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Recognition of Prior Learning: an agile mechanism for upskilling in the field of additive manufacturing

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Summary

The SAM Project[4] (Sector Skills Strategy in Additive Manufacturing) is addressing the need at a European level to develop an effective system to identify and anticipate the right skills for the demands of the Additive Manufacturing (AM) sector, in response to the growing needs of the labour market. In this context, one of the main challenges is, in addition to developing accreditation schemes based on training pathways, to recognise and validate the skills of professionals currently working in AM fields. SAM contributes to the recognition of these professionals, through the introduction and validation of Recognition of Prior Learning (RPL) methodologies within the AM training and accreditation scheme promoted by the European Welding Federation[5], the IAMQS[6] (International Additive Manufacturing Qualification System).

1. The challenge of finding the right skills-set when technological progress is highly disruptive as in the additive manufacturing field

The possible pathways when an organization aims at "ensuring" novel skills among their staff are quite evident: train current personnel and/or hire new personnel who already have those skills. Both alternatives can be achievable as long as skills are easily recognizable, through clear and identifiable training, qualification and accreditation schemes. However, when these skills are related to disruptive technological and/or methodological advances, difficulties arise. Being one of the key manufacturing advances in the last decades, AM currently faces this issue as one of the most important barriers for its full exploitation.

AM is a technology with incredible capabilities, derived from the possibilities of manufacturing directly from a 3D file, the growing base of technology providers and materials, the increasing amount of success stories around them, etc., with potential use in any organization that develops and/or manufactures products. Despite these characteristics, a detailed approach to the different AM technologies reveals different levels of complexity, and beyond some conceptual common points between the 7 groups of technologies currently recognized by the ISO/ASTM 52900[7] standard, the differences between the specific technologies can be very significant. This applies to the technologies/machines themselves, their manufacturing capabilities, the design rules of

[1] IDONIAL Technology Centre. For more information, follow this link.
[2] EWF, European Welding Federation. For more information, follow this link.
[3] École Centrale de Nantes. For more information, follow this link.
[4] Sector Skills Strategy in Additive Manufacturing, SAM. For more information, follow this link.
[5] European Welding Federation. For more information, follow this link.
[6] IAMQS - International Additive Manufacturing Qualification System. For more information, follow this link.
[7] ISO/ASTM 52900:2021. Additive manufacturing_General principles_Fundamentals and vocabulary. For more information, follow this link.

application to each one of them, and finally, to the skills required to achieve and efficient implementation of one specific AM technology.

As a technological advance causing a big impact on the industry, different training initiatives have aroused around AM in recent years, but they are focused on limited and/or very specific subjects, and represent isolated efforts for providing knowledge and for generating skills on AM, lacking in recognition at levels beyond the framework that have designed and implemented them, thus most of them lack a wider, international and intersectoral recognition by industry.

2. Generating widely recognized knowledge and experience schemes around AM.

If it was exclusively taken into account what have been described in the previous sections, the outlook would be that AM holds a great potential from a technological point of view, but that the lack of wide and internationally recognizable schemes of skills can act as an important barrier for a wider and better industrial implementation. The good news is that remarkable efforts are being made to provide the market with a clear skills training, recognition and accreditation scheme around the different AM technologies. The International Additive Manufacturing Qualification System (IAMQS), for example, is being promoted and developed thanks to the impetus of the European Welding Federation (EWF[8]), with the support of its partners in the European funded projects CLLAIM[9], SAM[10] and ADMIRE[11], that are coordinated to define and develop:

- AM professional profiles, for different industrial AM technologies.
- Competence units that structure and define the required knowledge and skills for the different AM professional profiles.
- Training pathways, through which potential candidates can obtain recognition and accreditation against the defined competence units and professional profiles.
- Methodologies and tools for the training, evaluation and accreditation of candidates.
- Pilot activities, aimed at validating the identified methodologies and tools.

Thanks to these activities, EWF and its partners are producing an internationally recognizable scheme for training and accreditation around AM technologies, aligned with industrial requirements, to which training organizations will be able to associate, and which is the most important effort of standardization of the provision and the recognition of skills around these technologies at European level.

[8] European Welding Federation. For more information, follow this link.
[9] Creating Knowledge and Skills in Additive Manufacturing, CLLAIM. For more information, follow this link.
[10] Sector Skills Strategy in Additive Manufacturing, SAM. For more information, follow this link.
[11] European Master Degree in METAL ADDITIVE MANUFACTURING, ADMIRE. For more information, follow this link.

3. IAMQS: a single scheme, several pathways to develop and accredit skills in AM.

IAMQS is therefore a training and qualification system that ensures skills recognition and accreditation scheme in the field of AM. IAMQS offers a training-type pathway, which allows the trainee to:

- Identify the fields of AM in which to be trained and/or accredited, based on the different professional profiles available, for the different AM technologies covered by the system.

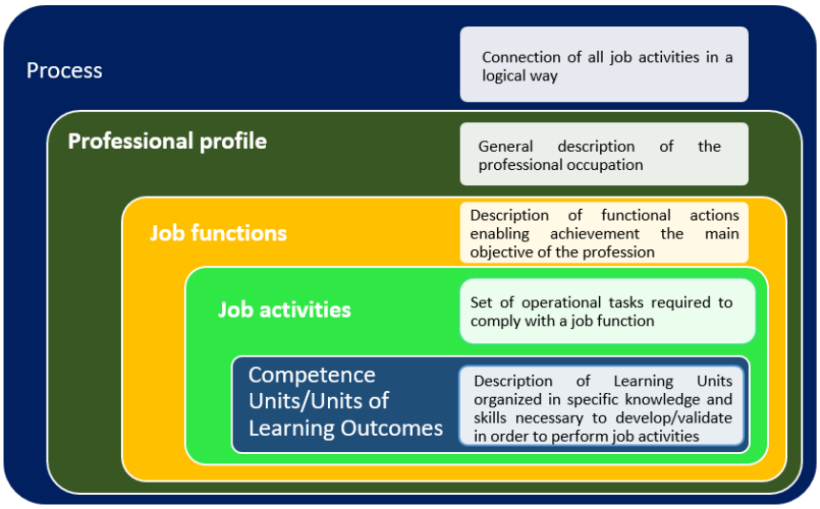

Figure 1: Definition of terms related to a professional profile[12]

- Based on the selection of a professional profile, the trainee will be trained in the related competence units, and prove, when appropriate, that he/she has earned the required theoretical and/or practical knowledge for each of them.

- Based on passing the tests and demonstrations (when applicable) for the different competence units, demonstrate having all the necessary knowledge and skills foreseen for a specific professional profile.

The progression within the IAMQS assumes that the trainee starts from low levels of prior knowledge and experience, and therefore demands that she/he will be trained on the different competence units, to undergo then an examination phase. Under this itinerary, positive evaluation for the different competence units allows the candidate to obtain partial or complete qualification for a specific AM professional profile.

[12] This diagram is extracted from the document "Definition of Professional Profiles Design & Review Process and AM Sectoral Framework to Sustain and Feed the AM Qualification System" (deliverable from SAM project). For accessing the full document, follow this link.

However, it is necessary to take into account that although AM is a discipline perceived sometimes as novel by the general public, many professionals have already developed important skills around it, based on previous training activities, based on their own professional activity, or thanks to a combination of both. In this sense, the IAMQS system contemplates a second pathway, which relies on a Recognition of Prior Learning (RPL), that is, the recognition and validation of previously obtained skills without the need to undergo a training process, in line with the same professional profiles and competence units' scheme.

Thus, under IAMQS, three possible pathways for qualification in the field of AM are contemplated:

1) Training itinerary: the trainee can be trained in the required skills for each AM professional profile and competence units, by attending courses developed around them, and by successfully passing the respective qualification exams.

2) RPL itinerary: the candidate can present and show evidences related to skills already obtained on a selected AM professional profile and competence unit/s, which may give the candidate the right to access the qualification exams, without the need to receive a prior training.

3) A “mixed” itinerary, in which the candidate can choose a Training or RPL itinerary for each competence unit, depending on the candidate´s prior level of knowledge and skills.

Especially for experienced AM professionals, the RPL pathway is therefore of high interest, as it provides a skills accreditation alternative that is able to take into account their past experience, compatible with their working activity and time availability. Of course, RPL does not exclude that the candidates can choose to undergo a training in competence units where their skills are less developed.

4. Recognition or Prior Learning within the International Additive Manufacturing Qualification System scheme.

The basic application of RPL in the context of IAMQS was originally developed in the CLLAIM project for the Metal AM Operators, Designers and Supervisors, and later on refined in the SAM project for the Metal AM Engineer Profile. The following diagram shows the main phases of the process:

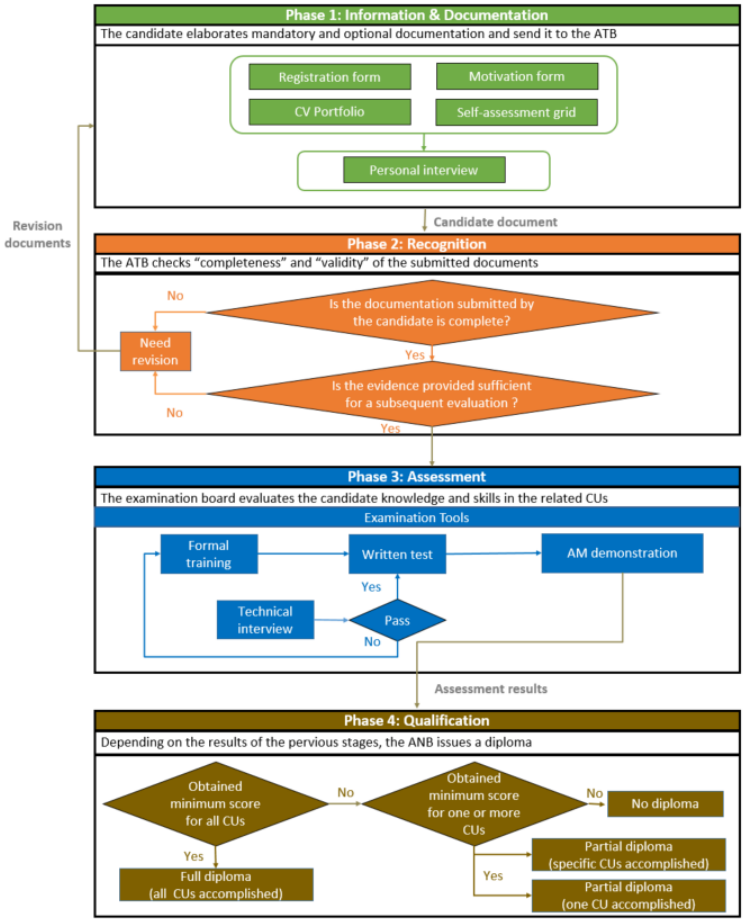

Figure 2: RPL Scheme and phases[13]

Taking into account that the previous scheme is applicable for each competence unit, the fundamental steps can be summarized as follows:

- Phase 1: Information and documentation. To access the process, the candidates must provide (to an authorized training body, ATB, authorized to provide training within the IAMQS scheme) with sufficient information to evaluate their profile. In this way, the candidate provides data and documentation on previous background in relation to the profiles and competence units to which the candidate is applying.

- Phase 2: Recognition. The information provided in the previous phase is evaluated by the ATB, determining if the candidate can access the accreditation process via RPL, or if the candidate must take the training courses that correspond to each competence unit in which the previous knowledge and experience shown by the candidate may be evaluated insufficient.

- Phase 3: Assessment. If as a result of the previous phase the candidate has been considered suitable for being assessed under a RPL itinerary for a specific competence

[13] This diagram is extracted from the document "Definition of Professional Profiles Design & Review Process and AM Sectoral Framework to Sustain and Feed the AM Qualification System" (deliverable from SAM project). For accessing the full document, follow this link.

unit, the candidate is subjected to a technical interview, based on a questionnaire that is specific to each competence unit. Passing successfully the interview entitles the candidate to take the written accreditation exam for said competency unit (as well as the practical demonstration, if demanded by the competence unit as part of the process); not being passed in the interview would lead to a recommendation for the candidate to undergo a training itinerary for said competence unit.

- Phase 4: Qualification. This is a common stage for any of the pathways, in such a way that:

    - The overcoming of each competence unit will provide the candidate with a partial accreditation for the correspondent competence unit.
    - A complete accreditation for a professional profile is obtained when all the competence units for that professional profile are overcome.

5. IAMQS and RPL as a recognition and accreditation option for current professionals in additive manufacturing.

New technologies traditionally pose challenges when it comes to creating training paths and alternatives for skill recognition. Schemes exclusively focused on mandatory training activities, which are key options for accessing a qualification, are insufficient nowadays, at a time in history when technology advances are fast and with many ramifications, that these schemes alone can´t satisfy the demands, either for skills creation, but especially for skills recognition. Besides, the number of professionals accumulating skills in AM through direct experience in work environments is consistently growing. Fortunately, a scheme such as IAMQS provides an additional RPL itinerary, capable of providing these professionals with a more direct path to obtaining skills recognition and a professional profile accreditation.

Final remarks

As previously described, SAM project is an important initiative in the implementation of an internationally recognizable scheme for developing and accrediting skills in AM. If you want to know more about the process that has been followed to create and update IAMQS professional profiles, we encourage you to consult the public documents that have been generated in the context of the SAM project in its Work Package 3 “Methodology for developing and revising professional profiles and skills”[14].

[14] For more information of SAM project and its results, please follow this link.

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