (ECVET)

The European System for Vocational Education and Training (ECVET) is a common methodological framework used to facilitate the transfer of learning credits from one qualification system to another, promoting transnational mobility and access to lifelong learning for learners and workers across EU.

The ECVET Recommendation (2009) has established the European Credit System for Vocational Education and Training (ECVET) at all levels of the EQF with reference to VET qualifications in order to facilitate transfer, recognition and accumulation of individuals' achievements in formal, and where appropriate, non-formal and informal learning contexts.

In the context of ECVET Recommendation:

- Units of learning outcomes can be assessed and validated with a number of associated ECVET points.
- A general framework of cooperation, networking and mutual trust between partners – sending and receiving/hosting organisations - is defined in the Memorandum of Understanding (MoU).
- Learning agreements and personal transcripts are applied to the two partners and the specific mobile learner involved in the mobility process, in order to summarise the training and validation process carried out in the framework of the MoU.
- ECVET points are allocated first to the qualification, and then to its units.

ECVET points are numerical representation of the overall weight of learning outcomes and units in a qualification. ECVET points promote the understanding of a qualification since, together with other specifications, learning outcomes descriptors and units, can indicate whether the scope of a qualification is narrow or broad.

In this sense, the ECVET points were allocated to the EW qualification through the definition of teaching hours, workload, and must be considered as a reference.

10.4 European Welder Competence Matrix

The European Welder Competence Matrix (in Annex B) maps the core skills and competences of the EW Qualification according to the European Qualifications Framework (EQF). The qualification referenced to the EQF is described in terms of learning outcomes, having ECVET (European Credit System for Vocational Education and Training) points allocated.

The relational used for the definition of teaching hours, workload and ECVET points was already described in Section 8 of this document.

11. Specific Requirements

The national welding organisations, being members of International Institute of Welding (IIW), mutually acknowledge the Diploma of the European Welder awarded in any Member State following education and training, conducted in accordance with this Guideline for this purpose, and given at a training body (ATB) approved by the ANB for this purpose, and examination conducted at an ANB approved examination / test centre.

In case when an ATB is not authorized for the entire Guideline (e.g. regarding welding processes) the relevant scope shall be specified, as appropriate.

In addition to the rules given in Document IAB-001 (last edition), the following is required:

11.1 International/European Welder Training Requirements

Further to the general rules as given in IAB-001 (last edition) the following are applicable to the Welders courses:

- The welder training workshop must include the number of training booths required to cover the maximum number of trainees. The booths must be fully equipped, have correct ventilation and proper screening to protect other workers.
- The range of welding and auxiliary equipment must reflect the scope of approval and must be in sufficient quantity to cover the maximum number of students. It must be in good working order and fit for its purpose.
- Protective clothing and eye protection for trainees must be provided. Such items must be clean and in safe, good condition.
- Instruments for checking welding parameters must be available and calibrated, validated or verified as appropriate (see e.g. ISO 17662).
- Reference standards according to appendix 1 of the EW Guideline shall be available for the students during theoretical education and examination.
- The use of an ICT tool (e.g. gamification) in the welder training requires that its content is aligned with the specific welding processes and materials covered by this guideline.
- The use of the ICT tool must be supported by a computer system with updated operating systems and internet connection.

11.2 International/European Welder Teachers/Instructors

Teachers for theoretical education shall at least have an International/European Welding Specialist diploma or equivalent qualification that shall be assessed and approved by the ANB.

Note: ANBs shall put pressure on the ATBs to reach at least I/EWS-qualification for their teachers.

Instructors teaching practical skills shall have either:

a. A valid ISO 9606 certificate, or skill qualifications based on equivalent technical conditions, appropriate to the scope of training provided or
b. An International Welding Practitioner diploma (covering the welding processes subject to teaching) and active in the field of welding in the last 3 years or,
c. An I/EW-diploma, covering the appropriate level (I/EFW, I/EPW or I/ETW), the welding processes and parent material subject to teaching, and active in the field of welding in the last 3 years or,
d. Instructor who at least the last 5 years has worked as instructor in practical welding will be evaluated by the ANB. If approved, he/she can work as International/European Welder Instructor for practical training. (Alternative iv. is valid 5 years for new ANBs from start of their implementation of the I/EW Guideline).

Note: It is recommended that instructors shall have technical knowledge at least at level of I/EWS.

Teachers and instructors shall demonstrate competence in instructional techniques (transfer of practical skills and theoretical knowledge).

The above matters and monitoring of course performance shall be covered by appropriate documentation for review by the ANB.

11.3 ANB Authorised Examiner

The Board of Examiners shall implement the European Welder Guideline through the appointment of competent persons, to be known as ANB Authorised Examiners. All practical examinations that can lead to the award of an EW diploma (i.e. examinations after modules 2, 4 and 6) shall be conducted under the general supervision of the ANB Authorised Examiner.

ANB Authorised Examiners shall be qualified to at least the level of European Welding Specialist (EWS).

The Authorised Examiner can be part of the ATB providing that he/she is independent of the training of the person being examined. However, this independence has to be demonstrated through a Quality Manual and the ANB must be satisfied with both the Quality Manual and with its implementation. There is no obligation on the ANB to accept a proposed Authorised Examiner from within the ATB if the ANB is not convinced about his/her impartiality and independence as well as his/her competence.

11.4 European Welder Examinations

Regarding theoretical examination, after the theoretical Competence Units, there are theoretical examinations of the multi-choice type for the relevant level of diploma.

The sets of European harmonised examination papers approved by IAB Group A (Education, Training and Qualification) shall be used for theoretical examination. The exam papers will be chosen from those sets of examination papers under the authority of the Board of Examiners of the ANB. At the discretion of the ANB, the European examination papers can be completed with a national exam.

The examination procedure shall comply with the requirements as set forth in IAB-001 (last edition) and OP17.

Although the modules A, B and C represent three modules of theory, at the discretion of the ANB, they may be added together and taught and examined as one total, provided they are finalised at the moment of finalising the first level of practical training.

In addition to the examination of the Competence Units A, B and C, the examination of the new CU “Introduction to Computer and Simulation”, the specific welding process (S) module and – if applicable – the appropriate material (P) modules is required.

The hours to be allocated to the European harmonised examination should be totally 3 hours and 37 minutes (for all modules, including the created CU, “Introduction to Computer and Simulation”).

Any additional National exams will be defined by the ANB and their duration shall be added to the duration defined in Table 1.

12. Conclusion

This EW Updated Guideline will be presented to the EWF Working Group (WG) in order to be presented and possibly approved in the EWF Members during the Annual General Assembly (GA).

By validating the created Competence Unit “Introduction to Computer and Simulation”, as well as the welding simulator used for the practical training, EWF members will allow the work done by DIGIWELD consortium towards the updating of the EW course to be considered in a updated European Welder Guideline, and if so, it will be made available within the EWF members, including the network of Approved Training Bodies (ATB).

ANNEX A

General Description of the Welders Profile based on the EQF descriptors

QUALIFICATION	KNOWLEDGE	SKILLS	RESPONSIBILITY/AUTONOMY	TEACHING HOURS	WORKLOAD (Hours)	ECVET POINTS	EWF Proficiency Levels
European Welder for Tube/Pipe	Knowledge of facts principles related with the welding process and general concepts in the welding field, as well as related joining and weld joint fit up activities, that was under the scope of training.	A range of cognitive and practical skills required to accomplish tasks and solve problems, when applying welding process and related technologies.	Take responsibility to perform autonomously welding work on a construction sites, ensuring the appliance of the proper welding practice.	350	375	12,5	Basic
European Welder for Plate	Knowledge of facts principals related with the welding process and general concepts in the welding field, as well as related joining and weld joint fit up-activities, that was under the scope of training.	A range of cognitive and practical skills required to accomplish tasks and solve problems, when applying welding process and related technologies.	Take responsibility to perform autonomously welding work on a construction sites, ensuring the appliance of the proper welding practice.	243	264,5	9	Basic
European for Welder for Fillet	Basic factual knowledge of the welding field and welding process as well as weld joint fit up-activities, that was under the scope of training.	Basic cognitive and practical skills required to use relevant information in order to carry out welding tasks and to solve related basic problems.	Perform welding under supervision with some level of autonomy.	125	137,5	4,5	Elementary

ANNEX B

Summary description of Welders Profile – Competence Units and learning outcomes description

THEORETICAL TRAINING

QUALIFICATION	COMPETENCE UNIT	KNOWLEDGE	SKILLS	RESPONSIBILITY /AUTONOMY	TEACHING HOURS	WORKLOAD (Hours)	ECVET POINTS	EQF LEVEL
FILLET WELDER	**A**	Basic factual knowledge of principles, processes and general concepts about fillet welding and welded joints in plates, including operating principles of welding equipment, principles regarding the use of consumables, as well as health and safety requirements.	Basic cognitive and practical skills required to use relevant information in order to carry out arc welding and visual inspection in a fillet.	Perform arc welding according to a given welding procedure specification, with some level of autonomy.	20	40	1,5	2
PLATE WELDER	**B ***	Knowledge of facts principals, processes and general concepts related to fillet and butt welding and welded joints in plates, including distortion effects imperfections, testing methods and the need for welding to relate to quality assurance.	A range of cognitive and practical skills required to accomplish butt welding and prepare joints in plates, as well as perform visual inspection of welds, by applying basic welding process and allied technologies.	Take responsibility to perform autonomously welding work on a construction sites, ensuring the appliance the proper welding practice.	18	36	1,25	3
TUBE WELDER	**C***	Knowledge of facts principals, processes and general concepts related to welding and welded joint, including methods to avoid failure and harmonised system of welding Standards.	A range of cognitive and practical skills required to accomplish butt welding and prepare joints in pipes, by applying basic welding process, allied technologies and international standards.	Take responsibility to perform autonomously welding work on a construction sites, ensuring the appliance the proper welding practice.	7	14	0,5	3(4)
Fillet, Plate, Tube Welder	**S – Specific Welding Process: MMA, MAG FCAW, MIG TIG Gas Welding**	Basic factual knowledge on welding process regarding the working principles and characteristics, welding equipment, the use of consumables, as well as health and safety measures to avoid hazards. (*The above statement is applied to a specific welding process)*	Basic cognitive and practical skills required to use relevant information in order to understand/implement/ follow a Welding Procedure Specification (WPS).	Check welding parameters and consumables according to a given welding procedure specification, with some level of autonomy.	22	44	1,5	2

QUALIFICATION	COMPETENCE UNIT	KNOWLEDGE	SKILLS	RESPONSIBILITY /AUTONOMY	TEACHING HOURS	WORKLOAD (Hours)	ECVET POINTS	EQF LEVEL
	P - Specific Material **Stainless steel Aluminium**	Basic factual knowledge about the application of welding process to a specific base material, the use of consumables, weldability and methods to avoid imperfections. (*The above statement is applied to a specific material.)*	Basic cognitive and practical skills required to use relevant information in order to identify, handle welding specific material in the welding shop floor.	N/A	16	32	1,25	N/A
Fillet, Plate, Tube Welder	**"Introduction to Computer and Simulation"**	Elementary principles of digital tools, learning management system (LMS), augmented reality and welding simulators	Elementary use of learning management systems (LMS) for synchronous and asynchronous training, identification of the differences between simulated welding and real welding and welding simulator as practice for preparing to real welding contexts, identification of additional welding digital tools used in training and elementary use of additional digital tools in the context of practical training in welding when applicable	N/A	12	24	1	2

c) Tube Welder qualification does not exist in the Spanish national catalogue of qualifications.

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Competence Unit "Introduction to Computer and Simulation"

Competence Unit "Introduction to Computer and Simulation" (A.10/B.10/C.5)	CONTACT HOURS
SUBJECT TITLE	
Training Digital Tools and Methodology	1
Learning Management System (LMS)	1.5
Welding Simulators	1.5
Total	**4**
WORKLOAD	**8**
ECVET	**0,25**

LEARNING OUTCOMES – Introduction to Computer and Simulation	
Qualification	**European Welder**
KNOWLEDGE	Elementary principles of: ▪ Digital tools ▪ Learning management system (LMS) ▪ Augmented reality ▪ Welding simulators
SKILLS	Use learning management systems (LMS) for synchronous and asynchronous training Identify the differences between simulated welding and real welding Use welding simulator as practice for preparing to real welding contexts Identify additional welding digital tools used in training Use additional digital tools in the context of practical training in welding when applicable

DETAILED KNOWLEDGE	
QUALIFICATION	**European Welder**
CONTACT HOURS	**4**
DEPTH	**ELEMENTARY**
Training Digital Tools and Methodology Digital tools used in welding training Advantages and disadvantages of digital tools in training	1
Learning Management System (LMS) Virtual Learning Environments Definition and characteristics of LMS Settings and Functionalities of a LMS LMS – challenges and advantages Available LMS tools	1,5
Welding Simulators Welding simulators systems Augmented Reality Virtual Reality Difference between simulator and real welding system Advantages and disadvantages of welding simulators Set-up of welding simulators	1,5