Deliverable D7.12
Intermediate Report on
Coaching sessions to SME

WP7. Dissemination & Exploitation

Lead Beneficiary : EMC2
Delivery date 18 03 2022
Dissemination level: PU
Version V1.0

EMC2

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 862017

Index

1. Introduction

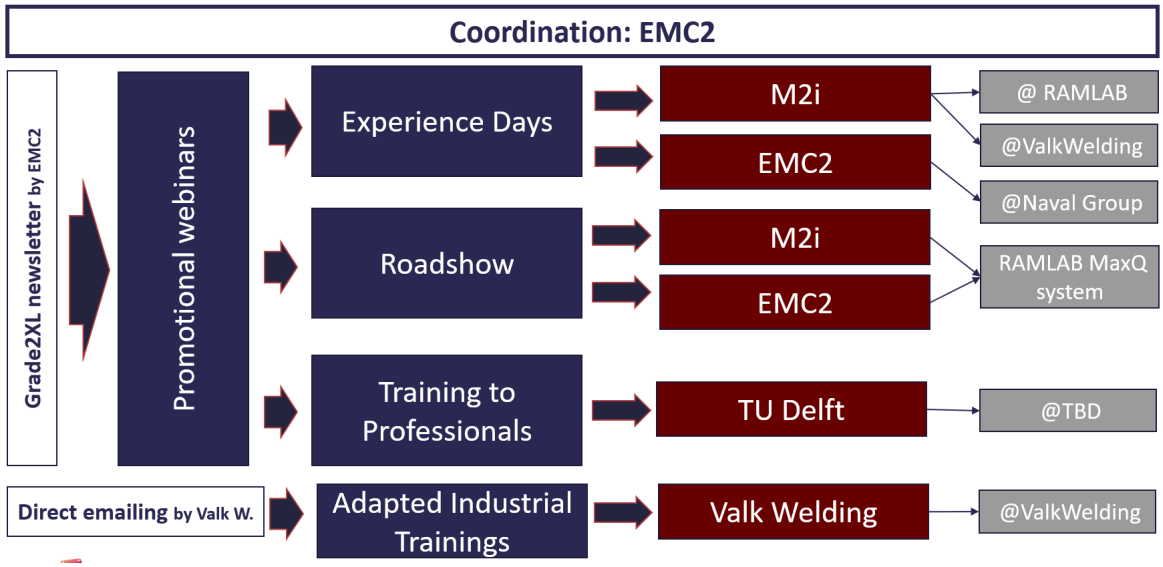
1.1. Context of the document

To sum up, WP7 objectives consists of raising awareness about WAAM, disseminating R&D results and paving the way for their exploitation. Industrial SME is a key target group for Grade2XL dissemination and exploitation of project results.
Communication, dissemination and exploitation activities were detailed in Deliverable D7.2 *Intermediate Dissemination & Exploitation Plan* released on M24 (February 2022). This report **D7.12 *Intermediate Report on Coaching sessions to SME*** focuses on dissemination actions targeting industrials that would use multimaterial WAAM and manufacturing systems resulting from Grade2XL project. This report builds up on topics described in D7.6 *Initial report on Coaching Sessions to SME*. Please refer to this document for further details on the context.

1.2. General Principles

Coaching sessions to SME gather 4 kind of dissemination actions:

a) WAAM Experience Days by EMC2 and M2i with Naval Group and RAMLAB respectively
b) WAAM Roadshow (mobile version of *WAAM Experience Days*) by EMC2 and M2i with technical support of RAMLAB
c) Training to Professionals by TU Delft
d) Adapted Industrial Training by Valk Welding



Squares in **dark red**: organisation responsible for promoting the event and realizing the attendance list (enrolling SME).
Squares in **light grey**, the organisation responsible for the technical aspects of the event and hosting it in its facilities.
Promotional webinars aim at enrolling SME to attend physical events and to make participants starting their thinking process about their possible WAAM use-case. (refer to D7.2 for details)

2. WAAM Experience Days

2.1. Context

SME on the European continent will be offered the opportunity of witnessing a WAAM prototyping demonstration and receiving coaching to start a WAAM business or equip with a WAAM system.

Synergies will be sought with the network of EIT Manufacturing (of which TU Delft, vaBWG and CEA are partners) to further enlarge the selection base. With Autodesk in the Industrial Advisory Group, we will leverage its customer community and attract media interest.

The coaching sessions during *the WAAM Experience Days* will be widely advertised through professional networks and associations – such as the International Welding Institute. A wide network of multipliers will be contacted, including the companies from supply chains of the Grade2XL partners, national welding societies, toolmakers association, foundries, robot manufacturers, materials suppliers. Grade2XL developed tools and contents to advertise the events: articles are written on the website, a project newsletter was created , monthly webinars inform of the physical event.

Furthermore, information on WAAM will be included in the trainings already delivered by current partners and replicate the sessions beyond the project end-date. In Grade2XL, requests for coaching sessions from all over Europe are considered and are expected to reach at least twice as many countries as those represented in the consortium. Contacts requesting dissemination materials and wishing to participate to events are added to the D7.3 *Stakeholder Database*. Indeed, a list of industrials is created. The *WP7 leader* updates it. It aims at enabling an easy and exhaustive involvement of dissemination targets and keeping track of the interactions.

2.2. Overall

This action will ensure the delivery of simple and fast routes for the rollout of WAAM technology in the relevant industrial sectors and promote WAAM as an attractive business opportunity for SMEs.

Objective and targets

The experimentation is the best way to understand the technology and assess its business potential. Due to the low CAPEX involved, we can expect that most of players on the emerging WAAM market will be SMEs. The target audience for this action are therefore SME interested in starting a WAAM business or in using WAAM for prototyping or for repairing. Large manufacturing companies will also be involved. People expected to attend are process engineers, production engineers. A maximum of two representatives per SME will be selected on a “first come first served” basis, provided that their business has proven relevance with WAAM potential.

Evaluation & follow-up indicators

Participants will be required to register to the event and specify a few information about their expectations of the day and their business. They will be asked sign an attendance sheet so the consortium can report to the EC. At the end of the day, attendees will be asked to answer a “satisfaction survey” so the impact can be measure qualitatively. This feedback would also be extremely useful for the business plans of Valk Welding & RAMLAB (updated market study).
Then, interested companies will be coached one-by-one in a personalized way to build their business case. Interested companies are known thanks to the satisfaction survey done at the end of the experience day.

The key performance indicator for such dissemination event will be the total number of participants compared to the number of companies building a business case and finally investing in WAAM (conversion rate). It is monitored by EMC2 as *WP7 leader.*

Locations
Experience days will occur at different places. At RAMLAB facilities (Rotterdam area, NL), at Naval Group facilities (Nantes area, FR) and at Valk Welding (Czech Republic, Denmark, France, and the Netherlands).

2.3. Agenda

An experience day is divided into 4 key moments:

1. Technical description
2. Demonstration
3. WAAM business model explanation
4. Individual use-case definition

Appropriate coffee breaks and a lunch will be provided to the participants, to allow opportunity for networking and bilateral exchanges. Within a week after the event took place, one-to-one coaching for financing is offered to interested companies so they are supported until they become early adopters.

Step 0. Welcome introduction
Length: 30min.
Objective: Participants get the basic knowledge about the context (project Grade2XL) and the agenda of the day is reminded.

1. Welcome word from the host - 5min.
2. Reminder of the context (general project presentation ppt + video) - 20min.
3. Schedule of the day – 5 min.

Contents used by speaker: PowerPoint presentation + project video.

Step 1. Technical description
Length: 60min.
Objective: SMEs should understand what is possible to realize with the WAAM technology as developed within Grade2XL.
Contents provided to the audience:

a) What is possible? Design possibilities in terms of shapes, size of parts, materials available, multimaterial capabilities, lead time.
b) How does it work?
    a. General knowledge about WAAM (difference with other AM techniques).
    b. Grade2XL solution: the WAAM cell process.
c) Manufacturing constraints are explained: multimaterial deposition (supplying), production time (kg/hours), cooling impact on quality of the parts.
d) What are the necessary equipment? List and define machines such as 6 axes robots, the cooling system for WAAM? The NDT machine. In case of subcontracting (WAAM-as-a-service),

what are the preliminary works and equipment necessary? (adapt CAD? specifications ? calculate stiffness do determine material ?).

Contents used by speaker: PowerPoint presentations.
Person responsible (speaker): technical person from RAMLAB or Naval group (engineers).

Step 2. Demonstration

Length: Possibilities will be defined according to the possibilities at each site. The targeted activity is a practical exercise, of approximately 90 minutes so the audience gets familiar with the machines.
Person responsible (speaker): Technical person from RAMLAB, Naval group (engineers).
Objective: Have the participants see and thus experiment the WAAM cells in motion, to help them better understand the process and try to see if it fits in with their own business and shop floor.
Contents provided to the audience: Manufacturing of a part. Explanation of the process. From theory (part 1 Description) to practice (part 2 Demonstration).
2 possibilities:

- Option a) Usual parts produced (to be discussed with RAMLAB) possibility to keep production that was already planned for that very day.
- Option b) Parts of a participating SME (from its own CAD) are produced.

The demo case should be representative of the capabilities of the technology: complex shape, multimaterial etc. What will be showed should convince the participants to adopt the technology. The ideal demo part is to be discussed with engineers. The part produced should be ready in a few hours: it must fit within the experience day length.
Contents used by speaker: hardware and software of the WAAM cell in the experience centre, knowledge of the speaker.

Step 3. Business Model explanation

Length: 90min (60 min about the 8 use-cases + 30 min on economical facts)
Objective: Participants get info on WAAM business model, so they are then able to determine their relevant use-case.
Person responsible (speaker): Salesperson of Valk Welding
Contents provided to the audience:
The ways to access to WAAM manufacturing is described:

a. WAAM-as-a-service at RAMLAB facilities.
b. Buying complete cell from Valk Welding.

The interest for Grade2XL-WAAM solution of the eight use-case are detailed. It shows the accuracy of this manufacturing technology on a business perspective. The industrial use-cases are also reassuring and enable a positive feeling of emulation.

Obviously, it also depends on the results of the research carried out during the project and of the need of the potential user. A straightforward part (bulk, monomaterial) may take much less to execute. So this timeline and scheduling will be discussed with engineers and researchers in due time.

Return-On-Investment (ROI): basic info is given so the audience knows the criteria on which calculate their ROI when adopting WAAM.
Financing tools available such as grants and loans are introduced e.g. support by BPI France, regions, European Digital Innovation Hub (EDIH), EC funding, EIT Manufacturing, etc. Each Grade2XL partner will investigate funding instruments in its countries on Q3 2022 to provide the info that will be

integrated to the *Experience Day* PowerPoint presentation which could help SME to adopt the technology.

Step 4. Use-case definition

Length: 90min (60min of BM drafting + 30min of feedbacks)
Objective: Participants determine their relevant use-case and understand how WAAM as offered by Grade2XL meets their requirements. First data about budget/investment is drafted, so the ROI appears interesting to the companies.
Contents provided to the audience: A questionnaire is provided to help the company to precise its use-case and determine how WAAM as offered by Grade2XL should be the most relevant. First technical constraints can be identified. The audience fills the form.
This questionnaire could be an enhanced "BM canvas". How to ensure that an accurate and usable business model is created? The speaker(s) should support each participant.
This would be done in two steps: firstly, description of the technical use-case in itself, secondly, definition of the use-case from a business perspective (putting figures on the technical use-case previously described), cost estimates, revenues forecasts.
Person responsible (speaker): EMC2, M2i, RAMLAB, Valk Welding
Contents used by speaker: PowerPoint presentation, Questionnaire

Focus on **The satisfaction survey**
*Audience that attends the day **should answer a "satisfaction survey"** at the end of the day so the impact can be measured qualitatively. This feedback would also be extremely useful for the business plans of Valk & RAMLAB (i.e. updated market study).*
Although the contents of such survey are to be defined, see below some examples of questions:
1 - Do you foresee a use-case in your company for Grade2XL solution?
1.a - If yes: describe.

- *How many kg/ hour?*
- *Dimension of part.*
- *Tact time.*
- *Which metals or alloys?*
- *Etc.*

1.b - If not: what prevent you to use this technology?

2 - What in the Grade2XL solution are you interested in:

- *Multimaterial.*
- *Cooling capabilities*
- *Large parts.*
- *Design of part: complex shapes.*
- *Quality of NDT solution.*

3 - Are you interested in a further coaching service from the Grade2XL partners to investigate the funding possibility for your company? Yes/No + Contacts details.

Next step: One-to-one coaching for investment

Objective: Transforming the use-case in a business case enabling to invest, in order for the company to become an early-adopter of Grade2XL solution (exploitation of results)
Contents provided: Personalized support

Person responsible: EMC2. Perhaps external companies such as innovation consultancies in support. Maybe, in 2023, the European Digital Innovation Hubs funded by the EC under the Digital Europe program could play this role.
Contents used by speaker:

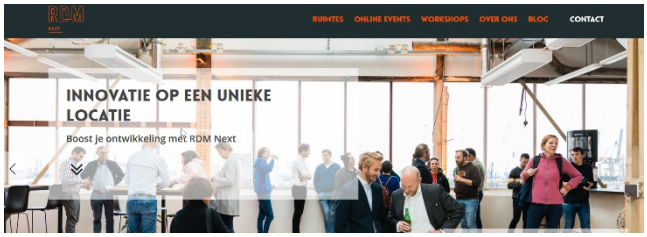
- The BM as draft during experience day
- ROI calculation form
- Technical feedback from RAMLAB/Valk
- Template for project proposal (EUcalls for SMEs for demonstration projects or loans from public innovation banks)

2.4. WAAM Experience Days at Naval Group

The first WAAM Experience Day at Naval group will occur on the 25th of October 2022. The date was setup taking into account the production and communication constraints. The second WAAM Experience Day at Naval group will occur on early 2023. (exact date To Be Confirmed)
The event won't be hybrid: it will be a physical event only. It will occur at Indret facilities within the building NEF R&D FA Innovation. A room with a capacity of 30 people (including covid19 measures) is booked. The group estimated to 20 participants will be split to take turns to access to the demonstrations at the robotic cell. A Grade2XL Demonstrator will be accessible at the robotic cell. A lunch will be provided to all participants.
The targets are industrial SME which already have the internal skills enabling to apprehend the topic of production with WAAM such as machining mechanics companies and tools & equipment manufacturers.
Invitation will be sent by the communication manager thanks to the EMC2 stakeholder database issued on March 2022.

2.5. WAAM Experience Days at RAMLAB

The first WAAM experience days at RAMALB facilities will occur on the 8th of November 2022. It will be combined with Valk Welding's yearly customer training day.
The "RDM Loft" is the suitable place



Contents:
- presentation introduction to WAAM, Grade2XL
- demonstration of MaxQ system
- Workshop/brainstorm applications with (multi material) WAAM.

After the day a follow up with the participants who have serious interest in the WAAM technology will be done by RAMLAB. Valk Welding is currently working on other dates at their other EU locations.

2.6. Alternative events

Offering too often the same physical event such as *WAAM Experience Days* faces operational difficulties to overcome:

- Availability of the robotic cells for demonstration (due to manufacturing of confidential parts)
- Enrolment of participants to a very same event

In addition, the targeted audience can be reluctant to travel from far (when allowed by member states) to attend events considered as technological watch. Indeed, technological watch activities are by essence not a priority for the professional profiles targeted.
Consequently, in addition to the webinars described previously, other events are organized to reach objectives in volume of physical events with demonstrations (static or dynamic). The avoidance response taken consists of organizing different kinds of events (than *WAAM Experience Days* at Naval Group of RAMLAB facilities). It offers the advantage to occur at different location thus improving the outreach of dissemination actions across Europe.

Other kinds of technical Days (Physical event) than WAAM Experiences days were organized.

- Example 1: On the 30th of November 2021: an event entitled "*Matinée Techno by EMC2*" about additive manufacturing for metal parts (focus on WAAM) offered 5 conferences, an innovation workshop and an exhibition (see full description of event in appendix).
- Example 2: On the 23rd of June 2022: an event entitled "Tech Day" about WAAM & WLAM with conferences and an exhibition with stands of industrials

In the case of new governmental restrictions in the future, another alternative imagined by Grade2XL is turning WAAM Experience Days into online events. Indeed, other lockdowns would forbid the organization of physical events because of Member States regulations on physical meetings (due to coronavirus outbreak responses), the event would occur online. Live technical demonstrations of WAAM Experience Days & WAAM Roadshow would be replaced by videos; coaching sessions would occur in webinar based on a serious game methodology.

3. WAAM Roadshow

3.1. Initial WAAM Roadshow

The Roadshow is based on the same principle of the *Experience Days* but is the mobile WAAM system to reach others area and SMEs that would not travel to one of the facilities in Europe offering *WAAM Experience Days.*
Using a mobile WAAM system, prototyping and coaching sessions will be delivered at any other location in Europe. EMC2 and M2i will lead the selection of SMEs to receive coaching, by reaching out to both their national and European networks, including the clusters dedicated to advanced manufacturing technologies (such as Produtech Portugal, TCS Tools Slovenia, Manufacturias Spain, Smart Industry Netherlands and incubators, to ensure a wide geographical coverage).

Pictures above: *Example of a mobile WAAM system (developed by Valk Welding and owned by Autodesk): shown during transportation (left); installed and ready for operation (centre) and during operation (right).*

Voestalpine Böhler Welding volunteered to join the Roadshow team. They offered to participate to the explanations. Their engineers could for instance contribute on topics such as basics on the materials used in AM:

- impact of heat input and temperature control on the material metallurgy,
- mechanical technological data
- material selection and optimization.

3.2. MaxQ system demonstration

The Autodesk container offers mobility thus increasing the Outreach of the project dissemination and enables demonstrations in faraway locations. However, the container is used to produce the Grade2XL demonstrators so is not often available. The backup plan consists of a MaxQ system using a Cobot (see picture below). It is more efficient to achieve the dissemination results. Indeed, it downscales the moving around because a 2mx1m table is easier to move to trade fairs.

On the picture above, a Cobot (robotic arm) with the MaxQ (scanner in the grey box) can be seen. Kuznia Jawor Die is to be repaired. The system scans the die then generate the toolpath and finally repairs with WAAM Technique (welding torch).

For demonstration based on the Kuznia Jawor die, Universities of South Europe are considered. Identify parties interested in south Europe will happen in Q2 and Q3 of 2022. Vanguard Initiative network (EMC2) and the networks of Universities involved in the consortium (see D7.3 *Stakeholder Database*) will be mobilised

In addition to WAAM Roadshow, demonstrations will occur at trade fair such as

- Automatica in Germany in June 2022. With no additional cost. Grade2XL banner to be included.
- The technician Exhibition in September 2022 in the Netherlands.
- The trade fair Forge in Spain (Bilbao) in September 2022 about forging

4. Adapted Industrial Trainings

Adapted industrial trainings aim at creating more awareness about WAAM and making people consider using WAAM in their production processes. It targets people with a little background in welding-process. Valk Welding involves dedicated experienced people giving training in robot programming.

Valk Welding will organize trainings at Alblasserdam in the Netherlands with the objective of reaching 480 SMEs. It is initially planned to be divided into 40 trainings per year during 4 years with trainees from 3 different SMEs at each session. Valk Welding will contact the SMEs through its newsletter and through the industrial exhibitions the company takes part in. Besides, the company will spread the news about WAAM among its sales-engineers throughout Europe so they can contact the customers in their region which could be interested in this process. The company will also spend a part of its regular programming-trainings, which they give to all their customers, to instruct about WAAM. Herewith they would spread widely the knowledge about WAAM.

The trainings will be split into two parts: a theoretical one and a practical one. The theoretical training consists on an explanation of the possibilities of the WAAM process. This theoretical part teaches the WAAM principles, when it is interesting to use it and for which kinds of parts. The practical part teaches how to generate a robot-program for making a WAAM-part. As indicator, there won't be final test (so the trainees are not frightened with some sort of exam to pass). If the trainees are convinced that WAAM is a serious alternative for other production methods, the training is considered as a success.

Valk Welding will contact the SMEs through its newsletter and through the industrial exhibitions the company takes part in. Besides, the company will spread the news about WAAM among its sales-engineers throughout Europe so they can contact the customers in their region which could be interested in this process. The company will also spend a part of its regular programming-trainings which they give to all their customers to explain about WAAM. Herewith, it will spread widely the knowledge about WAAM.

The premises in Alblasserdam consist of several buildings that are particularly appropriate to organise industrial trainings featuring Assembly halls, Warehouses for welding wire, a training centre of 360 sqm and classrooms of 90 sqm as well as a demo centre of 360sqm. In addition, Alblasserdam facility lays in the industrial heart of Holland, close to Rotterdam and close to RAMLAB. Alblasserdam is surrounded with all kinds of metal industries. The premises are located directly at the highway A-15 and therefore easy reachable by car, train or from the airport.

5. Training of professionals

Courses for training of professionals will be crafted having in mind the skills needed for the future engineers operating robotic WAAM machines. RAMLAB and Naval Group will guide the content of these courses. The International Welding Institute and other professional associations, such as the European Welding Federation will be involved in the development of the course providing contents.

All this with the intention to organise further trainings during and after the project. The course content will remain dynamic to incorporate new developments in the technology and will serve as a tool to re-educate the welding professionals in the spirit of WAAM.

These courses for WAAM professionals will be organised by TU Delft with the support of the International Institute of Welding (IIW) and the European Welding Federation – through links via the national welding institutes. This training is facilitated by having key members of our team in leading positions at the International Welding Institute.

Grade2XL consortium will also liaise with other AM projects and initiatives to ensure a good fit with the needs for AM workforce development at European level: Made in Europe (EIT Manufacturing, the I4MS project, the AM-platform (via M2i), CECIMO (via Valk Welding) and the TMS Materials Societies (via TU Delft). The aim is to create synergies and reach a critical mass of welding engineers and professionals who are trained on WAAM.

The training would go on the AM and specifically WAAM topic. This is typically of interest for manufacturing schools for instance.

The targeting audience for this training is:

- The European Welding Federation
- Manufacturing schools
- National welding institutes
- Certifications bodies
- Designers (how to incorporate Graded WAAM into the design aspects)
- Software developers: tool path generation

It concerns the operators level as well as the European welding engineers level.

Training program would deal with the following topics:

- Naval & RAMLAB would emerge as trainers.
- Robotic deposition
- WAAM process (printing strategies, heating & cooling as well as NDT)
- NDT as specific topic
- Design aspects

The training will be offered in a compact version of four hours and a more extended version up to 40 hours.
The length of the course would depend on

a) Level of knowledge to be reached (from general introduction to detailed information)
b) The background / entry level of the participants at the beginning of the training

The training will be dealing with both **theoretical aspects and manufacturing-applied aspects**. Training and coaching by manufacturers (Naval Group & Valk Welding) could show their welding capacity. These players are members of Grade2XL consortium. They have extensive experience in welding. An academic partner (TU Delft) would add scientific knowledge.

The outcome could be some sort of presentation in combination with supplementary document (featuring comments remarks) about **the entire flexible manufacturing system** or on **specific functions of the system** (hardware, software).

Such training would be a perfect base that could be adapted by Valk Welding for **maintenance training** to prepare their clients to use and maintain their Grade2XL installation. The aforementioned presentation would be used in addition to Valk Welding's tailor-made content for Adapted Industrial Training (see dedicated paragraph).

Emerging business to be investigated: A possible new business could emerge from Grade2XL. It would concern the "training industry". On-site training on WAAM could be envisaged**.** Typical welding schools could extend their activities towards WAAM. Personnel can be certified by the teaching programs approved by the national Welding Institutes. It could be performed by RAMLAB (as future owners of the state of the art). This is not in the core-business of the company. There is no business unit on "training to professionals" and not even anything planned in this direction. It remains an idea at this step. It will be discussed with RAMLAB later. Because it is not in their strategy at the moment (see business case in the Exploitation part). Nevertheless, RAMLAB and also Naval Group are open to explore the idea of organising professional trainings after the project is ended.

Focus on the platform of the European Welding Federation

- Promotion platform. A topic is dedicated to Additive Manufacturing. 20 competences are listed. They mention certification of personal. Guideline on arc welding, on laser cladding etc. Grading of parts could be discussed within this event. Both with industrial and academic participants.
- Related European projects are listed (with links on the Cordis website).
- Training & certification platform. It should design programmes for certification of personnel. Grade2XL would contribute to this platform. TU Delft will contact EWF via the national welding institute, to promote Grade2XL with the objective of creating a programme available for education (by M6). A set of presentations could be sent, as input for the training programme of these organisations.
  The training is based on the concept of "Competences units". It features 40 hours on AM. Grade2XL may contribute by adding a competence on grading structures. The content will include a presentation on the current capabilities of WAAM, after which will introduce grading and its potential in terms of materials and cost savings - as well as on the process requirements and possible adaptations of current hardware.

Focus on policy making platform: the European Technology Platform in Additive Manufacturing M2i, who is leading the policy-making actions within WP 7, will liaise with the persons in charge and will investigate the options to link and promote Grade2XL on this platform
Many Grade2XL partners are also members of this platforms, the others will again be encouraged to register.

Focus on Training of certification companies (classification societies such as Bureau Veritas, DNV GL and Lloyd's Register)
Certification is given by the classification societies to the industrial users of WAAM. The certification procedures for WAAM are only recently developed and could be further adapted, to reflect the developments in the field, for example emerging topics such as NDT applied to WAAM. For example, if a system is equipped with an NDT equipment, the operator should have certification on NDT.
The certifying bodies could attend trainings to learn the possibilities of the technology. The trainings would enable them to further train their own inspection staff.

Bureau Veritas (BV) and DNV GL are classification societies involved in Grade2XL, one as partner, also leading a work package on certification, the other one as member of the Industrial Advisory Group. Training possibilities for such organisations will be investigated by EMC2 with BV directly and, if interest is found, it will be confirmed by talks with DNV GL during the first IAG meeting.

6. Appendix

Example of alternative physical event : "Matinée Techno by EMC2"

On the 30th of November 2021, a physical dissemination action organized by Grade2XL occurred in the *Technocampus Océan*, a R&D platform of the Region *Pays de La Loire* in the West of France.

EMC2 had organized a technological watch event entitled "*Matinée Techno*" **to raise awareness about WAAM**. It featured 5 conferences, a workshop and networking breaks. Parts produced with additive manufacturing processes and in particular with WAAM technique were exhibited such as a boat propeller, a rotor of a pump and a mold for an aerospace part.

Among the 5 conferences chosen for their approach focusing on industrial use-case, Grade2XL project was introduced by Anne-Sophie THORR, Welding Engineer IWE at NAVAL GROUP and Hervé MOTTE, Industrial Development & Innovation Manager at Shapers'. The work on the B3-Demonstrator, a mold for plastic injection, had been highlighted. In addition, INTEGRADDE project which have received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 820776 was introduced to the audience during a conference by IRT Jules Verne and Loiretech. Two other industrial SMEs also had the opportunity to present their work with additive manufacturing and WAAM: PCM Technologies and AFU 3D Metal.

Despite a busy production agenda these months for most of the members of the local community, the event gathered 30 people of two Grade2XL target groups: industrial engineers designing metallic parts and researchers on advanced manufacturing processes.