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1. Summary

This document fulfils the requirement of the European Commission Horizon 2020 framework (FoF-01-2014: Process optimisation of manufacturing assets) project 'Real-time dynamic control system for laser welding' ('RADICLE'): Work Package 7: Deliverable 7.11 'Training questionnaires prepared'.

This deliverable is developed under the scope of Task 7.4, Training. The main objective of this task is to optimise the collaboration between the RADICLE partners by exchanging knowledge by means of training activities. It covers the following activities:

- Preparation of questionnaires to collect the RADICLE partners' training needs and expertise related to scientific, technological and manufacturing aspects. The idea is to create a survey to collect the organisations' inputs, and then to elaborate a training programme;
- Preparation of an educational programme defining objectives, target audiences, training needs and skills. Support the project with course modules with the collaboration of all the partners. The course material will be planned as lectures at consortium meetings and distributed to the collaborating partners for use in their organisations.

This deliverable is created to respond to the first point above. In the next pages are contained the questions to be used to better understand the training needs of the project partners. When necessary, this questionnaire can be modified to be used inside several partners' product value chain.

2. RADICLE training questionnaire

The present survey is created to contribute to the definition of a training course in Laser welding with an adaptive control system. Therefore, we would like to request your collaboration by answering to the set of questions presented next.

This questionnaire is to be filled out considering the entire operational capacity of the organisation plus its supply chain. Therefore, respondents should not only consider the components and applications discussed within the scope of RADICLE, but consider various possibilities for the implementation of the RADICLE system within the product's value chain, being it within different components, materials, joint configurations, etc., and being that product manufactured in-house or outsourced to external suppliers.

After treating and analysing the answers provided in each issue, a report will be drafted focused on the components that should be included in a future training course.

2.1. Part I: Analysing the current state of art

Part I of this questionnaire aims at understanding what are the existing laser welding systems in the RADICLE partner organisations, the manufacturing process characteristics and what is the existing staff participation and influence in the manufacturing process.

ABOUT THE COMPANY

2.1.1. Identify your organisation:

RADICLE end-users

- GE
- CRF
- RR
- GKN

RADICLE RTDs

- MTC
- LOE
- Permanova
- TWI

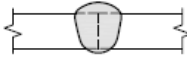
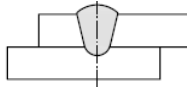

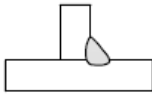

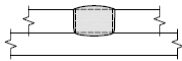
ABOUT THE JOB

2.1.2. How is laser welding being used in your organisation? Please select all the relevant options next:

a) Material

- | | |
|----------------------------------|--------------------------|
| Galvanised steel | <input type="checkbox"/> |
| Mild steel | <input type="checkbox"/> |
| Carbon steel | <input type="checkbox"/> |
| Medium strength structural steel | <input type="checkbox"/> |
| High strength structural steel | <input type="checkbox"/> |
| Stainless steel | <input type="checkbox"/> |
| Aluminium alloys | <input type="checkbox"/> |
| Titanium alloys | <input type="checkbox"/> |
| Nickel alloy | <input type="checkbox"/> |
| Other (please detail below) | <input type="checkbox"/> |

b) Joint configuration

- | | | |
|-----------------------------|---|--------------------------|
| Square butt |  | <input type="checkbox"/> |
| Lap |  | <input type="checkbox"/> |
| Flanged butt |  | <input type="checkbox"/> |
| Corner |  | <input type="checkbox"/> |
| Edge |  | <input type="checkbox"/> |
| Plug |  | <input type="checkbox"/> |
| Other (please detail below) | | <input type="checkbox"/> |

c) Equipment and accessories

- | | |
|--|--------------------------|
| Beam profiler in the production line | <input type="checkbox"/> |
| Beam profiler out of the production line | <input type="checkbox"/> |
| Power meter in the production line | <input type="checkbox"/> |
| Power meter out of the production line | <input type="checkbox"/> |
| Seam tracking | <input type="checkbox"/> |
| Cover glass monitor | <input type="checkbox"/> |
| Photodiodes | <input type="checkbox"/> |
| Acoustic sensor | <input type="checkbox"/> |
| Optical depth sensor | <input type="checkbox"/> |
| Scanning vibrometer | <input type="checkbox"/> |
| Other (please detail below) | <input type="checkbox"/> |

2.1.3. In your organisation, what is the level of supervision currently implemented for laser welding systems? Select the most correct option:

a) At the operator level:

1. High degree of operator dependency: operator constantly monitors and adjusts the manufacturing process
2. Moderated degree of operator dependency: operator frequently monitors and adjusts the manufacturing process
3. Minimum degree of operator dependency: operator seldom monitors and adjusts the manufacturing process
4. Absence of control: no operator monitors or adjusts the manufacturing process

b) At the coordinator level

1. High degree of coordinator dependency: coordinator constantly monitors and adjusts the manufacturing process
2. Moderated degree of coordinator dependency: coordinator frequently monitors the manufacturing process (the operator performs the adjustments to the process)
3. Minimum degree of coordinator dependency: coordinator seldom monitors the manufacturing process (the operator performs the adjustments to the process)
4. Absence of control: no coordinator monitors or adjusts the manufacturing process

ABOUT THE STAFF

2.1.4. Consider the laser welding applications in your organisation. What are the profiles of the personnel involved in the manufacturing process?

1. Manufacturing/production engineer
2. Mechanical engineer
3. Welding engineer
4. Quality control engineer
5. Materials engineer
6. Metallurgist
7. Robot technician/operator
8. Laser safety officer
9. Quality control technician
10. Systems Integrator
11. Other (detail below)

2.1.5. Consider only the profiles you selected before. Are these people internal staff from your organisation, or are they part of a subcontracted, bought-in service?

1. Internal staff
2. Bought-in service

2.1.6. If you selected option 2 before, please identify the service provider(s) name(s) below:

2.1.7. Consider only the profiles you selected before. For these, what is this staff's highest level of education/qualification?

Profile \ Education	Manufacturing/production engineer	Mechanical engineer	Welding engineer	Quality control engineer	Materials engineer	Metallurgist	Robot technician/operator	Laser safety officer	Quality control technician	Systems integrator	Other (detail below)
1. Doctor's Diploma	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Master's Diploma	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Bachelor's Diploma	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Professional qualification/apprenticeship	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Secondary school certificate	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Other (detail below)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

2.1.8. Consider only the profiles you selected before. For those, what are their current main duties and responsibilities? Add any missing rules and responsibilities.

Profile \ Duties and responsibilities	Manufacturing/production engineer	Mechanical engineer	Welding engineer	Quality control engineer	Materials engineer	Metallurgist	Robot technician/operator	Laser safety officer	Quality control technician	Systems integrator	Other (detail below)
Defines the welding conditions (WPS)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Monitors and evaluates the welding parameters	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Evaluates the weld and adjusts the parameters if needed	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ensures safe production and compliance with EHS standards	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

2.2. Part II: Analysing the future requirements

Part II of this questionnaire targets the changes to be done in the laser welding systems available in the partner organisations, when introducing the RADICLE system.

ABOUT THE JOB

2.2.1. Identify new situations or operations in which the RADICLE system can be used in the future in your organisation or in your supply chain:

2.2.2. Will new safety procedures need to be adopted when performing laser welding with the introduction of the RADICLE system? If yes, which?

ABOUT THE STAFF

2.2.3. Besides the employees currently working in laser welding in your organisation or product value chain, do you think other employees should be involved when performing laser welding with the RADICLE system? Would they come from other company departments, or would they be new employees? Please detail below:

2.2.4. Consider the personnel in your organisation currently involved in the laser welding manufacturing process. Identify what skills and knowledge need to be improved or introduced in the future to enhance staff performance when implementing the RADICLE system.

Profile \ New skills	Laser welding technology	ICT (Human-interface machine)	Science of Materials	Optics systems	Camera sensor systems	Seam tracking sensor systems	Other sensor systems	RADICLE system maintenance	Welding defects analysis	Other (detail below)
Manufacturing/production engineer	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Mechanical engineer	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Welding engineer	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Quality control engineer	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Materials engineer	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Metallurgist	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Robot technician/operator	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Laser safety officer	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Quality control technician	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Systems integrator	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

2.2.5. Consider the new staff profiles that may need to be introduced in your laser welding manufacturing department, when using the RADICLE system. List the new profiles, and identify what skills and knowledge are needed:

<div style="text-align: center;">Needed skills and knowledge</div> <div style="text-align: left; padding-top: 5px;">New Profile</div>	Laser welding technology	ICT (Human interface machine)	Science of Materials	Optics	Camera sensor systems	Seam tracking sensor systems	Other sensor systems	Equipment maintenance	Welding defects analysis	Other (detail below)
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

2.3. Part III: Training course in Laser welding with an adaptive control system

Part III of this questionnaire aims at collecting specific information on the design of the RADICLE system training course.

ABOUT THE TRAINING COURSE

2.3.1. In your opinion, to what staff profiles should the RADICLE system training course be directed to? Choose all the relevant options:

1. Manufacturing/production engineer
2. Mechanical engineer
3. Welding engineer
4. Quality control engineer
5. Materials engineer
6. Metallurgist
7. Robot technician/operator
8. Laser safety officer
9. Quality control technician
10. Systems Integrator
11. Other (detail below)

2.3.2. In your opinion, what should be the training course's main Learning Units?

2.3.3. Consider the modular design of the RADICLE system. Should the training course follow the same approach, separating the Learning Units in accordance with the installed sensors?

2.3.4. After concluding the training course, what tasks should the learners be able to do regarding laser welding the RADICLE system (e.g. sensor technology setup, use and maintenance, process monitoring and evaluation of defects)?

2.3.5. In your opinion, which training program models better fit your needs?

- 1. On-the-job training: training taking place in a normal working situation
- 2. e-learning: training conducted via electronic media, typically on the Internet
- 3. b-learning: training combining online digital media with traditional classroom methods
- 4. Problem solving: training focused on finding solutions to problems
- 5. Other (detail below)

2.3.6. In your opinion, how long should the training course be (number of hours)?

- 1. 1-5 hours
- 2. 5-10 hours
- 3. 10-20 hours
- 4. 20+ hours

2.3.7. What percentage of time should be allocated to the theoretical training and to the practical training for the RADICLE system training course?

- 1. 50% Theoretical training and 50% Practical training
- 2. 25% Theoretical training and 75% Practical training
- 3. 75% Theoretical training and 25% Practical training
- 4. Other (detail below)

2.3.1. Please detail any other aspect not covered in this questionnaire, and that you feel it is important to consider during the development of the RADICLE system training course:

Thank you for your cooperation!