Co-funded by the
Erasmus+ Programme
of the European Union

CLLAIM

Recognition of Prior Learning Guideline in the AM Sector

April 2020

Co-funded by the
Erasmus+ Programme
of the European Union

This project has been co-funded with support from the European Commission. This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

Open Licence

All these public and educational materials obtained from Erasmus+ funding are published free of charge and under an open license. Permission is granted for any use of this work/document, exploitation, sharing or adaptation of this resource, as well as the creation of derivative works without restriction. Only authorship must be recognized. Therefore, free access and possibility to use the deliverables is allowed. An open license is not a transfer of copyrights or Intellectual Property Rights (IPR) and the benefit.

© 2021 CCLAIM This work is licensed under a *Creative Commons Attribution 4.0 International Licence.*

This project has been co-funded with support from the European Commission. This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

INDEX

0. CONTEXT AND PURPOSE OF THIS DOCUMENT 5
0.1. Abbreviations used in this document 6
1. INTRODUCTION TO RPL (RECOGNITION OF PRIOR LEARNING) CONCEPT 7
1.1. Challenges of Developing an RPL Scheme for AM. Added Value 8
2. MAIN PHASES AND ACTORS OF THE AM RPL PROCESS 8
2.1. AM RPL Process Actors 8
2.2. Defining a RPL Scheme Applicable to AM. General Validation Process 9
3. AM VALIDATION RPL PROCESS STEPS 10
3.1. RPL Process Workflow 10
3.2. Information on AM Process and Opportunities. 12
3.3. Identification and Documentation 17
3.4. Recognition 18
3.5. Assessment 19
3.6. Qualification 20
4. SUPPORTING TOOLS IN DETAIL 20
4.1. Basic Evidence Extraction Tools 20
4.2. Identification and documentation Tools 21
4.3. Recognition Tools 22
4.4. Assessment Tool 23
5. Annexes 25
5.1. Annex 1. Additive Manufacturing professional and training registration form 26
5.2. Annex 2. Additive Manufacturing Professional and Personal Motivational Form 32
5.3. Annex 3. AM Interview guide *(Optional)* 34
5.4. Annex 4. Self-assessment grid *(optional)* 36
5.5. Annex 5. AM Check-list portfolio - Operator 37
5.6. Annex 6. Portfolio technical review document – CU 00 40
5.7. Annex 7. Technical interview guide 41
5.8. Annex 8. AM demonstration 42
5.9. Annex 9. Resources 46

Co-funded by the
Erasmus+ Programme
of the European Union

This project has been co-funded with support from the European Commission. This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

Co-funded by the
Erasmus+ Programme
of the European Union

This project has been co-funded with support from the European Commission. This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

0. CONTEXT AND PURPOSE OF THIS DOCUMENT

Additive manufacturing has shown great strength in recent years in industrial fields, where through the "layer by layer" manufacturing concept, these technologies are able to transcend a large part of the limitations associated with traditional manufacturing means. Additive manufacturing is also basic for the introduction of associated concepts as "digital manufacturing", encompassing modern design, engineering, simulation and scanning tools, which in conjunction with the great advance in the field of communications, altogether lead to a new paradigm for manufacturing in these early stages of the 21st century.

The advantages of additive manufacturing with respect to traditional manufacturing technologies are well known, and the objective of this document is not to delve into them. Suffice it to say that their potential is based on aspects such as the elimination of design restrictions, the more rational use of materials, the considerable acceleration of the design, engineering and validation processes, or the new business models made possible by these technologies; all of them more than enough reasons to highlight their interest from any point of view.

This potential for improvement is also being recognized by the industry, this being evident if some of the most significant macro-indicators are analysed in relation to the growth of the additive manufacturing technologies market. Thus, according to the report issued by Wohlers in 2019 (one of the main consulting and advisory companies in the field of additive manufacturing worldwide) this sector is passing through a time of evident growth, with sustained increases in the sale of materials (for example, a 40% annual sustained growth of metal materials sales in the last 5 years), the increase in sales of industrial equipment (for example, 80% increase in the sales of metal AM systems from 2017 to 2018), or the continuous increase in the number of producers and providers of technology. The forecasts are also optimistic, as the same source predicts a market of more than 35,000 million dollars by 2024.

In this way, and despite the fact that on many occasions and especially in non-industrial forums, additive manufacturing continues to be treated as a novel technology, since its inception in the 1980s and the first applications strictly linked to visual models and non-functional prototypes, these technologies have come a long way. This path has led us to our days, where additive manufacturing technologies are an essential tool for the development and manufacture of improved solutions, not accessible to previous manufacturing technologies. This is why industries traditionally at the forefront of technology, such as the automotive, aeronautics and medical industries, are adopting it at an accelerated rate, and very clear actions can be identified in pursuit of its adoption in practically all sectors based on manufacturing.

In any case, the growth and implementation of any technology demand a series of conditions for making it sustainable, being a totally and absolutely critical aspect the existence of properly trained professionals, competent in the use and application of the technology. In the field of additive manufacturing, this has in fact been pointed out as one of the most important aspects, and documents such as the EY 3D Printing report from April 2016 confirm this, identifying the lack of

This project has been co-funded with support from the European Commission. This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

qualified experts as one of the most important barriers for the expansion of these technologies. In this sense, at the present time, it can be said that there is a gap between the industry that can and is currently making use of AM (demanding precisely those qualified professionals), and the Vocational and Educational Training (VET) systems throughout Europe. Thus, as already recommended by the European platform for Additive Manufacturing in 2014, actions such as the development of (certifiable) training programs adapted to industrial agents become necessary, taking into account the specific cases in the industry and its value chains. Making this process broad enough to encompass the implementation of technology in all its aspects (design, modelling, pre and post-processes, materials and applications) becomes a requisite as well.

In line with these recommendations, **CLLAIM project** (Creating knowledge and skiLLs in Additive Manufacturing) aims to be a relevant tool to fill the appointed, through these objectives:

- Set up the basis for the creation of an innovative industry-led and harmonized training system in AM.
- The introduction of current work-based learning/ industry based-learning, recognition of prior learning among EU partners in AM sector.
- Establishing an operational framework to develop a model based on European Qualification Framework (EQF) levels, boosting the recognition and transfer of credits by applying European Credit System for Vocational Education and Training (ECVET) methodology and tools.
- Enhancing skills and competences of trainers in the field of AM sector by promoting exchange of successful pedagogical methods and practices between teachers and trainers from Vocational Education and Training (VET).
- Developing an EU Network to stimulate future cooperation and mobility in the field of education and work and promoting the project results as a best practice to other sectors.

Within the framework built around these objectives, the present document aims to serve as a guide for the validation of knowledge, skills and experience of professionals around additive manufacturing technologies acquired outside the standard training route defined by CLLAIM. Thus, this guide shows how, based on the definition of a series of Additive Manufacturing Professional Profiles and learning outcomes (LOs), it is possible to implement a sequence of steps that allow a professional to see their competences recognized.

0.1. Abbreviations used in this document

Abbreviation	Term
AM	Additive Manufacturing
ANB	Authorised National Body
ATB	Authorised Training Body
DED-Arc	Direct Energy Deposition-Arc
DED-LB	Direct Energy Deposition-Laser Beam
ECVET	European Credit System for Vocational Education and Training
EQF	European Qualification Framework

Co-funded by the Erasmus+ Programme of the European Union

This project has been co-funded with support from the European Commission. This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

EWF	European Welding Federation
LOs	Learning Outcomes
PBF-LB	Powder Bed Fusion-Laser Beam
RPL	Recognition of Prior Learning
VET	Vocational Education and Training

1. INTRODUCTION TO RPL (RECOGNITION OF PRIOR LEARNING) CONCEPT

All persons develop a continuous learning activity throughout their lives, in which knowledge, skills and experiences are accumulated, both personally and professionally. In the latter area, formal schemes have traditionally established solid learning routes, levels of recognition and qualifications, and under such premise labour market has implemented a job access system.

Although these systems that we could call "traditional" continue to exist and are fully in force, nowadays the possibilities for a person to acquire subsequent higher levels of knowledge and competence are considerably greater. Thus, at present, companies demand dynamic profiles, with the capacity to join and adapt to the increased pace of technological evolution and growing needs of industry and society. In this context, the knowledge and capacities of people no longer arise only within formal training contexts, as each person's own personal and professional trajectory lead to the obtention of new knowledge, skills and experiences. These can be obtained in informal/non formal contexts (provided due to their own growth in experience, contact with other professionals or self-study activities), can in most cases be corroborated, and therefore they should be recognized and give access to jobs that demand them.

It is precisely in this point where the concept of Recognition of Prior Learning (RPL) makes sense.

In a nutshell, RPL is the process that allows an individual to recognize knowledge, skills and experience towards achieving a specific qualification, through an evaluation process that seeks to establish whether said person is the holder of the standard learning outcomes expected for said qualification. An RPL process takes into account not only the knowledge, skills and experience accumulated through formal training and paid work activities, but the ones obtained under non-formal or informal training and experience systems, such as self-training, volunteering, participation in professional forums, etc., assuming these are traceable.

It is evident that the application of RPL concept to Additive Manufacturing (AM) is of paramount importance. Framed within the concept of digital manufacturing, it is obvious that the emergence of AM technologies in professional fields is being fast compared to the historical impact of previous manufacturing technologies. Its implementation is already a fact in the main organizations in the industrial sectors of greater importance and technological strength, and its "cascade" effect in the general context of the industry is highly relevant. Traditional training routes have not yet incorporated these technologies in a decisive way, and although very diverse training activities are proliferating, the relative novelty and the great variability of AM technologies currently make it difficult to configure easily recognizable and transferable schemes. On the other hand, at present a

This project has been co-funded with support from the European Commission. This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

good part of the knowledge and skills in AM are only obtainable through the direct experience in these technologies, which increases the need to give rise to tools with the capacity to generate recognition among the industry.

1.1. Challenges of Developing an RPL Scheme for AM. Added Value

The absence of recognizable RPL schemes causes certain difficulties among the various stakeholders, and due to the lack of definition, difficulties arise for AM professionals when it comes to demonstrating knowledge, skills and experience, as well as on the opposite, perceiving them by potential employers. Likewise, this situation gives rise to doubts regarding the transparency, uniformity and, ultimately, quality of the processes that currently train professionals in AM technologies.

Thus, the development of a harmonized scheme is especially advantageous for professionals in the AM field, since it allows them to access and obtain a qualification in AM in a considerably accelerated way compared to traditional training schemes, in a manner fully compatible with their work activity. Similarly, access and achievement of qualifications based on this scheme increases their employability and motivation, based on the establishment of areas of competence through which to develop their own professional profiles.

From the point of view of the contributions that this scheme makes to RPL as a general concept, it is a way not only to involve the candidates themselves to receive qualifications, as it also establishes benchmarks for employers searching for candidates adequately trained in AM technologies.

It is therefore obvious that the design of a harmonized scheme for AM RPL is itself an activity of great added value, by providing a scheme of recognition of knowledge, skills and experience in the field of AM technologies, where formal training routes are still absent.

2. MAIN PHASES AND ACTORS OF THE AM RPL PROCESS

2.1. AM RPL Process Actors

When establishing responsibilities in the AM RPL process, the following main actors can be identified:

- European Welding Federation (EWF). As a federation created to manage the processes of training, qualification and certification of welding, joining and cutting activities at an international level, the EWF articulates rules in this area, which are deployed to different countries through the designation of Authorized National Bodies (ANBs).

- Authorized National Bodies (ANBs). After having been properly evaluated and approved by the EWF, the ANBs carry out national deployment of the rules and standards defined by the EWF in the field of education and evaluation, and are its main guarantors at the national levels. In the context of this RPL process, these are the entities in charge of ensuring that the implementation of the system in their respective territories is effective, evaluating and

Co-funded by the Erasmus+ Programme of the European Union

This project has been co-funded with support from the European Commission. This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

accrediting Authorized Training Bodies (ATBs), as well as appointing Examination Boards and issuing certificates/diplomas.

- Authorized Training Bodies (ATBs). Evaluated and authorized by the respective ANBs (from which they are independent) to apply the rules and standards defined by the EWF, the ATBs are authorized to provide training and be part of the RPL process. In this RPL process, they are in charge of administering the process in the first instance, evaluating candidate´s compliance with the established requirements, as well as the authenticity and validity of all the information presented. The ATBs carry out their work through specialized technicians, authorized by the ANBs to develop the RPL process in each of the steps described.

- Candidates. People who want to see their level of knowledge, skills and experience recognized with respect to any of the identified AM profiles, and who undergo the validation process described in this guide.

- Examination Board. This body acts on behalf of the ANBs and is appointed by them, and supervises the RPL process as a whole, being composed of a chairman (representative of the ANB), different representatives of the industry and a representative of the ATB; all of them independent from each other. The examiners must present the profile shown in the following table:

Table 1: responsibilities and requirements for the members of an Examination Board

Examiner responsibilities	Examiner requirements
- Organization of theoretical and practical exams. - Establishment of the examination questions (written and oral). - Execution and scoring of exams. - Decision on results.	- Accredit adequate knowledge and experience in the technical field in which the validation process will be framed. - Know in detail the described validation process, as well as the detail of all the mechanisms, tools and documents that make up the process. - Make fluent use of the language in which the validation process will be developed (oral and written). - Impartiality and absence of prejudice.

2.2. Defining a RPL Scheme Applicable to AM. General Validation Process

Given the importance of designing a learning recognition system adapted to additive manufacturing, it is worth describing what is the essence of any RPL system, which is in this case to give visibility to the knowledge of people with verifiable abilities in the AM field, through a **validation process**. In the case of this guide, and in order to provide a recommendation on this general process, the following general sequence of stages is proposed (based on the

Co-funded by the Erasmus+ Programme of the European Union

This project has been co-funded with support from the European Commission. This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

recommendation of the COUNCIL OF THE EUROPEAN UNION, RECOMMENDATION of 20 December 2012 on the validation of non-formal and informal learning (2012 / C 398/01):

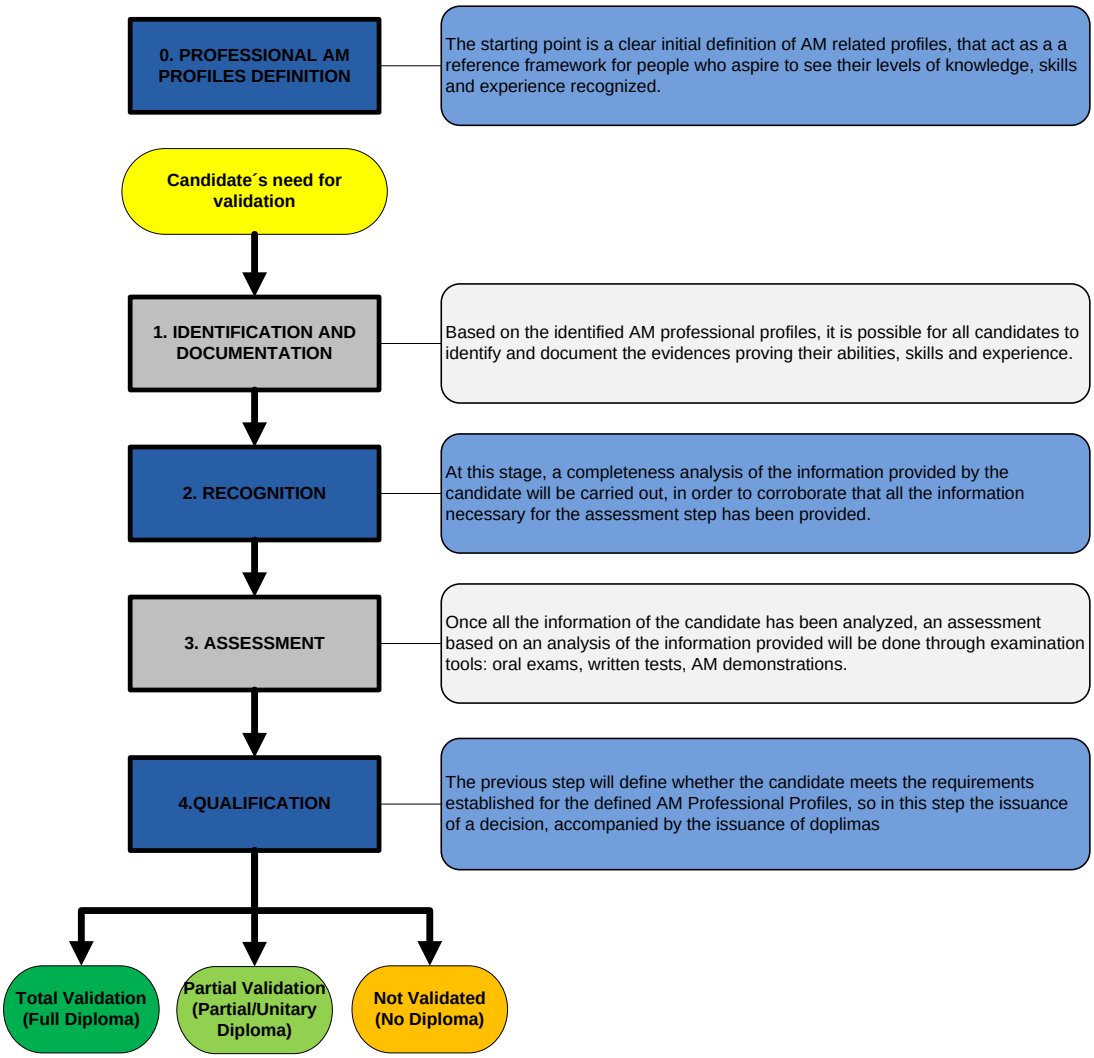


Figure 1: simplified diagram for AM RPL process

A description in detail of these different steps will be made from sections 3.3 to 3.7 of the present document.

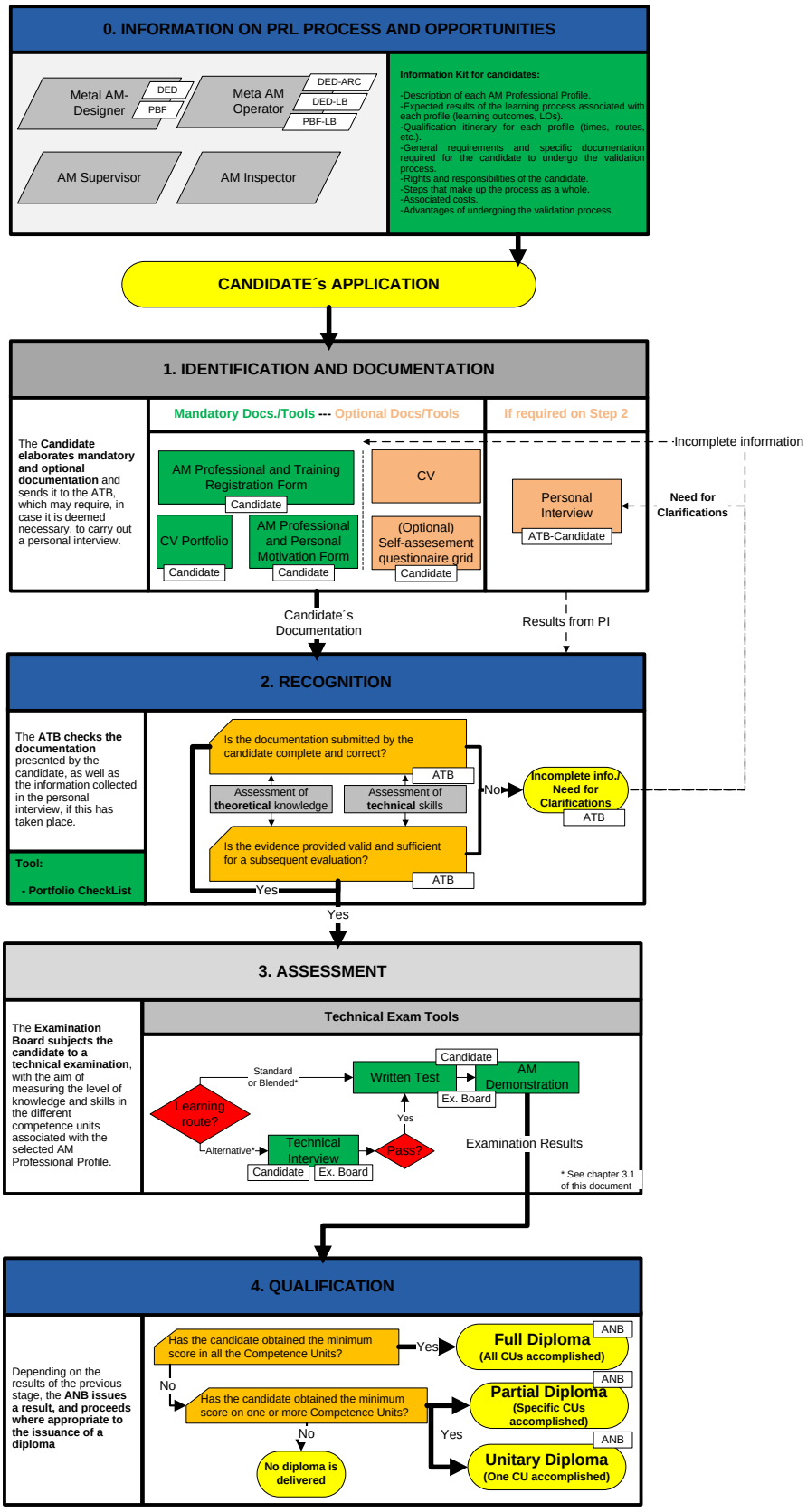
3. AM VALIDATION RPL PROCESS STEPS

3.1. RPL Process Workflow

A representative diagram of the entire validation process is presented below, which tries to condense its most relevant elements, and that will be developed in further detail in successive sections:

Co-funded by the Erasmus+ Programme of the European Union

This project has been co-funded with support from the European Commission. This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.



Co-funded by the
Erasmus+ Programme
of the European Union

This project has been co-funded with support from the European Commission. This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

Figure 2: Steps of AM RPL Process proposed by the present guide

3.2. Information on AM Process and Opportunities.

All training and experience validation process must start from a clear identification of professional profiles, against which the candidates will seek to accredit themselves. In this sense, it is necessary to take into account the particularities of AM technologies, which currently converge in the following AM Professional Profiles:

Table 2: Professional AM Profiles General Description

Profiles	General Description
Metal AM-Designer	Designer specialized in AM technologies, capable of making effective and efficient use of them, leading to specifically geared designs. The designer therefore possesses adapted design capabilities, knowledge of the general AM process, and specific knowledge of simulation (realization and analysis), as well as post-manufacturing processes. Due to the diversity of metallic materials printing technologies that currently exist, it is possible to define two sub-profiles.
DED Designer	Directed Energy Deposition specialized designer.
PBF Designer	Powder Bed Fusion specialized designer.
AM Operator	Person with capabilities for the preparation, configuration, start/stop and maintenance of additive manufacturing machines, as well as with abilities related to the realization and preparation of pre- and post-processes. This profile has a general understanding of the whole AM process, and has specific knowledge in post-process, safety, health and environmental matters, and quality assurance during the manufacturing process. Due to the diversity of metallic materials printing technologies that currently exist, it is possible to define three sub-profiles.
DED-Arc Operator	Directed Energy Deposition (Wire-Arc) Operator.
DED-LB Operator	Directed Energy Deposition (Laser Beam) operator.
PBF-LB Operator	Powder Bed Fusion operator.
AM Supervisor	Person capable of analysing not only the technical applicability of AM technologies to specific cases/designs, but to analyse the feasibility of applying the technology in industrial cases, around the identification and valuation of cost models, ranges of profitability and the use of any tool with prospecting capacity around the sustained use of the technology.
AM Inspector	Person/professional with the specific knowledge, skills, autonomy and responsibility to conduct inspections to Metal Additive Manufacturing parts production, with the main tasks of carrying out quality assessments of the AM process at various critical stages, performing inspection to all equipment ensuring its used adequately and controlled, conducting visual inspection to identify and evaluate Metal AM parts imperfections according to acceptance criteria, compiling and verifying the final inspection document package and, in addition, verifying all Metal AM related activities in production, including (but not limited to) the following points: ➢ Verify data and adequacy of material certificates (base and filler materials). ➢ Verify identification and traceability of the materials during the manufacturing process. ➢ Verify the compliance of feedstock against the applicable standards, codes and specifications.

Co-funded by the Erasmus+ Programme of the European Union

This project has been co-funded with support from the European Commission. This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

Thus, **one of the most critical points of the entire process is to ensure that candidates have access to a complete information about the entire process**, according to the AM Professional Profile to which the candidate intends to apply.

Based on the aforementioned indications, a clear and concise identification of the different AM Professional Profiles is of the highest relevance. At this point**, these are the supporting tools that this guide offers for ATBs when developing this process step**:

- Brief description of AM profiles. In this sense, the information provided by Table 1 can be very useful, as well as the "tasks" column in Table 3.
- Description of the requirements associated to each AM Professional Profile. The information provided by Table 2 can be used as a reference

Table 3: Professional AM profiles requirements

Profile	Tasks	Education, background and experience requirements
Metal AM-Designer	- Designing Metal AM solutions ensuring and validating that parts can be made cost-effective and efficiently. - Redesign existing parts to increase efficiency or improve performance using Metal AM processes. - Contributing to projects in a teaming environment cooperation with AM Team.	Candidates can have access into the Metal AM Designer training course by proving an experience of, at least 2 years developing the tasks defined for the profile. Candidates must present evidences about having knowledge of Additive Manufacturing procedure development and optimization, analysis and numerical operation and simulation (FEA analysis), and an introduction to materials as well. Candidates must have the ability of, at least, manage complex technical or professional activities or projects, taking responsibility for decision-making in unpredictable work contexts, and in addition, take responsibility for managing professional development of individuals and groups.
Operators	Common to all operator profiles, candidates must have the ability of, at least, take responsibility for completion of tasks in work and adapt own behaviour to circumstances in solving problems.	
DED-Arc Operator	- Operate arc based DED machines for AM, including, fitting and setting up, maintenance and repair.	Candidates can have access into the DED-Arc Operator training course by proving an experience of, at least 2 years developing the tasks defined for the profile.

Co-funded by the Erasmus+ Programme of the European Union

This project has been co-funded with support from the European Commission. This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

Profile	Tasks	Education, background and experience requirements
	- Verify arc related parameters and positioning in DED-Arc machines for AM. - Self-manage the handling of feedstock (approval, storage, contamination, traceability). - Develop solutions on basic and specific problems related with DED-Arc machines and processes for AM.	In this case, is not mandatory candidates have corresponding background.
DED-LB Operator	- Operation of the Laser based DED machines for AM, including, fitting and setting up, basic maintenance and repair. -Verifying Laser beam measurement and positioning in DED machines for AM. - Self-managing the handling of feedstock (approval, storage, contamination, traceability). - Developing solutions on basic and common problems related with Laser based DED machines and processes for AM.	Candidates can have access into the DED-LB Operator training course by proving an experience of, at least 2 years developing the tasks defined for the profile. In this case, is not mandatory candidates have corresponding background.
PBF-LB Operator	- Operating powder bed-based Laser beam machines for AM, including fitting and setting up, maintenance and repair. - Removing parts and prepare them for post-processing steps. - Verifying Laser beam measurement and positioning in powder bed based machines for AM. - Self-managing the handling of powder (approval, storage, contamination, traceability, and developing solutions on basic and specific problems related with powder-bed-based machines and processes for AM.	Candidates can have access into the DED-LB Operator training course by proving an experience of, at least 2 years developing the tasks defined for the profile. In this case, is not mandatory candidates have corresponding background.
AM Metal Supervisor	- Evaluating manufacturing suitability for customers' requests, defining which processes are fit for the request, developing cost models. - Applying a wide variety of engineering techniques, contributing to projects in a teaming environment and compare, investigate, transfer, and adapt procedures, techniques, or methods to new applications.	- Candidates can have access into the Supervisor training course by proving an experience of, at least 2 years developing the tasks defined for the profile. - Candidates must have the ability of, at least, manage complex technical or professional activities or projects, taking responsibility for decision-making in unpredictable work contexts, and in addition, take responsibility for managing professional development of individuals and groups. - Candidate must present evidences about having knowledge of Additive Manufacturing procedure development, analysis and control costs, quality of the manufacturing procedure, and an introduction to materials as well.

Co-funded by the Erasmus+ Programme of the European Union

This project has been co-funded with support from the European Commission. This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

Profile	Tasks	Education, background and experience requirements
AM Inspector	- Conducting and applying inspections to Metal Additive Manufacturing parts production. - Detecting errors in the manufactured pieces/parts	- Candidates must have the ability of, at least, manage complex technical or professional activities or projects, taking responsibility for decision-making in unpredictable work contexts, and in addition, take responsibility for managing professional development of individuals and groups. - Candidates must present evidences about having knowledge of Additive Manufacturing procedure development, as well as in the field of analysis, verifying and material/pieces inspection, and an introduction to materials as well. In addition, candidates must be able to carry out quality assessment and quality control regarding the manufacturing processes, as well as having relevant knowledge about using inspection equipment and tools. - Candidates can have access into the Metal AM Inspector training course by proving an experience of, at least 2 years developing cited tasks below.

- Summary expected Learning Outcomes for each profile, associated with the different Competence Units established for each profile (for the details of this information, see for example document EWF-AM-WUAL-001-19: "EWF Guideline for European/Internationlal Directed Energy Deposition - Arc Operator", from the European Welding Federation). An orientation towards said summary can be presented in the following table:

Table 4: summary of expected Learning Outcomes for each AM Professional Profile

AM METAL DESIGNER	
DED Designer	**PBF Designer**
-Additive Manufacturing Process Overview -Post Processing -Relevant Principles of DED Processes for Design -Design Metal AM parts for DED Processes -Simulation Analysis-Simulation Execution	-Additive Manufacturing Process Overview -Post Processing -Relevant Principles of PBF Processes for Design -Design Metal AM parts for PBF Processes -Simulation Analysis-Simulation Execution

OPERATORS			
DED-Arc Operator	**DED-LB Operator**	**PBF-LB Operator**	**PBF-EB Operator**

Co-funded by the Erasmus+ Programme of the European Union

This project has been co-funded with support from the European Commission. This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

-Additive Manufacturing Process Overview -DED-Arc Process (independent) -Quality Assurance in DED-Arc -Health, Safety and Environment in DED-Arc -Fit and Set-up of DED-Arc Systems -Manufacturing of DED-Arc Parts -Post-processing of DED-Arc Parts -Maintenance of DED-Arc Systems	-Additive Manufacturing Process Overview -DED-LB Process (independent) -Quality Assurance in DED-LB -Health, Safety and Environment in DED-LB -Fit and Set-up of DED-LB Systems -Manufacturing of DED-LB Parts -Post-processing of DED-LB Parts -Maintenance of DED-LB Systems	-Additive Manufacturing Process Overview -PBF-LB Process (independent) -Quality Assurance in PBF-LB -Health, Safety and Environment in PBF-LB -Fit and Set-up of PBF-LB Systems -Manufacturing of PBF-LB Parts -Post-processing of PBF-LB Parts -Maintenance of PBF-LB Systems	-Additive Manufacturing Process Overview - PBF-EB Process (independent) -Quality Assurance in PBF-EB -Health, Safety and Environment in PBF-EB -Fit and Set-up of PBF-EB Systems -Manufacturing of PBF-EB Parts -Post-processing of PBF-EB Parts -Maintenance of PBF-EB Systems

AM METAL SUPERVISOR
-Additive Manufacturing Process Overview - DED-Arc Process - DED-LB Process - PBF-LB Process - PBF-EB Process -Quality Assurance for Metal AM Processes -Health, Safety and Environment for Metal AM Processes -Powder Handling
AM INSPECTOR
-Additive Manufacturing pieces inspection -Quality Assurance for Metal AM Pieces

Based on all the previous information, **ATBs must provide candidates with an information kit** for each professional profile, made up of the following elements:

- Overview of the whole validation process.
- Description of each AM Professional Profile.
- Learnings Outcomes (LOs) associated with each profile.
- Qualification route for each profile.
- General requirements and specific documentation for the candidate to undergo the validation process.
- Candidate´s rights and responsibilities.
- Associated costs.
- Advantages of undergoing the validation process.

Last, it is very important to clarify as well **how the potential candidates can have access to the overall validation process, as an individual could achieve the expected Learning Outcomes (LOs) for an AM Professional Profile trough three possible routes**:

Co-funded by the Erasmus+ Programme of the European Union

This project has been co-funded with support from the European Commission. This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

- Standard Route. This route will be that of those candidates who can prove that they have successfully passed the official courses approved by the EWF. Since these courses are structured around Competence Units aimed at satisfying the requirements of each of the identified profiles, this is the recommended route for candidates.

- Blended Route. This route differentiates between theoretical and practical training:

    - Reception and satisfactory completion of theoretical Competence Units, in distance learning activities managed by the ANB.
    - Reception and satisfactory completion of practical Competence Units, in training activities managed and developed by ATBs in their own facilities.

- Alternative Route. This route is intended for those candidates who, without having completed any of the previous modalities, consider that they nevertheless have knowledge, competences and experience sufficiently relevant for a selected AM Professional Profile, obtained through formal, informal or not formal education/training. Under this modality, it will be possible to carry out the validation in turn through two variants: the direct recognition of Competence Units, and the recognition of prior learning (RPL).

3.3. Identification and Documentation

This task represents the start of the process for the candidates, once the ATB has made all the required information available. From there, each candidate will review the requirements and proceed to collect and present the documentation related to the selected AM Professional Profile. This is the detail of the documentation to be collected and prepared by the candidates:

Table 5: List of mandatory and optional documentation

Mandatory	Optional
- **AM Professional and Training Registration form**, which in addition to the previous document, deepens in the candidate´s AM background, identifying training, relevant professional and non-professional activities, as well as other details of interest (languages, digital skills, etc.). A form is proposed according to Annex 1 of this document. This document will have an additional utility, which is to indicate the different types of documents that may constitute evidence of compliance with the requirements for the selected profile. - **AM Professional and Personal Motivation Form**, where the candidate will express general interests for entering the validation process and will express preferences on the various areas of AM. A form is proposed according to Annex 2 of this document. -Additionally, the candidates must present a **CV Portfolio**, in which they will collect the evidence	- Candidate´s **Curriculum Vitae**. The AM Professional and Training Registration Form (mandatory) is aimed at gathering all the candidate´s details on knowledge, skills and experience related to AM, but a more general CV could be helpful in order to obtain complete details on the candidate´s general context. -The candidates may submit a **Self-assessment Questionnaire/Grid**, a document in which they evaluate themselves against the established requirements. Thanks to this questionnaire, candidates can make a direct comparison of their experience against Learning Outcomes established for the selected AM Professional Profile, identifying both their knowledge, skills and experience and the contexts in which they were obtained, and ultimately providing detail on the information presented in the mandatory documents.

Co-funded by the Erasmus+ Programme of the European Union

This project has been co-funded with support from the European Commission. This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

related to the professional and non-professional degrees and experiences identified in the AM Professional and Training Registration form, and which will therefore be made up of diplomas , certificates and, in general, documents accrediting the information presented. - As a result of a non-conclusive analysis of information on the next stage of the process (Recognition Step), **ATB could ask the candidate for clarifications on the presented information or for additional documents**.	Although this document is not evaluable in itself (it does not ensure that the candidate can see validated Competence Units) it is highly useful for examiners, since it facilitates the interrelation of all the evidence presented by the candidate, and further increases the objectivity of the process. A format is proposed according to Annex 4 of this document. - Although not a document, the candidate may be called by the ATB for a **Personal Interview if this action is required, as a result of a non-conclusive analysis of information on Recognition step** (next stage of the process, see chapter 3.3), in which the information provided may be reviewed on-site, and additional evidence on its characteristics may be obtained. A form is proposed according to Annex 3 of this document.

3.4. Recognition

Once the required documentation has been supplied by the candidate, at this step ATB technicians responsible for the process will carry out the relevant checks, aimed at:

- Verifying that the information and documentation presented by the candidate has been formally presented in full, and if not, request the missing information from the candidate.

- Verifying the validity of the evidence provided by the candidate, through analysis and verification of the CV Portfolio provided.

- Evaluating the compliance of said information and documentation (the information collected in a Personal Interview will be taken into account if this has taken place) and therefore, of the knowledge, skills and experience required by the selected AM Professional Profile.

ATB technicians will use checklists to assess compliance with the requirements established for each of the profiles; this guide proposes forms for that purpose, according to annexes 5 and 6 of this document.

If during this review process doubts would arise not allowing the ATB to reach a conclusion on the fulfilment of the candidate's selected AM Professional Profile requirements, the process would return to the previous stage (Identification and Documentation), either to request clarifications or additional documentation from the candidate, or to call for a personal interview that would clarify doubts or expand information (or both actions).

Co-funded by the Erasmus+ Programme of the European Union

This project has been co-funded with support from the European Commission. This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

3.5. Assessment

On this step of the process, the selected **Examination Board will assess whether the candidate has earned the expected Learning Outcomes (LOs) for the selected AM Professional Profile**. Here a differentiation between de different learning routes of the candidates must be done:

- **For candidates having followed a standard or blended route** (see 3.2). The examination will consist on two tools:

    - A written exam/test, formulated on the basis of single or multiple-choice questions.

    - An AM demonstration (practical test). Ideally, this activity would be conducted in the candidate's workplace, in order to facilitate the demonstration of abilities and skills, relying on the documentation generated and the work done in the candidate´s own work context. This document proposes an example for conducting AM demonstrations, as presented in annexes 8 and 9.

  The results of both tests will be evaluated by Competence Unit, so that in order to consider each of them passed, the candidate must achieve a minimum score of 60%. Incomplete or incorrect answers will be valued with a 0, while the correct answer will be valued with the maximum score corresponding to the question.

- **For candidates having followed an alternative route** (see 3.2):

    - As in this case the candidate has not passed through a route that could demonstrate the completion of the required Competence Units (standard or blended), the examination will begin with a technical interview. This will consist of an oral exam, where the candidate will be asked questions of a technical nature, directly related to the expected Learning Outcomes for the selected AM Professional Profile. This document proposes possible guidelines for conducting the technical interview, as presented in annex 7.

      The results of the interview will be evaluated by Competence Unit, so that in order to consider each of them passed, the candidate must achieve a minimum score of 50%. Incomplete or incorrect answers will be valued with a 0, while the correct answer will be valued with the maximum score corresponding to the question posed (see interview-scoring sheet in the Excel AM Technical Interview document).

    - **Whenever the candidate has earned the minimum scores on the technical interview**, the next stage will be going through the same tests identified for candidates coming from standard o blended routes, this is, a written exam/test and an AM demonstration (same conditions related to minimum scores apply)

Co-funded by the Erasmus+ Programme of the European Union

This project has been co-funded with support from the European Commission. This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

Ideally, all the process would be conducted in the candidate's workplace, in order to facilitate the demonstration of abilities and skills, relying on the documentation generated and the work done in the candidate´s own work context.

3.6. Qualification

The use of the above tools will lead to the candidate obtaining a result for each of the Competence Units, leading to the last step of the process. This last step will take place based on three successive actions, managed by the **Examination Board**:

- Test results evaluation: assigning a score for each of the Competence Units under examination.
- Decision-making and communication: final evaluation of the results and communication to the candidate.
- Opening of an appeals period: the candidate will be given the opportunity to disagree with the decisions taken and to opt for a review process, if appropriate.

This process step will lead to the **issuance of a diploma** by the ANB, under one of the following modalities:

- Full Diploma. The candidate has obtained the minimum score in each one of the Competence Units.
- Partial Diploma. The candidate has obtained the minimum score in specific Competence Units.
- Unitary Diploma. The candidate has obtained the minimum score in a single Competence Unit.

In cases in which the candidate has not obtained the minimum required score in any of the Competence Units, no diploma of any kind will be issued.

An overview of the accreditations obtainable for each of the established profiles can be consulted by reviewing Table 3, included previously, and which correspond to the overcoming of the Competence Units for each profile.

4. SUPPORTING TOOLS IN DETAIL

Throughout the description of the previous steps, a series of tools have been referred to, which are now presented in detail in the following subsections:

4.1. Basic Evidence Extraction Tools

When carrying out the described RPL process, there are a series of fundamental tools when it comes to extracting evidence, documenting and presenting it. Let's see the most important ones below:

Co-funded by the Erasmus+ Programme of the European Union

This project has been co-funded with support from the European Commission. This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

- Written exams and tests. These tools are of help when evaluating the theoretical knowledge acquired by a candidate, although by themselves may not be sufficient to show all their capabilities, especially in areas where such knowledge is implementable at an eminently practical level, as is the case of manufacturing.

- Conversational methods. Interviews are supporting tools to increase understanding of a candidate's previously documented knowledge and skills. This tool also has a structuring function of said knowledge and skills, as it is possible to review and corroborate them based on an interview scheme carefully defined beforehand. Thus, to fulfil its function effectively, the application of this tool requires the previous definition of a methodological guide, which serves as the basis for conducting the interview.

- Declarative methods. This tool takes advantage of the candidate's own ability to transparently identify and describe aspects of their knowledge, skills and experience, so tools such as the Curriculum Vitae or self-assessment questionnaires can play a relevant role. These tools are of great importance for evaluators, for whom these documents constitute means of contrasting all the information available, based on the guide provided by the candidate.

- Observations and evidences on practical activities. When the knowledge and skills to be evaluated have a practical application, observing the candidate during the assignment and carrying out of application cases/demonstrations allows the collection of additional evidences.

Given the characteristics of the process described in this guide, the above tools may be implemented during several of the steps described, although they are fundamentally linked to the Identification and Documentation step and the Qualification step

In subsequent sections, the tools cited throughout the document are compiled and described in more detail.

4.2. Identification and documentation Tools

1. AM Professional and Training Form (Mandatory)	
This document correlates the most relevant aspects of the candidate's professional career, related to the AM profile to which the candidate is applying. Thus, this document will correlate aspects such as the jobs and organizations in which they were held, as well as the requirements demanded by these jobs and the performed functions. In support of the candidate, the form will contain a list of the different types of documents that could act as evidence of compliance with the knowledge and skills required by the selected AM Professional Profile. The information reflected in this document, in conjunction with that included in the document "AM Professional and Personal Motivation Form", also provides information for the preparation of a Personal Interview with the candidate, if it is deemed necessary.	
Proposed form:	See **annex 1** of this document

Co-funded by the Erasmus+ Programme of the European Union

This project has been co-funded with support from the European Commission. This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

1. AM Professional and Training Form (Mandatory)	
Suited for:	**Candidates**

2. AM Professional and Personal Motivation Form (Mandatory)	
This document is focused on identifying candidate´s motivations to embark on the validation process, as well as detecting interests at a technical level and, ultimately, attitudes and expectations towards the qualification and AM Professional Profile that they intend to obtain. The information reflected in this document, in conjunction with that included in the document "AM Professional and Training Form", also makes it possible to gather complete information for the preparation of a Personal Interview with the candidate, if it is deemed necessary.	
Proposed form:	See **annex 2** of this document
Suited for:	**Candidates**

3. AM Interview Guider (Optional)	
The Personal Interview is a commonly used tool in any selection and evaluation process in the training and professional fields, and as such, it can be in this case an important tool to complement the information from the (mandatory) documents "AM Professional and Training Form" and "AM Professional and Personal Motivation Form". The Personal Interview is an optional tool, which in any case is recommended as a mean to achieve the maximum understanding of the documents provided. The interview may take place in a semi-structured or structured way. In both cases, this RPL guide proposes Annex X as an interview script. The Personal Interview could be performed as far as possible in the candidate's workplace, where the candidate's ability to demonstrate his knowledge and skills based on his own application cases is a benefit for the process.	
Proposed form:	See **annex 3** of this document
Suited for:	**ATB** in coordination with the candidate

4. Self-Assessment Grid (Optional)	
Through this document the candidate will carry out a self-diagnosis, a tool to compare their own knowledge, skills and experiences with the Standard Learning Outcomes identified for the AM Professional Profile to which they aspire, identifying the context in which they were acquired, either through professional or training activities. Although its completion is optional for the candidate (and therefore it is a document that can be consulted by the ATB, but not evaluated), this document has a potentially high value in providing consistency and integrity to the information provided by the candidate in the documents “AM Professional and Training Form” and “AM Professional and Personal Motivation Form”.	
Proposed form:	See **annex 4** of this document
Suited for:	**Candidates**

4.3. Recognition Tools

Co-funded by the Erasmus+ Programme of the European Union

This project has been co-funded with support from the European Commission. This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

1. Port-Folio Check-list (Mandatory)	
Once the candidate has presented all the documentation, and (when appropriate) the Personal Interview has been conducted, all the available information will be analysed, in an activity aimed at evaluating the sufficiency of the presented evidences. In the event that said information is incomplete, or errors are detected, the candidate will be contacted to collect the remaining information or correct the erroneous data. This technical review process will be carried out through a checklist, with a structure very similar to tool 4 (Self-Assessment Grid) described in the previous step.	
Proposed form:	See **annex 5 and 6** of this document
Suited for:	**ATB**

4.4. Assessment Tool

1. Technical Interview Guide	
This document is the basis for conducting the technical interview, a vital instrument when finding out if a candidate coming form an alternative learning route has the knowledge and skills necessary to tackle the final tests of the process. Thus, the interviewers (at least two are recommended) will use this guide as a mean of evaluating the result of the candidate's interview. The results of the interview will be evaluated by Competence Unit, so that in order to consider each of them passed, the candidate must achieve a minimum score of 50%. Incomplete or incorrect answers will be valued with a 0, while the correct answer will be valued with the maximum score corresponding to the question posed (see interview-scoring sheet in the Excel AM Technical Interview document).	
Proposed form:	See **annex 7** of this document
Suited for:	**Examination Board**

2. AM Demonstration	
AM Demonstrations are aimed at evaluating the candidate's knowledge and skills through the development of an application case study, selected by the examiner, in which the candidates must demonstrate their ability to apply the knowledge and experience required by the selected AM Professional Profile. Each AM Demonstration will make use of an evaluation grid so that the examiner (who can be a trainer) can record the candidate's results in each of the assigned tasks. Each of these tasks is made up of a series of evaluation criteria; the candidate must meet at least half of these criteria to see a task validated.	
Proposed form:	See **annex 8 and 9** of this document
Suited for:	**Examination Board**

Co-funded by the Erasmus+ Programme of the European Union

This project has been co-funded with support from the European Commission. This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

3. Written Test and Examination	
The candidate will be required to undergo a written examination, which will consist of a series of single or multiple answers questions, the length and duration of which will depend on the number of Competence Units included in the exam. The results of the test will be evaluated by Competence Unit, so that in order to consider each of them passed, the candidate must achieve a minimum score of 60%. Incomplete or incorrect answers will be valued with a 0, while the correct answer will be valued with the maximum score corresponding to the question.	
Proposed form:	N/A
Suited for:	**Examination Board**

This project has been co-funded with support from the European Commission. This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

5. Annexes

Annex 1 – AM Professional and Training Registration form

Annex 2 – AM Professional and Personal Motivational form

Annex 3 – AM Interview guide

Annex 4 – Self-assessment grid

Annex 5 – Portfolio Check-list

Annex 6 - Portfolio technical review document

Annex 7 – Technical Interview guide

Annex 8 – AM Demonstrations

Annex 9 - Preliminary AM Work order form

Co-funded by the
Erasmus+ Programme
of the European Union

This project has been co-funded with support from the European Commission. This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

5.1. Annex 1. Additive Manufacturing professional and training registration form

1. PERSONAL DATA

Name_____

Identification card number _____
valid until ____ / ____ /____ , issued by_____

2. IDENTIFICATION OF THE HIGHEST EDUCATION OR TRAINNG LEVEL

Qualification/ Course_____

Grade awarded _____Level of Qualification (EQF)_____

3. IDENTIFICATION OF PROFESSIONAL TRAINING

(Describe the main training acquired. You should describe the training courses taken, both in training entities and companies, as well as internships, seminars and other events that you deem relevant).

Date of realisation (*)	Name of the Training Activity/Course	Provider	Total duration (in hours)	Grade awarded	Acquired Knowledge	Evaluation methods (ex: project, tests)

Co-funded by the Erasmus+ Programme of the European Union

This project has been co-funded with support from the European Commission. This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

(*) From the most recent to the oldest.

This project has been co-funded with support from the European Commission. This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

4. IDENTIFICATION OF PROFESSIONAL ACTIVITIES

(Describe all the jobs you have had so far, regardless of whether they are related to the application for certification. It is important that you describe your entire career path. In this field, you should mention only your employment experience).

Period (*)	Duration (years/ months)	Employer/ Company (**)	Branch of Activity	Professional Category	Positions held	Tasks/ Responsibilities (***)
From:__/__/__ To: __/__/__						
From:__/__/__ To: __/__/__						
From:__/__/__ To: __/__/__						
From:__/__/__ To: __/__/__						
From:__/__/__ To: __/__/__						
From:__/__/__ To: __/__/__						

Co-funded by the Erasmus+ Programme of the European Union

This project has been co-funded with support from the European Commission. This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

From:__/__/__ To: __/__/__						
From:__/__/__ To: __/__/__						
From:__/__/__ To: __/__/__						

Co-funded by the
Erasmus+ Programme
of the European Union

This project has been co-funded with support from the European Commission. This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

(*) From the most recent to the oldest.

(**) In this field you should also mention the self-employment experience.

(***) In this field you should include information about conditions of work performance: a) Information received to carry out the tasks - type of information, who gives it and how it is transmitted; b) Information transmitted to others in the course of their tasks - what kind of information it gives, whom, how and why it does it; c) Professional relations with the outside of the company, for example, with clients or suppliers; d) Control of your work (by whom, how and when this is done, who decides the organization of your work).

5. IDENTIFICATION OF NON-PROFESSIONAL ACTIVITIES/ EXPERIENCES

(Indicate the information that you consider useful for the evaluation of your professional experience. You should mention in this field the activities/ tasks/ functions performed on a voluntary basis).

Identification of work developed	Duration (years/ months)

6. Other relevant info (e.g. languages proficiency, certifications, licenses, etc)

Languages proficiency	
ICT proficiency	
Certifications/Licenses	
Other:	

7. Attachments (Checklist of proofs)

(You should seek to gather evidence to demonstrate that you are able to perform the tasks you have pointed out)

8. Remarks

_____
_____
_____
_____

5.2. Annex 2. Additive Manufacturing Professional and Personal Motivational Form

Name _____

_____

Identification card number _____ Expiration date ____ / ____ / _____

Attitude towards application

• What reasons led you to enrol in a validation of competences' process?

• What do you expect to achieve with this process?

- From the areas listed below and based on your experience, please indicate areas you have higher and lower preference. The non-ticking of an area means that it is not of your preference:

Additive Manufacturing Areas		Higher preference	Lower preference
	AM processes and equipment		
	Materials		

AM Designer	AM construction strategies and design		
	Fabrication, applications engineering		
	Manufacturing strategies		
	Pieces build-up		
AM Inspection	Quality Assurance/Quality Control		
	Testing of pieces and reporting		
AM Supervision	AM processes and equipment		
	AM designs and strategies		
Manufacturing processes	Laser processing		
	Layer thickness		
	Manufacturing platform level		
	Powder quantity		
	Optimization of working area		

5.3. Annex 3. AM Interview guide *(Optional)*

A. Explain the purpose of the interview
(remark: The interview shall be used when the information gathered is not enough to properly document the candidate experience)

B. What is the intended aim of the validation of skills previously acquired

C. Education background
- Reasons for choosing the course
- Areas/subjects of higher and/or lower preferences and their reasons
- Areas/subjects with less or with greater difficulty of accomplishment and their reasons

D. Training activities, professional qualification courses, workshops, etc.
For each one of the courses attended, ask the candidate about:
- Reasons for attending the course
- Reasons for dropping out of the course, if applicable
- Usefulness of each of the training activities
- Preferred tasks/subjects and their reasons
- Tasks/ themes less preferred and their reasons
- Tasks/ topics where you had /have greater difficulty of accomplishment and their reasons
- Tasks/ topics where you had /have less difficulty of accomplishment and its reasons

E. Professional career
For each one of the professional positions, ask the candidate about:
- Reasons for choosing activity
- Reasons for the completion of the activity
- Preferred tasks/subjects and their reasons
- Less preferred tasks/ themes and their reasons
- Tasks/ themes where you had/ have greater difficulty of accomplishment and their reasons
- Tasks/ topics where you had/ have less difficulty of accomplishment and their reasons
- Concerning additive manufacturing:
    - Knowledge about AM
    - AM processes/technologies used (DED-Arc, DED-LB, PBF-LB, other)
    - Materials used (carbon steel, stainless steel, aluminium alloys, other)
    - Type of product used

F. Non-professional activities/ experiences

For each one of the activities/ experiences, ask the candidate about:

- Reasons for choosing that activity
- Reasons for the completion of the activity
- Preferred tasks/ subjects and their reasons
- Less preferred tasks/ themes and their reasons
- Tasks/ themes where you had/ have greater difficulty of accomplishment and their reasons
- Tasks/ topics where you had/ have less difficulty of accomplishment and their reasons

G. Experience by AM areas of activity

- Identifying areas of more and less interest (ask for concrete examples of daily life that support the self-assessment)
- Ask the candidate to rank the interests in order of experience

5.4. Annex 4. Self-assessment grid *(optional)*

(Example for CU 00 – Additive Manufacturing Processes Overview)

EWP LOs Standard	Self-assessment grid (Optional)			
To be used as reference for RPL process	Date and Place:			Candidate Name and Surname:
	With my signature I confirm the authenticity of the information and attachments:			
ACTIONS	**PROFESSIONAL EXPERIENCE**	**CERTIFICATE or DIPLOMA**	**N.A**	**EVIDENCES**
Competence Unit 00 - Additive Manufacturing Processes Overview	Indicate where you gain knowledge and skills to perform the action (to fill with a short description)			List the relevant evidence (e.g. Operator certificate, recommendation letter, etc.)
00.1. Distinguish parts produced by different AM processes				
00.2. Recognize the advantages and limitations of AM processes from a manufacturing chain point of view				
00.3. Identify the applicability of different AM processes, according to the characteristics of each process				

5.5. Annex 5. AM Check-list portfolio - Operator

Candidate name and surname:		
Compliance with requirements for applying Recognition of Prior Learning Scheme (*[1]) (to be filled in by the Authorised Training Body - ATB)	Yes	No
Min. 2 years' experience as AM operator in the industry		
Min. 2 year job function as AM Practitioner in the industry, namely in coordinating AM personnel and tasks		
Min. 2 year job function as Metal Practitioner in the industry		
The candidate fulfils the access requirements		
ATB Signature_____Date and place_____		

(*[1]) The ATB should verify the authenticity and validity of the evidences, as well as the compliance with the entry requirements.

AM Check-list portfolio – AM Metal Designer

Candidate name and surname:		
Compliance with requirements for applying Recognition of Prior Learning Scheme (*[1]) (to be filled in by the Authorised Training Body - ATB)	Yes	No
Min. 2 years' experience as AM Metal Designer in the industry		
Min. 2 year job function as AM Designer in the industry, namely in coordinating AM personnel and tasks		
Min. 2 year job function as Metal Designer/FEA Calculator/FEA Simulator in the industry		
The candidate fulfils the access requirements		
ATB Signature_____Date and place_____		

AM Check-list portfolio – Supervisor

Candidate name and surname:		
Compliance with requirements for applying Recognition of Prior Learning Scheme (*[1]) (to be filled in by the Authorised Training Body - ATB)	Yes	No
Min. 2 years' experience as AM Supervisor in the industry		
Min. 2 years´ job function as AM Supervisor in the industry, namely in coordinating AM processes and costs		
Min. 2 years´ job function as Metal Supervisor, costs controller and manufacturing procedure controller in the industry		
The candidate fulfils the access requirements		
ATB Signature_____Date and place_____		

AM Check-list portfolio – AM Metal Inspector

Candidate name and surname:		
Compliance with requirements for applying Recognition of Prior Learning Scheme (*[1]) (to be filled in by the Authorised Training Body - ATB)	Yes	No
Min. 2 years' experience as AM Metal Inspector in the industry		
Min. 2 year job function as AM Inspector in the industry, namely in coordinating AM personnel and tasks		
Min. 2 year job function as Metal Inspector/Testing-Analysis Performer		
The candidate fulfils the access requirements		
ATB Signature_____Date and place_____		

Type of documents	Yes	No

Additive Manufacturing Professional and Personal Motivations Form (*[2])		
Additive Manufacturing professional and training registration form (*[2])		
Self-assessment grid		
School diplomas (*[2])		
Diplomas for training courses (*[2])		
Diplomas of participation in seminars		
Certification documents (*[2])		
Performance evaluations		
Statements from previous employers		
Previous job descriptions (*[2])		
Recommendation Letters		
Photography's/videos related with performed jobs		
Awards/ rewards		
Report about AM Demonstrations (*[2])		
Result of the Technical Interview (*[2])		
Others. Which? _____ _____		

(*[2]) The presentation of these documents is mandatory

5.6. Annex 6. Portfolio technical review document – CU 00

EWP LOs Standard	Technical Review of Portfolio		
To be used as reference for RPL process	Authorized Training Body (ATB) identification		
	Date and Place:		
	In the portfolio assessment, the ATBs should identify candidate knowledge and skills in each CU		
ACTIONS			
Competence Unit 00 - Additive Manufacturing Processes Overview	**YES**	**NO**	**REMARKS**
00.1. Distinguish parts produced by different AM processes			
00.2. Recognize the advantages and limitations of AM processes from a manufacturing chain point of view			
00.3. Identify the applicability of different AM processes, according to the characteristics of each process			

5.7. Annex 7. Technical interview guide

(Example of questions for the CU 00 - Additive Manufacturing Processes Overview)

Scores: Candidate must obtain at least 50% of the scores to successfully pass the test.

Technical Interview Guide								
Authorized Training Body (ATB) identification:								
Date and Place:								
After the Portfolio analysis, a technical interview is conducted with focus on the key actions addressed in each CU. To be approved in the interview, the candidate has to score at least 50% in each CU.								
ACTIONS/SKILLS		QUESTION	ANSWER			SCORING	WEIGHTING	NEXT STEPS
Competence Unit 00 - Additive Manufacturing Processes Overview								Validation
Mark the boxes below of "Answer Box" with an "X" where it corresponds (*C or I or IC*), depending on the answer provided by the candidate. ➢ **C**: Correct Answer (1 point) / **I**: Incorrect Answer (0 points) / **IC**: Incomplete Answer (0.5 points) ➢ **Q**: Question / **A**: Answer			C	I	IC			
A1. Distinguish parts produced by different AM processes	1	**Q**: *Tell 2 main visual characteristics of parts produced by PBF-LB* **A**: The 2 main visual characteristics of parts produced are the roughness on the own piece printed, and support/scaffold marks that could be possible to find on piece surface.					**1**	
A2. Recognize the advantages and limitations of AM processes from a manufacturing chain point of view	1	**Q**: *Regarding DED-Arc, PBF-LB and PBF-EB technologies, which of them requires less post-processing tasks? Why?* **A**: PBF-EB is the technology that requires less post-processing due it is the technology that has less number of supports/scaffolds and, in many other cases, does not need them.					**1**	
A3. Identify the applicability of different AM processes, according to the characteristics of each process	1	**Q**: *Which of the DED-Arc, PBF-LB and PBF-EB technologies is the most suitable on to print out a piece/part of more than 1m³? Why?* **A**: DED-Arc is the most suitable technology to print out a piece of 1m³ of volume due it is the technology with the highest deposition ratio as well as it is a technology that could be attached to a large scale machines.					**1**	
						CU 00 Σ candidate score	**3**	

5.8. Annex 8. AM demonstration

<table>
<tr><td>NQF level:
EQF level:</td><td>Qualification: European Additive Manufacturing Operator</td></tr>
<tr><td>Candidate name:</td><td></td></tr>
<tr><td rowspan="3"></td><td>Practical exercise to be used during the Additive Manufacturing Demonstration (AMD)</td></tr>
<tr><td>Additive Manufacturing Integral machine and work preparation</td></tr>
<tr><td></td></tr>
<tr><td>1. GOAL</td><td>The candidate for the Operator Professional Profile, must demonstrate his/her technical skills acquired during the training sessions developed as well as his/her prior knowledge in this matter (if he/she has it) in the case of preparing the AM machine, materials and works, in order to accomplish with a real AM work.</td></tr>
<tr><td>2. DURATION</td><td>Demonstration will be developed in 3 days, divided in the different CUs that the candidate wants to successfully pass:

Day 1

Duration of 1-1.5 hours, expended in machine preparation and commissioning of the manufacturing works related.

During this day, CUs evaluated will be the indicated below

<table>
<tr><td>Evaluation of CU 15</td><td>Evaluation of CU 18</td><td>Evaluation of CU 48</td></tr>
<tr><td>Evaluation of CU 16</td><td rowspan="2">Evaluation of CU 21</td><td rowspan="2">Evaluation of CU 49</td></tr>
<tr><td>Evaluation of CU 17</td></tr>
</table>

Day 2</td></tr>
</table>

	Duration of 1-1.5 hours, expended in taking out the piece/s manufactured from the AM machine, and in addition, applying thermal treatment to piece/s removed. During this day, CUs evaluated will be number *19* Day 3 Duration of *1-1.5 hours*, expended in the cutting out procedure of the piece/s from the manufacturing platform, removing manufacturing supports task and blasting tasks. During this day, CUs evaluated will be number *20* **If the candidate wants to obtain the full qualification/diploma awarding, related to all CUs involved in, he/she must assist to the 3 sessions explained previously. In the case of Day 1, candidate can apply for evaluation of just one CU, a few CUs or all CUs.
3. RESOURCES (equipment, materials, tools, etc)	▪ Additive Manufacturing Machine (EOS machine) ▪ Thermal treatment furnace. ▪ Cutting saw. ▪ Further tools to remove manufacturing supports by hand. ▪ Blasting devices. ▪ Sieve device. ▪ PPEs: work clothes, safety boots, safety glasses, protection gloves, breathing mask. ▪ Annex 9. Preliminary AM work order form
INSTRUCTIONS (these instructions can/or not be available for the candidate)	Examiner instructions: provide to the candidate work routes and manufacturing files. *Day 1* (CUs 15-16-17-18-21-48-49) ▪ To check out the candidate uploads properly manufacturing files at the manufacturing machine.

<table>
<tr><td></td><td>

- To check out the candidate uses the recoater, material and right machine parameters to be used with the manufacturing machine in each different case.
- To check out the candidate uses the manufacturing platform and also, levels the platform properly at the machine.
- To check out the candidate controls powder feeding, and if powder is sieving properly.
- To check out the candidate is wearing and using all PPEs indicated.

Day 2 (CU 19)

- To check out the candidate performs the removing piece/s procedure properly.
- To check out the candidate applies the suitable thermal treatment, depending on the material used in the manufacturing.
- To check out the candidate is wearing and using all PPEs indicated.

Day 3 (CU 20)

- To check out the candidate removes properly manufacturing supports from piece/s.
- To check out the candidate blasts piece/s properly.
- To check out the candidate is wearing and using all PPEs indicated to this task.

</td></tr>
<tr><td></td><td></td></tr>
<tr><td>5. ASSESSMENT GRID (performance during the AM demonstration</td><td>
<table>
<tr><td>Weighting</td><td>10</td></tr>
<tr><td>1. Time spent in the execution</td><td>/0.8</td></tr>
<tr><td>2. Compliance with health and safety rules</td><td>/0.7</td></tr>
<tr><td>3. Ability to take decisions and solve problems</td><td>/0.5</td></tr>
<tr><td>4. Work planning</td><td>/1</td></tr>
<tr><td>5. Compliance with the appropriate sequence of work</td><td>/1</td></tr>
<tr><td>6. Adequate demonstration of conceptual and technical knowledge</td><td>/1.5</td></tr>
</table>
</td></tr>
</table>

	7. Selection and correct use of spaces, equipment, tools and materials	/1
	8. Skill to perform the task	/0.5
	9. Optimization of time and materials	/1
	10. Innovation/creativity	n.a
	11. Quality of the final product/result	/2
	12. Team work ability	n.a

5.9. Annex 9. Resources

Preliminary AM Work order form

Launch Order Requirements					
Work Order Number:		Created by:		Date:	
Order Quantity:		Revised by:		Date:	
Launch Date:		Approved by:		Date:	
Delivery Date:		Denied by:		Date:	

Manufacturing Order Pre-Checks / BOM			
Raw Material Nº			
Layer Thickness			
Lot Reference Nº			
Powder Quantity		Quantity per part	
Gas			
Gas Quantity			
Filters			
Filter Reference H09			
Filter Reference H13			
Machine ID			
System Nº		Serial Number	
JobReport			
Job ID			
EventsReport			
Job ID			

Manufacturing Files Report			
Part file reference		Created by:	
		Revised by:	
		Approved by:	
		Denied by:	
PSW file reference		Created by:	
		Revised by:	
		Approved by:	
		Denied by:	

Manufacturing Process Control Plan					
Nº	**Operation**	**Operation Description**	**Operator**	**Launch Time**	**End Time**
Machine Start-up checks / Pre-Processing					
1	Overall Cleaning	Proceed to an overall cleaning pay attention to avoid contamination.			
2	Recoater Check & Cleaning	Check Recoater mint condition and Proceed to deep clean.			
3	Filter Installation	New Filters required, please register their reference.			
4	Lens Cleaning	Manufacturer procedure.			
5	Building Plate Fix	Building plate not less than 30mm.			
6	Powder Fill	Add register their LOT reference and fill for full quantity required.			
7	Check the powder compaction.	Manufacturer procedure.			
Machine Operation Parameters					
1	Levelling	Manufacturer procedure.			
2	Purge	Manufacturer procedure.			
Machine Exposure Parameters					
1	Check File name				
2	Layer Thickness				
3	Parameter Exposures				
Post-Processing					
1	Remove powder	Manufacturer procedure.			
2	Remove Platform	Manufacturer procedure.			
3	Photo Report	Take pics from visual defects (if present) and overall appearance			
4	Prepare for Ship to.....	Require shipping address to			
5	Receive Incoming package	Advice ..... to check the integrity prior continue.			
6	Remove part from Building Plate	Standard procedure			
7	Remove Support Structures				
8	Blasting				
9	Prepare for Ship to.....	Require shipping address to			