Co-funded by
the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Education and Culture Executive Agency (EACEA). Neither the European Union nor EACEA can be held responsible for them.

IQSIM2

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

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

D5.1-2 Course program---IQSIM in future education

Version: **Final**

Date: **25.03.2024**

D5.1-2 IQSIM and education

Table of Contents

Background

The intention of this document is to:
a) Try to identify how IQSIM can be used in education and training at the different EQF levels
b) Try to identify how IQSIM can be used in education and training at different EQF levels under the condition that a new IOSIM version, version IQSIM3, has the functionalities that are specified.
c) Identify thew responsibilities given after education and training at the different EQF levels

Target user groups-education and training.

It is foreseen the following user groups:

EQF 6
Welding Designer and Engineers or Welding Inspector with diploma from EWF and with education following the EWF Guidelines.
Responsibilities according the EWF Guidelines.
* Investigate welding related issues to improve product performance and increase productivity

*Design welded parts, assemblies, and structures such as buildings, pressure vessels, and pipelines

*Develop repair procedures and assess flaws to determine the fitness-for-service of structure

*Develop standards, materials, weld joint design, and welding processes

*Develop welding process procedure qualification, supplier qualification, and product testing

*Troubleshoot welding problems and provide corrective solutions

EQF5
Welding Technologist with diploma from EWF and with education following the EWF Guidelines.
Responsibilities according the EWF Guidelines.
*Set-up and operate welding and joining processes for lab tests, and perform welding experiments

*Work in cross-functional engineering teams to develop and test new products

*Conduct training programs and field service activities for clients

*Support related manufacturing requirements

*Interpret welding related requirements and troubleshoot welding problems

EQF 4
Welding Specialist with diploma from EWF and with education following the EWF Guidelines.
Responsibilities according the EWF Guidelines.

EQF3
Welder or International Welder with diploma from EWF and with education following the EWF Guidelines.
Applicants must possess sufficient knowledge of, or education in, metalworking to follow the course. They must also have a level of health, and physical and mental capability, to undergo the training for which they are applying.

Use of IQSIM at the different EQF levels

Education and training for EQF level 6.

Background.
Historical data implies that approximately 60-70 % of the cost of a product is already decided when a design has been created at the engineering level. However, the production engineering and the manufacturing operation also will have a great influence on the product costs if they can determine the production process at an early stage of the design. A close cooperation between design and production engineering is essential to minimise the total product costs.

However, in an environment with outsourced production the close cooperation between Design and Production Engineering is very often missing. Design produces detailed drawings and deliver these to the client for execution. In large companies the “distance” between design and Product Engineering may face the same problem.

The education of Design Engineers is focused on the theoretical content and as a result a limited amount of practical experience are in their curricula.

IQSIM 2 education and training for EQF level 6 allows the participants to run simulation as a designer and add data for production which allow them to compare their simulation results and bring those up as a discussion topic during the education.
Typical discussion might be for an arbitrary weld length:
1. What will happen if they recommend different welding technologies?
2. What type of welded joints can be selected and what is the consequence of the selection?
3. Why have the fillet welds different a-dimensions and what consequences does this have?
4. Why are the material quality been selected in the design and could another material be selected?
5. Why has the extent of inspection been selected and what are the consequences of altering that?

By selecting a set of cost factors then the total cost can be calculated.

A new IQSIM3 will allow the following problems to be addressed in addition:

1. Selecting a Design Class evaluate different welding technologies and the consequences for the total costs
2. Selecting a Quality class and Inspection to evaluate the total costs for a design.
3. Select Cost Calculation in order to evaluate the carbon footprint for the selected welding process
4. Select Store and Retrieve allows the designer to store the current simulation and retrieve it later. This allows a designer to compare different design alternatives for a product and to create design variations.
5. Fatigue design and allow the designer to evaluate both static and dynamic load conditions in order to optimize the design.
6. Simulation of the life cycle costs including life cycle costs based on possibility for repair at different levels
7. What considerations has been given to the green footprint of the production methods selected?

Education and training for the EQF level 5.

At the EQF level 5 the training will focus on the practical welding itself, the welding technology, and the production planning. At EQF level 5 you will be at an operative level in production with a daily responsibility of following up the day-to-day production and the quality of the production. This means mentoring of operators at EQF level 4 as well as planning and reporting of actual results of the production.
At EQF level 5 you will get first-hand information of the development of the production itself and the quality aspects of the production and the selected production methods and technologies.
EQF level 5 will carry out education and training towards EQF level 4 specifically regarding the consequences of selecting the correct process parameters and its influence on the costs as well as the green consequences of the welding process. Another important variable which will be extensively used in education and training is how the material fits together and if the assembly of the material is according to specification. If deviations occur, then the consequences of this

deviation will be highlighted. And--- it will focus on the responsibility of the EQF level 4 operator in reporting deviations.

However, in many companies a production engineering level will be absent. In such cases the EQF level 5 will directly be able to report back to EQF level 6 with relevant production data and production experience. Feedback loops with information may be established and a two-way communication will be created at the education level.

IQSIM 2 education and training for EQF level 5 allows the participants to run simulation as a designer and add data for production which allow them to compare their simulation results and bring those up as a discussion topic during the education.
Typical discussion might be for an arbitrary weld length:
1. What will happen if they recommend different welding technologies?
2. What type of welded joints can be selected and what is the consequence of the selection?
3. Why have the fillet welds different a-dimensions and what consequences does this have?
4. Why are the material quality been selected in the design and could another material be selected?
5. Why has the extent of inspection been selected and what are the consequences of altering that?
6. What will be the consequences of a bad fit-up?

A new IQSIM3 will allow the following problems to be addressed in addition:

1. Selecting a Design Class evaluate different welding technologies and the consequences for the total costs
2. Selecting a Quality class and Inspection to evaluate the total costs for a design.
3. Select Cost Calculation to evaluate the carbon footprint for the selected welding process
4. Create defect evaluation based on the different welding procedure data.
5. Create pWPS and document these
6. Fatigue design and allow the designer to evaluate both static and dynamic load conditions in order to optimize the design.
7. Simulation of the life cycle costs including life cycle costs based on possibility for repair at different levels
8. Evaluate the influence of gas concentration as well as fume concentration
9. Evaluate welding sequences and heat deformation

Education and training for the EQF level 4

At the EQF level 4 you will be a welding specialist. It is assumed that your technical background and mathematical understanding or interest, is limited.
It will be personal at EQF level 5 that will introduce the system for you and ask the questions that will be relevant for your education and training.

IQSIM 2 education and training for EQF level 4 allows the participants to run simulation as a designer and add data for production which allow them to compare their simulation results and bring those up as a discussion topic during the education.
Typical discussion might be for an arbitrary weld length:
1. What will happen if they recommend different welding technologies?
2. What type of welded joints can be selected and what is the consequence of the selection?
3. Why have the fillet welds different a-dimensions and what consequences does this have?
4. Why are the material quality been selected in the design and could another material be selected?

A new IQSIM3 will allow the following problems to be addressed in addition:

1. Select Cost Calculation in order to evaluate the carbon footprint for the selected welding process
2. Create defect evaluation based on the different welding procedure data.
3. Create pWPS and document these
4. Evaluate the influence of gas concentration as well as fume concentration
5. Evaluate welding sequences and heat deformation

Education and training for the EQF level 3

At the EQF level 3 you will be an International Welder and will be responsible for carrying out the welding tasks

IQSIM 2 education and training for EQF level 4 allows the participants to run simulation as a designer and add data for production which allow them to compare their simulation results and bring those up as a discussion topic during the education.
Typical discussion might be for an arbitrary weld length:
1. What will happen if they recommend different welding technologies?
2. What type of welded joints can be selected and what is the consequence of the selection?
3. Why have the fillet welds different a-dimensions and what consequences does this have?
4. What will the consequences be if the fit up and tack welding has not been according to specification?

A new IQSIM3 will allow the following problems to be addressed in addition:

1. Select Cost Calculation in order to evaluate the carbon footprint for the selected welding process
2. Create defect evaluation based on the different welding procedure data.
3. Create pWPS and document these
4. Evaluate the influence of gas concentration as well as fume concentration
5. Evaluate welding sequences and heat deformation

Other education groups.

IQSIM2 has tools and possibilities that allows other groups to use the system for educational purpose:

Purchasing
Purchasing of material is an important task. However, the material composition may vary quite extensively even within the same material group. To evaluate exactly the consequences of selecting a new material supplier, a simulation with the material chemical composition is very important. If the material composition is wrong, then the welding might not be possible or give results that are not acceptable. Education and training of purchasing personnel will easily evaluate this through the system.

Inspection
Most welds must be inspected by a non-destructive inspection method. The extent of inspection will result in several repair welds. IQSIM2 has tools for evaluation of repair and calculation of repair costs as well.
Through the evaluation between the different welding methods, welding parameters and the repair rate then the extent of inspection can be decided. This evaluation can be a two-way communication between EQF level 5 and 6 and also to EQF level 4. Different training scenarios can be developed for this purpose.

A welding operator at EQF level 4 will always have a mentor at EQF level 5 or higher. The operator will have access to the system in such a way that the consequences of the choices can be seen.
Most choices the operator will see will be:
* welding technology items, process parameters and its results on the technical performance
* welding technology and its influence on costs
* welding technology and its green influence
* fit-up of material and its influence on welding technology and total costs

List of functionalities envisaged for a new IQSIM3:

Function	List of functions envisaged	Output	Target EQF level
1	Select application	Select between several predefined applications or functionalities which will insert the application specific rules, materials. Default value is General Purpose.	3-4-5-6
2	Selecting design classes and evaluate the welding process that are most technically suitable	Recommendation for welding process for the selected design Creating a list, weighted, for different welding processes. Note. Maybe the recommendation	6

		of filler also could be incorporated here??	
3	Selecting the quality class and se influence on quality class versus welding method	Recommendation for welding process related to quality class	5-6
4	Cost calculation Calculating the cost for a selected process utilizing the essential variables for the selected process	Cost for a given welding length and in addition the energy consumption and carbon footprint for that production	5-6
5	Cost comparison Comparing the output of different cost calculations graphically	A graphical report that dynamically can be altered if some of the background parameters are altered. The variables are compared graphically	5-6
6	Environmental impact Compare the selected welding methods both numerically and graphically for the total job that is going to be processed. Maybe also type of equipment might be an alternative for each process as well--has to be evaluated.	Calculate the environmental impact of the welding methods selected. Calculate use of energy and carbon footprint. This calculation might cover both the process itself but maybe also the consequential results of selecting the energy method if applicable.	5-6
7	Defect analysis Analysing the probability of creating defects versus welding process and technically settings for a process	Probability of defect range and defect type	3-4-5
8	Technical analysis Analysing technical data based on material classes and material groups. Different material groups to be added and these should be selectable. To cover mild and high strength steels as well as aluminium	Different essential values to be simulated like hardness, tensile, preheat requirements and so forth	5-6
9	Documentation Documentation of simulation results mentioned above	Different types of standardized documents and reports to be generated, like: pWPS with welding data, material classes, heat treatment, welding position, drawings etc, and Work Instruction based on WPQR data input complemented with simulation data Cost reports and cost analysis, Design report for recommended	3-4-5

		design solution	
10	Fatigue design--Simulate static load	Either start with given joint configuration and simulate the load or run it reverse-- define the load and simulate to find the optimum joint configuration. Use IIW reference	5-6
11	Fatigue design--Simulate dynamic load	Either start with given joint configuration and simulate the load or run it reverse-- define the load and simulate to find the optimum joint configuration. Use IIW reference	5-6
12	Cost calculation for a product	Allow the user to build up a cost calculation model for the product and create simulations around that model	3-4-5-6
13	Feedback level	A system or tool that allows the user to submit feedback including technical details from own calculations, added with comments, to another user of the system	3-4-5-6
14	Education levels	A set of user interfaces that are tailored to different educational groups	3-4-5-6
15	Life Cycle costs	Allow a user to simulate the life cycle costs for a defined product	4-5-6
16	Consequence analysis	Add an analysing tool allowing the user to analyse the long-term effect of an occurrence. Ex If a repair % increase, then what will be the result in repair and reclamation. If the defect rate of a certain defect increase-what impact might this have on the maintenance costs ?	5-6
17	Green Welding covering IIW level, "Green Welding Technologies, Sustainable Development"	Today, there have had state-of-the-art life cycle assessment (LCA) methods that for example can accurately determine the ecological footprint of a welded product. With appropriate	4-5-6

		modeling and software capabilities, case studies on welding can be compiled to show exactly which "greener" technology (including yield material, protective gas, preparation work, energy using, etc.). We see an opportunity to connect with this topic from the University of Miskolc. We have LCA expert who usually analyses in a number of fields (e.g., building material developments, plastic development), and now we would like to start a common thread on the welding line as well.	
18	Fume and gas concentration	Calculate and evaluate the amount of fumes and gases for different processes	3-4-5
19	Welding sequences and deformation in a design	Evaluation of the welding sequences and its consequences for distortion. Consequences for the cost of a product as well as for the quality aspects	5