SECTOR SKILLS STRATEGY IN ADDITIVE MANUFACTURING

WP6 Short term Scenarios - Review Professional Profiles /Qualifications and Units of Learning Outcomes

D6.3 Part II - Overall Report on coordinator piloting

Qualification/Professional Profile:

International Metal Additive Manufacturing Coordinator

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Contents

Executive summary

This report describes the results achieved with the piloting activities of the full qualification of the International Metal Additive Manufacturing Coordinator conducted for the 1st time at European level, from November 2022 to May 2023 during SAM project. It is the second part of the Report on work package 6, deliverable D6.3: Short term Scenarios - Review Professional Profiles /Qualifications and Units of Learning Outcomes - Report. The first part deals with the revision of the Metal AM Coordinator professional profile and was prepared by work package 6 leader UBRUN. This second part reports on the piloting of the revised full qualification with a reduced amount of contact hours.

The objective of the International Metal Additive Manufacturing Coordinator piloting activity within deliverable D6.3 was to test the final methodology for creating and revising professional profiles and skills, through the implementation of the International AM Qualification System, where the revised AM professional profile will be updated. Considering the results achieved from the training courses, it was concluded that the methodology applied to revise training programs and professional profiles was suitable for the purpose. The implementation of the full Metal AM Coordinator professional profile was made with reduced contact hours than the initial ones that were suggested in the guideline, as the AM Experts involved in the review of the Qualification had expressed concerns with the overall course duration. At this regard, the course was successfully implemented, which confirms that the overall course can be conducted in less time. Trainers only recommended the revision of some assessment questions and the reduction of contact hours for special competence units after the conduction of the training courses. All results and findings from the piloting activities of the Metal AM Coordinator qualification will be used for future courses of the IAMQS.

The training for the coordinator professional profile with nine competence units at advanced level was given fully virtually in 29 online sessions, and the course language was English (Three competence units promoting upskilling from independent to advanced level and five competence units at advanced level). The total of 175 teaching hours were embedded in an introductory event and a closing event. The training courses were delivered by experienced trainers in the additive manufacturing field from eight partners from the SAM consortium. The piloting included the implementation of the training courses with a final assessment supervised by the EWF, on the behalf of the International Qualification Council (IAMQC) and the collection of feedback using an online questionnaire.

An overwhelming majority of the attendees (97%) stated that they are satisfied with the course as it met their expectations. The overall feedback was very positive, and the quality of all sessions was rated high. It is no surprise that 96% of the participants would also recommend the course accordingly. Trainers identified the following best practices in the courses: usage of quizzes after each session; usage of case studies, videos, practical examples from industry or invite guest speakers; usage of pre-recorded sessions or parts of sessions combined with Q&A-sessions and usage of a variety of resources.

58 participants started in the course, that was finished by 42 participants in May 2023. The overall performance of participants, independently of their profile and background, was quite positive, based on the assessment results. 93% to 100% of the examinations were passed by the

participants. In total, 360 Record of Achievements on the single competence units and 38 Diplomas of International Metal AM Coordinator (IMAM-C) were awarded.

1. Introduction

This document describes the results achieved with the piloting activities of the full qualification of the International Metal Additive Manufacturing coordinator conducted from November 2022 to May 2023 during SAM project. It is the second part of the Report on work package 6, deliverable D6.3: Short term Scenarios - Review Professional Profiles /Qualifications and Units of Learning Outcomes - Report. The first part deals with the revision of the Metal AM Coordinator professional profile and was prepared by work package 6 leader UBRUN. This second part reports on the piloting of the revised full qualification with a reduced amount of contact hours.

The objective of the International Metal Additive Manufacturing Coordinator piloting activity within deliverable D6.3 was to test the final methodology for creating and revising professional profiles and skills, through the implementation of the International AM Qualification System, where the revised AM professional profile will be integrated. As such, the focus of the pilots is not limited to the CU content, rather foresees the quality assurance rules/procedures, such as the use of harmonised training guidelines and internationally approved questions for the assessment, which is being supervised by an external body. Based on the results and feedback achieved from participants and trainers involved in the piloting course and the final assessment, conclusions can be drawn, whether the methodology and content in the guideline is appropriate for its purpose (e.g., developing and/or enhance AM knowledge and skills) or needs to be revised.

The training for the coordinator professional profile was given fully virtual in 29 online sessions, and the course language was English. The total of 175 teaching hours was embedded in an introductory event (1.5 h) on 11th November 2022 and a closing event (0.6 h) on 25th May 2023. The training courses were delivered by experienced trainers in the additive manufacturing field from the following organisations from the SAM consortium: Patras /LMS (Greece), ISQ (Portugal), MTC (United Kingdom), POLIMI (Italy), IMR (Ireland), EC Nantes (France), IDONIAL (Spain), LORTEK (Spain). During the course it was possible to establish synergies with several companies specialized in AM processes. Those organisations were invited as external speakers to present on their technologies during the implementation of the AM Coordinator Course namely, Meltio, AddUP (Beam), Hybrid manufacturing technology Ltd, Ansys, Flow3D and Siemens (Kaizen Ltd). The organisation of the piloting course on the International Metal Additive Manufacturing Coordinator professional profile was managed by LAK (Germany) and EWF (Belgium/Portugal) and counted with POLIMI (Italy) and ISQ (Portugal) support.

The course was promoted to internals (from the SAM consortium) and externals from August to October 2022. The access criteria to the course were to hold an Engineering degree in Mechanical, Materials, Aeronautic or equivalent and knowledge on AM was checked by considering the CVs of the applicants. It was decided to approve 54 participants in the beginning of the course. 4 participants from the waiting list were added later. The piloting included the implementation of the training courses with a final assessment supervised by the IAMQS and the collection of feedback using the feedback kit developed in WP2 (Forecast methodology: assessment of current and future skills in AM). Supporting training guides, with important information were provided for participants and trainers of the course.

Out of 58 participants who started the course in November 2022, 42 participants completed the course in May 2023. During the course, the project achieved remarkable outcomes, including the attainment of more than 360 Record of Achievements for the individual competence units (CUs) and the awarding of 38 Diplomas of International Metal AM Coordinator (IMAM-C).

2. Overview on Metal AM Coordinator piloting activities

2.1. Selection and distribution of piloting contents

Within work package 6 (Implementation of SAM's final methodology for creating Professional Profiles), deliverable 6.3 (Short Term Scenarios – Review of Professional Profiles/Qualifications and Competence Units/ Training Modules) in SAM project, the professional profile of the International Metal Additive Manufacturing Coordinator (IMAMC) was revised. The outcomes are described in the first part of the report "D6.3 Part 1". During the revision process, the high number of contact hours of the entire Coordinator profile was identified as potentially critical, and various solutions were discussed. To ensure a robust and fully revised qualification, it was agreed that a piloting of the advanced version will be carried out for the revised full Qualification, and with a reduced amount of contact hours in order to undertake a proper assessment of the evaluation. This report (Part 2) focuses on the conduction and outcomes of the piloting activities.

Another objective of the piloting activities, in the point of view of the consortium, was to test the methodology through the implementation of the revised guidelines, to validate whether the process, content, structure and recommended contact hours and conducted lessons are adequate to develop skills in AM or whether these require a revision process. While from the point of participants, it was tested, if these were able to pass the final exam after attending the courses of the full professional profile, when course and assessment were both prepared based on the guideline.

Figure 1 shows the structure of the International Metal AM Coordinator Professional Profile with all competence units (CUs) and recommended contact hours after the revision process in D6.3 (see also report "D6.3 Part 1 - Short term Scenarios - Review Professional Profiles /Qualifications and Units of Learning Outcomes - Report on the Revision of the Metal AM Coordinator"). The CUs were already approved by the International Additive Manufacturing Qualification Council (IAMQC) and achieved an official CU-number. All CUs are already existing in the International Additive Manufacturing System (IAMQS). Figure 2 shows the flyer used to promote the advanced coordinator training course.

COMPETENCE UNITS	IMAMC	
	Recommended Contact Hours*	Expected Workload**
CU 00: Additive manufacturing Process Overview	3,5	7
CU 01: DED-Arc Process	42	84
CU 08: DED-LB Process	35	70
CU 15: PBF-LB Process	35	70
CU 25: Post Processing	14	28
CU 34: Process Selection	28	56
CU 35: Metal AM Integration	21	42
CU 36: Coordination Activities	7	14
CU 72: Metal Binder Jetting process	28	56
TOTAL	**185.5**	**371**

Figure 1: Structure of the International Metal AM Coordinator Professional Profile

Figure 2: Flyer to promote the SAM advanced Training course on the International Metal AM Coordinator Professional Profile

The competence units of the coordinator professional profile were distributed among partners of the SAM consortium, who prepared and conducted the courses on the respective topics. Information on the distribution of the competence units, the number of trainers conducting the course, the contact hours of every course (reduced based on D6.3 part 1), the timeline and the sequence of the piloting activities is summarised in Table 1 below.

Table 1: Distribution of piloting activities among partners

Number of CU	Title of CU	SAM Partner conducting CU	Month	Contact hours	Trainers involved
Kick off	Course presentation	EWF, LAK, all piloting partners	November 2022	-	All
CU 00	Additive manufacturing Process Overview	ISQ	November 2022	3.5	1
CU 15	PBF-LB Process	IMR	November 2022	28	4
CU 72	Binder Jetting	POLIMI & MTC	December 2022	21	8
CU 36	Coordination Activities	MTC	January 2023	7	4
CU 01	DED-Arc Process	MTC & LORTEK	February 2023	35	1
CU 25	Post-Processing	LMS	March 2023	10.5	3
CU 34	Process Selection	EC NANTES	March 2023	24.5	3
CU 35	Metal AM Integration	IDONIAL	April 2023	17.5	3

CU 08	DED-LB Process	MTC	May 2023	28	5
Closing Session	Closure	EWF, LAK, all piloting partners	May 2023	-	All
9 CU`s	-	-	November 2022 – May 2023	**175**	**32**

2.2. Structure of the Competence units

This chapter provides more information on the single competence units of the International Additive Manufacturing Coordinator professional profile. Subject titles and recommended contact hours of every CU are shown in the following figures (Figure 3 - Figure 11). As described above, the original recommended contact hours were reduced for the piloting approach within SAM project.

CU00: Additive Manufacturing Processes Overview	CONTACT HOURS
SUBJECT TITLE	
Directed energy deposition	1
Powder bed fusion	1
Vat photopolymerization	1
Material jetting	1
Binder jetting	1
Material extrusion	1
Sheet lamination	1
Total	7
WORKLOAD	14

Figure 3: Subject titles and recommended contact hours for CU00 – Additive Manufacturing Process Overview

CU 01 DED-Arc Process	RECOMENDED CONTACT HOURS	
LEVEL	INDEPENDENT (I) (applied to Operators and Engineers)	ADVANCED (A) (applied only for Enginners)
DED-Arc System (Hardware & Software)	5	0
DED-Arc Physical Principles, Processes and Parameters	5	0
DED-Arc Build platform, feedstock and other consumables	3	0
Post processing operations	1	0
DED-Arc Processes	0	14
DED-Arc Build platform, feedstock and other consumables	0	5
DED-Arc Equipment and accessories	0	3
DED-Arc Manufacturing strategy	0	6
Subtotal Per Level	14	28
Cumulated Subtotal	14	42
		WORKLOAD
PER LEVEL	14	42
CUMULATED	28	84

Figure 4: Subject titles and recommended contact hours for CU01 – DED-Arc Process

CU 08: DED-LB Process	RECOMENDED CONTACT HOURS	
LEVEL	INDEPENDENT (I) (applied to Operators and Engineers)	ADVANCED (A) (applied only for Enginners)
DED-LB System (Hardware & Software)	5	0
DED-LB Physical Principles	2	0
DED-LB Parameters	3	0
Build platform, feedstock and other consumables	3	0
Post processing operations	1	0
DED-LB Processes	0	7
DED-LB Build platform, feedstock and other consumables	0	5
DED-LB Equipment and accessories	0	2
DED-LB Manufacturing strategy	0	7
Subtotal Per Level	14	21
Cumulated Subtotal	14	35
		WORKLOAD
PER LEVEL	14	35
CUMULATED	28	70

Figure 5: Subject titles and recommended contact hours for CU08 – DED-LB Process

CU 15: PBF-LB Process	RECOMENDED CONTACT HOURS	
LEVEL	INDEPENDENT (I) (applied to Operators and Engineers)	ADVANCED (A) (applied only to Enginners)
PBF-LB Process Principles	2	0
PBF-LB System – Hardware and Software	4	0
PBF-LB Parameters	3	0
PBF-LB Feedstock	2	0
PBF-LB Consumables	2	0
Post Processing	1	0
PBF-LB Processes	0	7
PBF-LB Build substrate, feedstock and other consumables	0	5
PBF-LB Equipment and accessories	0	2
PBF-LB Manufacturing strategy	0	7
Subtotal Per Level	14	21
Cumulated Subtotal	14	35
		WORKLOAD
PER LEVEL	14	35
CUMULATED	28	70

Figure 6: Subject titles and recommended contact hours for CU15 – PBF-LB Process

CU 25: Post Processing	CONTACT HOURS
SUBJECT TITLE	
General considerations	2
Thermal treatment	4
Plastic deformation methods	2
Subtractive manufacturing	2
Finishing operations	2
Practical application	2
Total	14
WORKLOAD	28

Figure 7: Subject titles and recommended contact hours for CU25 – Post Processing

CU 34: Process Selection	CONTACT HOURS
SUBJECT TITLE	
Economics and productivity	7
AM Job analysis	21
Total	28
WORKLOAD	56

Figure 8: Subject titles and recommended contact hours for CU34 – Process Selection

CU 35: Metal AM integration	CONTACT HOURS
SUBJECT TITLE	
Production Management	7
AM Commercial Integration	3,5
Case studies	10,5
Total	21
WORKLOAD	42

Figure 9: Subject titles and recommended contact hours for CU35 – Metal AM Integration

CU 36: Coordination activities	CONTACT HOURS
SUBJECT TITLE	
Communications and coordination	3
Documentation	4
Total	7
WORKLOAD	14

Figure 10: Subject titles and recommended contact hours for CU36 – Coordination activities

CU 72 Metal BJ Process	CONTACT HOURS
SUBJECT TITLE	
MBJ Process Steps	4
MBJ System – Hardware and Software	4
MBJ Feedstock and Consumables	3
MBJ Parameters	3.5
Sintering Principles	0
MBJ Process Capabilities	2
Post Processing	1
Industrialization of MBJ	0
Total	17.5
WORKLOAD	35

Figure 11: Subject titles and recommended contact hours for CU72 – Metal BJ Process

2.3. Piloting activities according to the AM Coordinator guideline

The implementation process linked to the piloting activities encompassed the following activities (all were conducted virtually using the software systems Teams or Zoom):

- Development of new or revision of existing training materials,
- Promoting the course, inviting participants, selecting and approving applicants,
- conducting a course based on the guideline of the CU,

- *if required: preparing new assessment material (according to IAMQS Quality Assurance System: independent and comparable final assessment, verified and approved by IAMQC),*
- participants doing the final assessment (supervised by EWF on behalf of the IAMQC),
- participants answering to the feedback questionnaire (D2.7; Kit to collect feedback on the qualifications and training modules),
- handing out certificates of completion to participants who passed the final assessment,
- writing of a report on the piloting activity.

Prior to the start of the coordinator piloting activities, all participants received a "TRAINEES GUIDE" prepared by POLIMI with useful information on organizational aspects to attend the piloting activities. This guide for the course participants contained general information on the procedure of the pilot courses (format, date, duration, language, period, syllabus, exam) as well as guidelines and hints on how to behave during the online courses and on the professional profile itself. In addition, the trainers involved were introduced and the procedure of the final exams, the feedback survey and the reception of the final Diploma or Record of Achievements were explained. All links to feedback surveys and to the individual training sessions were included, as well as the contact details of the contact persons in case of queries about the individual courses, the general procedure or the exam and issuance of the diploma. A similar guide was prepared for the trainers by EWF (TRAINERS GUIDE) with information on the professional profile, organizational aspects on the conduction of the courses and the evidence to be collected. A list with names, organisation and email address of all participants and the contact data in case of queries or comments on the piloting activities was provided as well.

Between November 2022 and May 2023, the advanced training course on the International Metal Additive Manufacturing Coordinator was implemented the 1st time at European level, through a combined cooperation of SAM partners involved in training. The whole process was managed by SAM partners LAK and EWF, with the support of POLIMI and ISQ, who also prepared and conducted the kick-off meeting and the wrap up session.

The piloting of the Metal AM coordinator professional profile started with a kick-off session on 11th November 2022, one day before the first course. The kick-off session was conducted virtually with the objective of getting all participants (trainees and trainers) together for a first "Hello", of introducing the trainers and their competence units and to align on organizational aspects of the course. 58 participants attended the kick-off meeting (please see also Figure 12). In the beginning, the SAM project, the IAMQS and the METAL AM Coordinator qualification were introduced. Then, the possible outcomes after attending the courses – the record of achievement and the diploma – were explained. The candidates also achieved information on the assessment and feedback procedures as well as the latest timetable of the sessions. In the end, all competence units of the qualification were presented with trainers, date, duration and main contents.

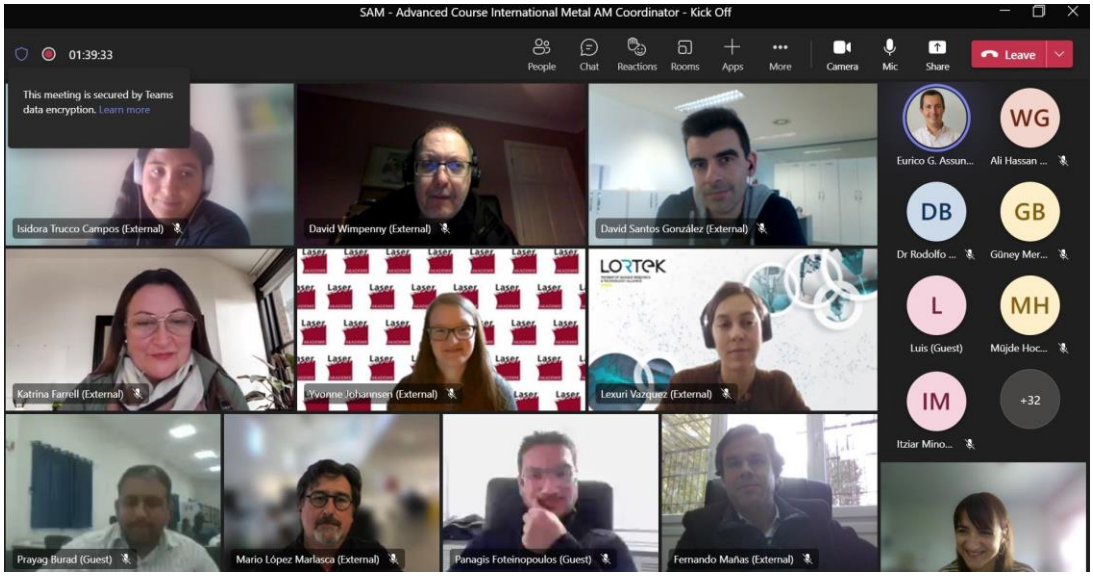

Figure 12: Screenshot of SAM ADVANCED TRAINING COURSE on the INTERNATIONAL METAL ADDITIVE MANUFACTURING COORDINATOR - kick off meeting on 11th November 2022

All in all, 9 competence units were piloted within the scope of the coordinator qualification engaging eight partners performing the courses for the course with 32 trainers involved:

- ISQ for CU00 (Additive manufacturing Process Overview)
- IMR for CU15 (PBF-LB Process)
- POLIMI and MTC for CU72* (Metal Binder Jetting Process)
  **older versions of documents used 75 as number for the CU72*
- MTC for CU36 (Coordination activities)
- MTC and LORTEK for CU01 (DED-Arc Process)
- LMS for CU25 (Post-Processing)
- EC Nantes for CU34 (Process Selection)
- IDONIAL for CU35 (Metal AM Integration)
- MTC for CU08 (DED-LB Process)

During the course it was possible to establish synergies with several companies specialized in AM processes. Those organisations were invited as external speakers to present on their technologies during the implementation of the AM Coordinator Course namely, Meltio, AddUP, Beam), Hybrid manufacturing technology Ltd, Ansys, Flow3D and Siemens (Kaizen Ltd).

The full advanced – but reduced by contact hours – course had a duration of 175 contact hours, calculating the same number of hours for self-study after the courses. All courses were given in English language and virtually – the platforms TEAMS and ZOOM were used for whole day or half day sessions. Trainers collected screenshots as evidence of the course, please see also Figure 13 and Figure 14 as an example. The numbers of attendees varied between the courses, since some candidates already performed one competence unit previously or they were not available on the day of the session and watched a recording later. There was an average of 86% of active participants over all competence units referring to attendance and examination. Some CUs had only one day of training (e.g. CU00), whereas for other competence units four or five days of courses were given depending on the overall contact hours of the competence unit. In total, 29

online sessions were conducted. Some partners gave quizzes after every day of training or started with a short recap in the morning of a new day of training. Before or sometimes after the courses, the presentations were handed to the participants, so that they could start their self-studies and preparation for the final assessments.

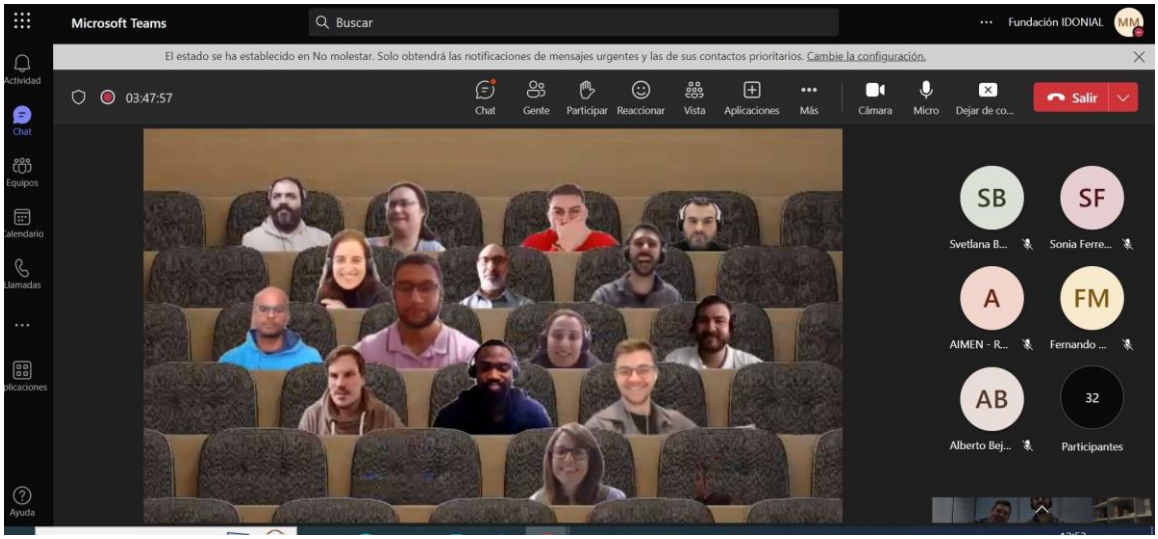

Figure 13: Screenshot of course on CU35 - group photo

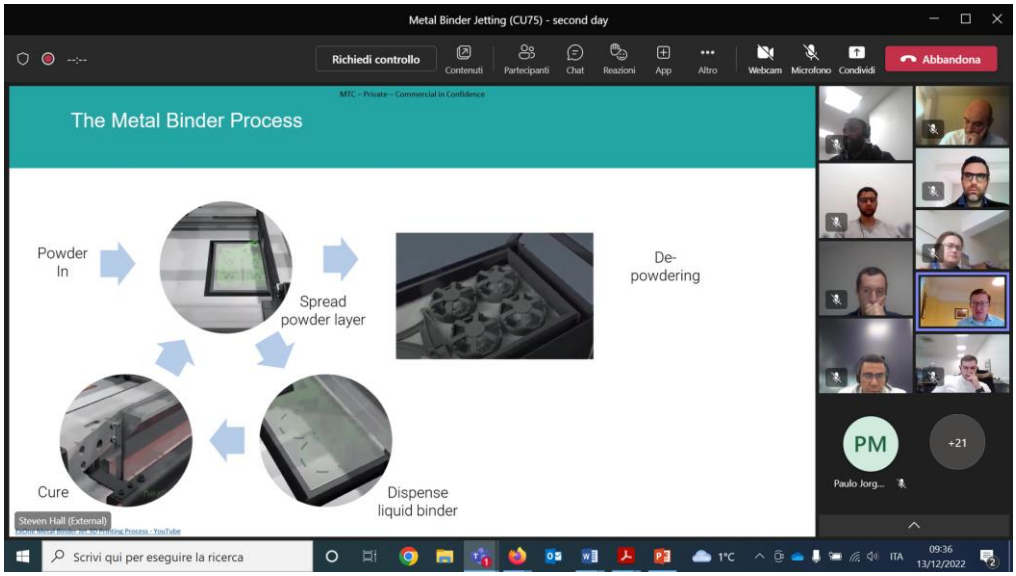

Figure 14: Screenshot of course on CU72 - Presentation of the Metal Binder Jetting Process

After every course, the candidates had at least one week for self-study and repetition on the topic before the final assessment took place (except for CU00, which had the exam directly after the course on the same day). More information on the final assessments is provided in chapter 3 and in Table 2. After having undertaken the final assessment for each CU, the participants were asked to fill a feedback survey on their attendance (please see chapter 4 for the results). If they passed the final assessment and filled the feedback survey, participants could achieve a digital record of achievement for the passing of the competence unit. Please see Table 1 and Table 2 for key information on the conducted courses and results in the assessment. If a participant

passed all 9 competence units, he or she achieved a Diploma as International Metal Additive Manufacturing Coordinator. In the end, 38 participants achieved this Diploma and 360 Record of Achievements were issued.

Table 2: Key data on the piloting activities of the International Metal Additive Manufacturing Coordinator Qualification

Number of CU	Period of implementation	Participants in assessment	Results of assessment 1st / 2nd /3rd try
CU00 (ISQ)	12th November 2022	45	36/6/1 (96%) passed 2 (4%) failed
CU15 (IMR)	21st, 22nd, 23rd, 24th November 2022	43	43/0/0 (100%) passed
CU72 (POLIMI & MTC)	12th, 13th, 15th December 2022	42	38/1/0 (93%) passed 3 (7%) failed
CU36 (MTC)	10th, 12th January 2023	45	24/9/10 (96%) passed 2 (4%) failed
CU01 (MTC & LORTEK)	13th, 14th 20th, 21st, 22nd February 2023	42	34/4/1 (93%) passed 3 (7%) failed
CU25 (LMS)	8th, 9th 10th March 2023	38	26/9/1 (95%) passed 2 (5%) failed
CU34 (EC NANTES)	16th, 17th, 20th, 23rd March 2023	39	34/4/0 (97%) passed 1 (3%) failed
CU35 (IDONIAL)	12th, 13th, 14th April 2023	40	40/0/0 (100%) passed
CU 08 (MTC)	25th, 27th April & 2nd, 4th May 2023	41	28/9/1 (93%) passed 3 (7%) failed

In May 2023, 42 participants completed the last competence unit. To close the piloting activity of the International Metal Additive Manufacturing Coordinator for the participants, a closure session was conducted on 25th May 2023 via Teams platform (see also Figure 15). In this last meeting with all participants and trainers, a short overview about the course implementation was given, as well as information on the final steps required to be awarded with the IAMQS Record of Achievements and / or the Diploma provided by EWF. Before closing, the participants were asked to give some general overall feedback on their course impressions and take aways (the results are presented in Chapter 4). The session and the coordinator course were then closed by acknowledgment to all trainers and partners and the farewell.

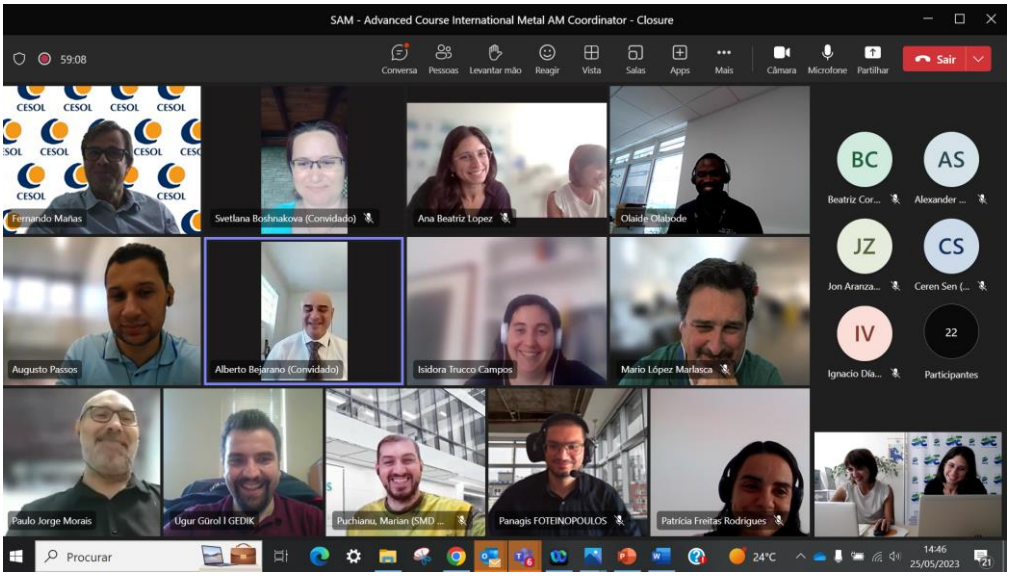

Figure 15: Screenshot of SAM ADVANCED TRAINING COURSE on the INTERNATIONAL METAL ADDITIVE MANUFACTURING COORDINATOR - wrap-up session on 25th May 2023

3. Final assessment

The regular examination or final assessment was offered directly, one week after ethe last CU session. Participants had at least one week after the end of the course to prepare for the exam with access to teaching material. As with the training, the final assessment took place virtually. It followed the specifications of the IAMQS and was also organized, conducted and supervised by a representative of EWF to ensure the IAMQS Quality Assurance System procedure and a harmonized assessment. The specifications for this were that there were single choice questions with four possible answers, each given one minute to answer. There was one examination question per recommended contact hour in the Guideline.

For each unit of competence, the exam was allowed to be retaken once if it was not passed with at least 60% on the first attempt. A total of three appointments were offered for each competence unit (one regular examination per competence unit, two extra assessment periods in January and May 2023) in case participants were unable to attend the general appointment or failed the first attempt and wished to retake the exam.

Table 2 in Chapter 2.3 shows the results of the assessment per CU giving the numbers how many participants passed on which of the three days of assessment. The overall percentage of the participants passing the CU can be found as well. All exams were passed by at least 93% of the participants, for CU15 and CU35 all participants passed in the first attempt (100%). By these results, it was shown that courses developed and conducted according to the guidelines of the IAMQS led to successful passed exams which were also developed according to these guidelines. After the courses, individual trainers indicated that the exam questions might need to be revised. Further information on the feedback can be found in chapter 4.4 (Results of the debrief meeting).

The attendees who passed one competence unit by scoring at least 60% in the exam, having an attendance of at least 60% and having answered to the SAM feedback questionnaire, received a digital Record of Achievements issued by the IAMQS. A Diploma in paper for the Metal AM Coordinator was awarded under the following conditions: attendance of at least 60% of the sessions, successful completion of all nine competence unit exams. For external participants (not belonging to SAM consortium) it was requested the Diploma payment related to its preparation and shipping. During the course, the project achieved remarkable outcomes, including the attainment of more than 360 Record of Achievements on the single competence units (CUs) and the awarding of 38 Diplomas of International Metal AM Coordinator (IMAM-C).

4. Feedback results and recommendations

4.1. Feedback achieved from the participants of the coordinator training course

At the end of the piloting activity, the participants were asked to fill out the satisfaction/ feedback survey. The main results – compiled from the overall feedback of all courses of the coordinator training – are presented below.

Regarding the profiles of the attendees, the results show that a broad number of different participants were reached by the pilot course offer. Almost **half of the participants (46%) were between 36 and 55 years old**. The second largest group, 37%, was between 26 and 35 years old. Only 17% of the participants were younger than 25 years. No participant was older than 55. According to the satisfaction survey, 76% of participants identified themselves as male and 24% as female. Thus, gender balance was not achieved, although partners made their best efforts to appeal to both genders. The data are shown in Figure 16.

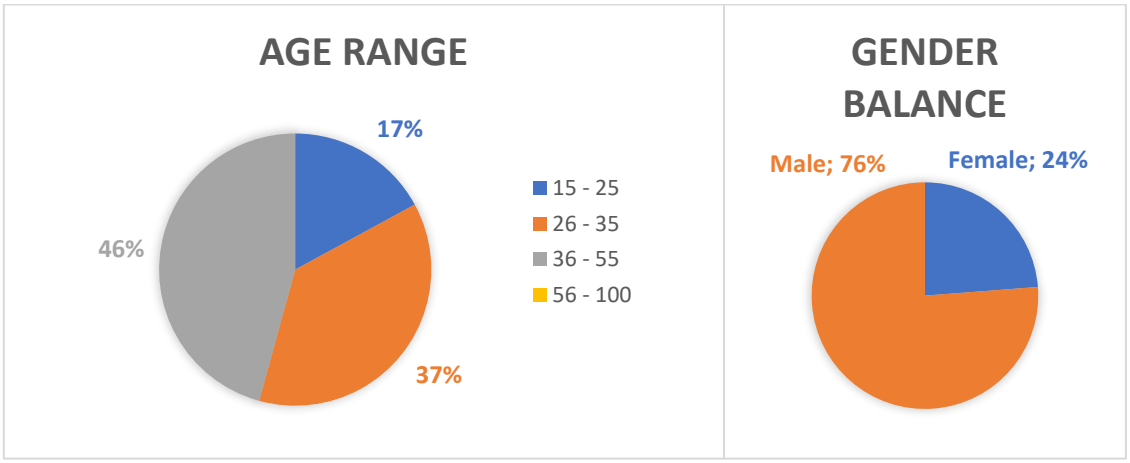

Figure 16: Distribution of age range of piloting course participants & Gender Balance

Most of the participants (83 %) were workers when attending the piloting course, followed by higher education students (16%). Only 1% answered to be VET trainees. In the coordinator training course, none of the participants was unemployed. The data on background can also be seen in Figure 17.

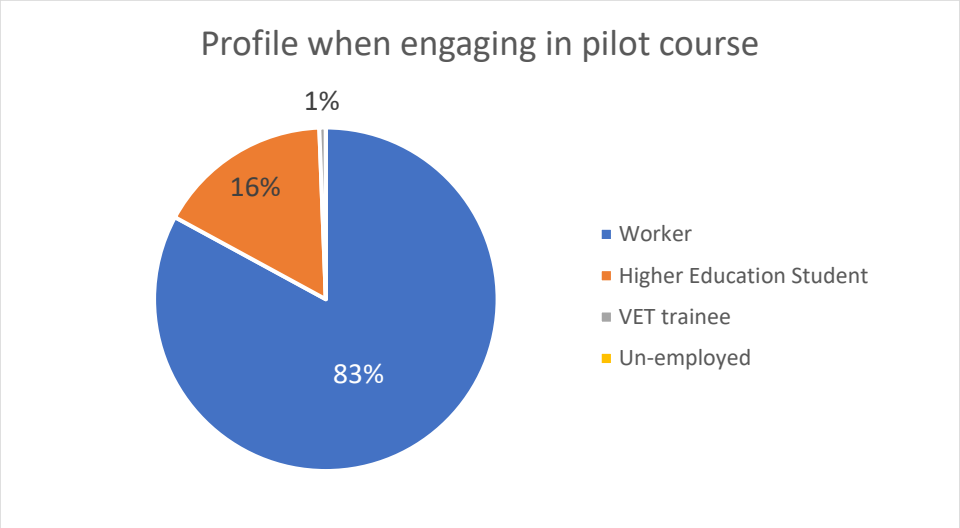

Figure 17: Job profile of participants who attended the piloting courses

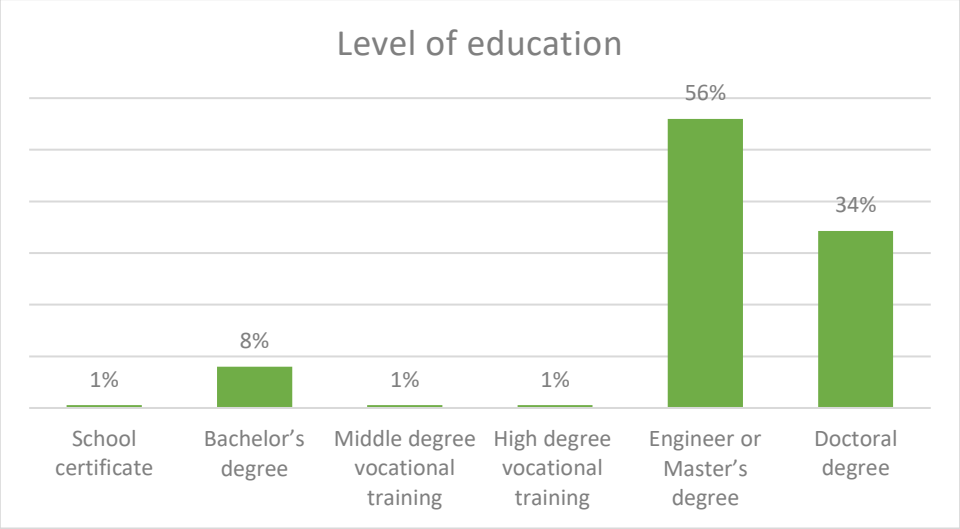

Figure 18: Level of education of participants who attended the piloting courses

The data of the age range matches with the level of education of participants. **Most of the participants (56 %) were engineers or had a Master's degree, followed by 34 % with a doctoral and 8 % with a bachelor's degree.** At the time of the pilot course, 1% each had a school certificate, middle degree vocational training or high degree vocational training. (Figure 18).

The feedback questionnaire asked for the main sector if the answer "worker" was given to the question above. **The four most frequently mentioned sectors** were the **Aerospace sector (24%)**, followed by **Industrial equipment & tooling (19%)** and the **Energy sector (14%)** and **Defence (13%)**. The remaining 9% of participants could not choose from the given possibilities and ticked **other**. They specified to work in Industrial testing & inspection, Railway Industry, Training, Research & Development, Higher education, Maintenance, Oil & Gas and finally Software. Figure 19 show further data on the responses achieved.

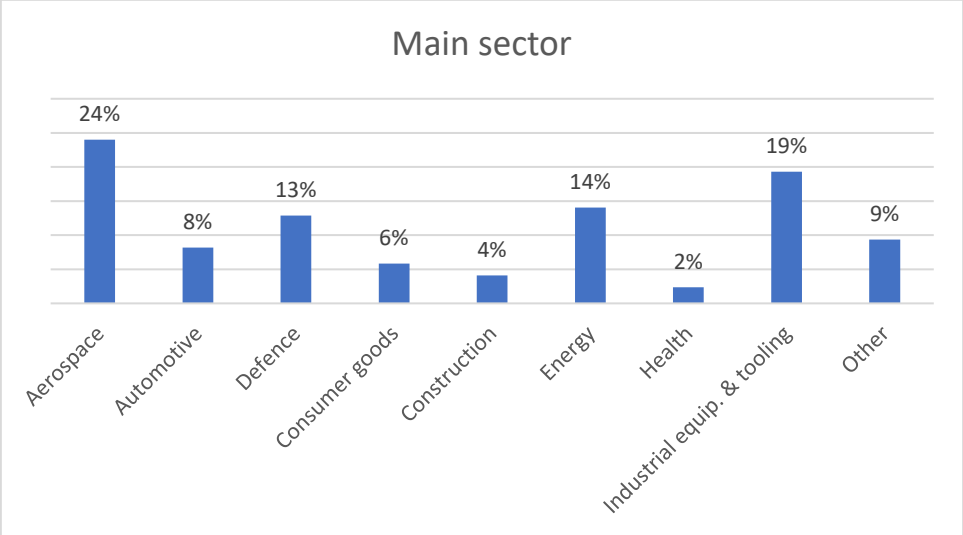

Figure 19: Main sectors of origin of the workers' group

Because the AM Coordinator training course was conducted entirely virtually, it was possible to get **people from all over the world** to participate. As a result, many participants came from countries that were not available for selection in the survey's response options and therefore ticked "Other". 70% of this group then indicated their origin as Turkey, with the others coming from Egypt, Peru, Brazil and Tunisia. In the list of European countries, Spain (22%) leads ahead of Portugal (20%) and the United Kingdom (13%) referring to the origin of the participants. Further information on the origin of the remaining participants can be found in Figure 20.

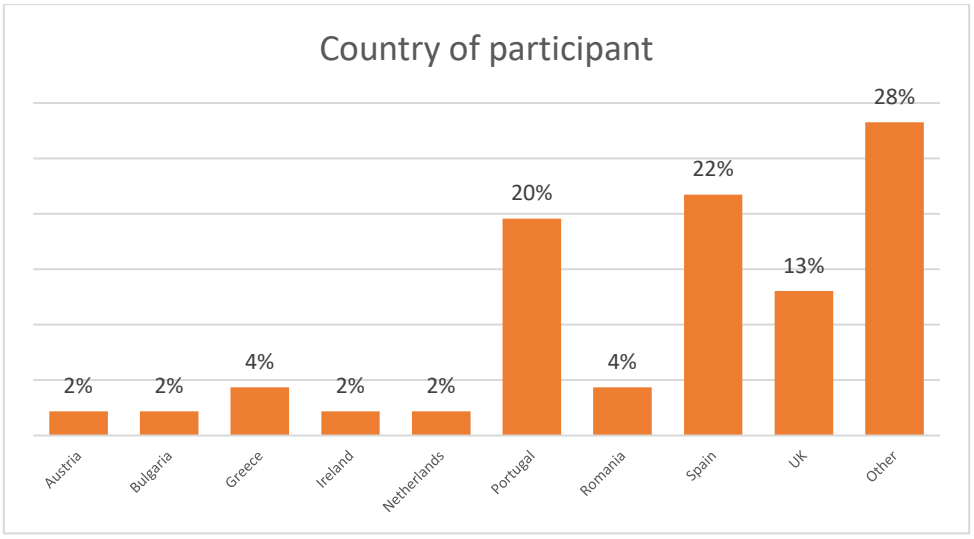

Figure 20: Origin of participants

The opinion of the participants on different aspects of the courses was asked referring to relevance, quality, attractiveness, and usability.

The overall attitude towards the conduction of the courses was very positive. When asked about the dynamic and configuration of the course, **88% agreed or strongly agreed that the training**

sessions were quite dynamic instead of being just expositive. Only 9% disagreed, and only 2% disagreed strongly (see also Figure 21).

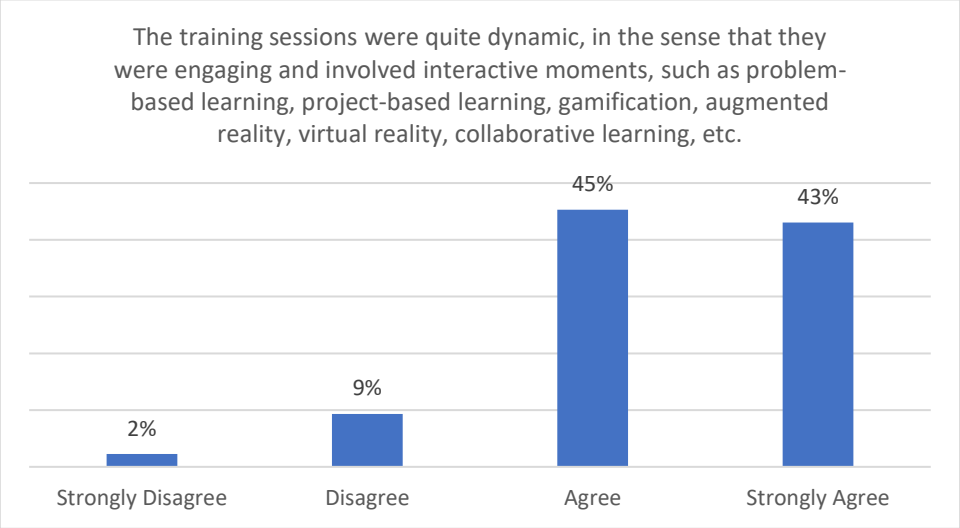

Figure 21: Opinions of attendees on the dynamic and configuration of the piloting courses

To check the significance and usability of the implemented content, the participants were asked to assess the relevance of the course to their job activities. In total, **66% were very satisfied with the content of the course in relation to their job activity** and 27% say that they are satisfied enough with the relevance (see also Figure 22). This positive result and the relevance that most of the participants in the AM training course understood for their own work, regardless of the CU attended, shows and underlines the need to offer and expand the range of training on AM. Only 1% rated the relevance as poorly satisfied and 3% as not satisfied enough.

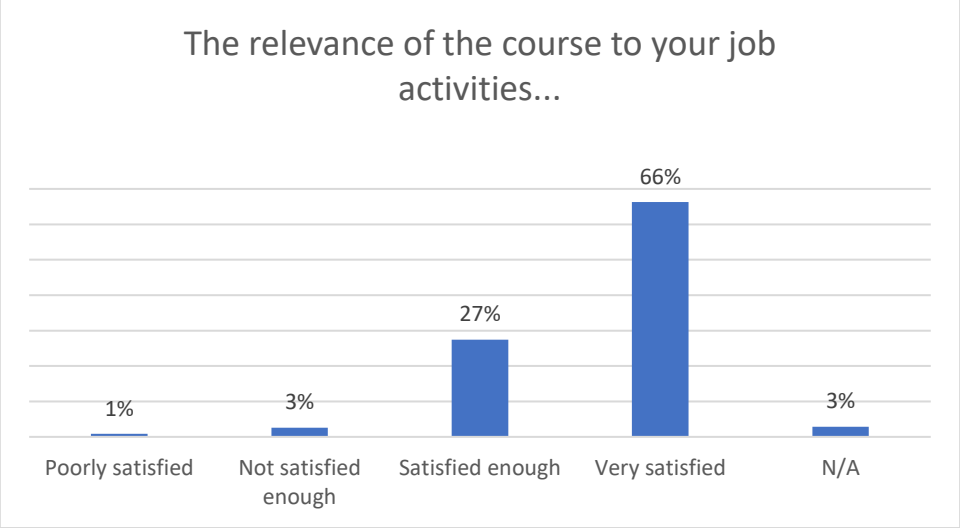

Figure 22: Relevance of the course

An overwhelming majority of the attendees **(97%) stated that they are satisfied with the course as it met their expectations**. The **overall feedback was very positive, and the quality of all sessions was rated high**. It is no surprise that 96% would also recommend the course accordingly (Figure 23).

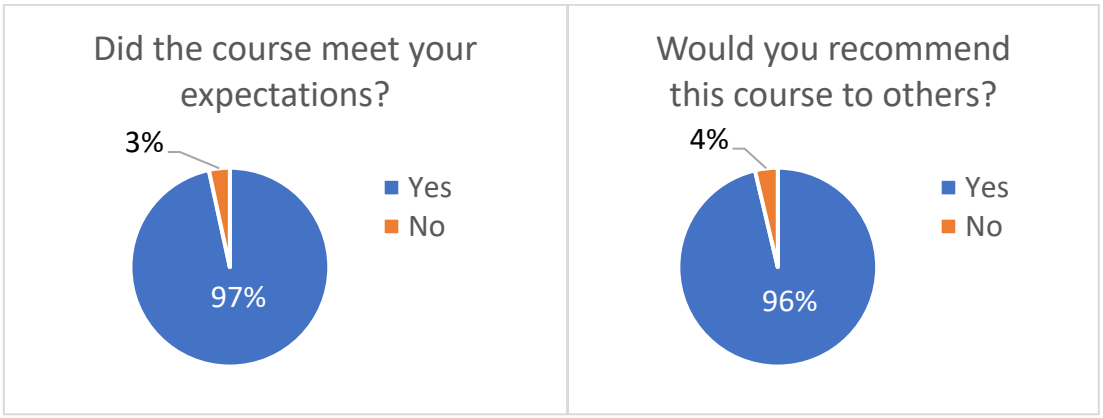

Figure 23: Satisfaction feedback survey - compliance of the course with expectations & recommendation rate

4.2. Feedback achieved from the trainers of the coordinator training course

From the eight SAM partners, engaged in the piloting activities, 24 trainers answered to the feedback survey. They came from Great Britain, Portugal, Greece, Ireland, France, Italy and Spain. The trainers were fine with the preparation of the course since 11 (46%) trainers stated to be satisfied and 13 trainers (54%) stated to be very satisfied with the support provided by the organisers (SAM team) and with the information achieved prior to the course to start the preparation, to deliver the course and to provide the evidence. No trainer stated to be dissatisfied or very dissatisfied. Some dissatisfaction was shown on the balance between theoretical and practical training and the allocated contact hours for the practical work (13 trainers were dissatisfied or very dissatisfied, 11 trainers were satisfied or very satisfied). More satisfaction was shown for the structure of the course (3 trainers dissatisfied (12,5%); 21 (87,5%) satisfied or very satisfied), the contents addressed (2 trainers dissatisfied (8%); 22 (92%) satisfied or very satisfied), the established contact hours (2 trainers dissatisfied; 22 satisfied or very satisfied) and the relationship between the contents and the learning outcomes (1 (4%) trainer dissatisfied; 23 (96%) satisfied or very satisfied). The majority agreed to the content of the guidelines in an open question.

Some positive aspects given by the trainers are listed below:

- Range of topics on the syllabus
- Establishing connection with other AM users, researchers and engineers from other organizations.
- People enjoyed the questions made through "Slido" platform. full range of topic were addressed. all class timeslots were organised.
- Well-structured learning content, broad coverage of different AM-related aspects, high level of engagement from students

Some aspects that might be improved, identified by trainers are listed below:

- Have more practical content
- Avoid some repetition between modules on certain topics
- Have more hands-on practice on both laboratory activities and software

4.3. Overall feedback achieved from trainers and candidates in the wrap-up session

At the end of the wrap-up session – the last time were all participants and trainers of the SAM coordinator training course came together – the participants were asked on the overall course impressions and their take aways. The answers were collected with the software SLIDO and are presented below in Figure 24, Figure 25 and Figure 26. Answers that were given more often, appear in a bigger and coloured font. The following questions have been asked:

- How would the course help with your AM future?
- If you would recommend the course to other, what would you highlight?
- Any other thing you would like to add?

Some of the items identified by the participants that would help them with their future in AM are the useful skills and knowledge they acquired in the course and they expect to have better job opportunities in the future. The main highlighted aspects of the overall coordinator training were the technical expertise of the trainers, the quality of the content and the specific case studies presented.

Figure 24: Answers given on the question: How would the course help with your AM future?

Figure 25: Answers given on the question: If you would recommend the course to others, what would you highlight?

Figure 26: Answers on the question: Any other thing you would like to add?

4.4. Outcomes and recommendations achieved from the debrief meeting

On 31st of May, during the transnational meeting 10 in Nantes, and after the completed implementation of the course, the partners conducted a meeting to debrief on the "Metal AM Coordinator Course" training activity with the trainers. The objective of the meeting was that trainers reflect their own view on the piloting activities and gave qualitative feedback. The meeting had a blended approach. All partners, who attended the TM10 in Nantes joined the discussion of the debrief meeting in-person whereas the trainers who did not travel to the

meeting, attended the debrief meeting virtually via TEAMs software. All piloting partners presented the main outcomes of their courses, focussing on the most positive and less positive feedback and procedures and the main recommendations achieved. After the presentation, partners discussed on the outcomes. The main comments, lessons learned, and recommendations that emerged during the session are summarised in the following Table 3.

Table 3: Feedback, best practices and recommendations of Coordinator piloting courses per competence unit

Competence Unit	Comments, Feedback, lessons learned, recommendations in discussion of debrief meeting
CU00 – Additive Manufacturing Processes **[ISQ; 0.5 days]**	In CU00, the possibility of creating a qualification framework (IAMQS) for additive manufacturing recognized at European level and also the strengthening of cooperation between the various companies working in the field of additive manufacturing was highlighted as very positive. Due to the virtual execution, participants from all over the world could be reached. However, due to the high number of participants and the virtual sessions, it was also more difficult to reach the candidates directly and to get feedback if the presented content was understandable. To improve the course unit, the inclusion of practical examples is suggested, as well as the reduction of the number of participants.
CU01 – DED-ARC **[MTC & LORTEK; 5 days]**	Brief feedback was collected for CU01 at the end of each day, which was generally very positive. The daily amount of contact hours was seen as critical, which was too high in the opinion of the participants. The activation for cooperation through various short surveys during the course was perceived as positive. The short quizzes, which were conducted to repeat the presented content at the "advanced" level, also received very positive feedback, as did the examples from the real world with direct reference to industrial application. Regarding CU01, the reduction of daily classes is recommended, possibly half-day classes rather than full-day classes, possibly with a short session on one main topic each. The usage of Slido questions and the quizzes has proven to be very beneficial and should be maintained.
CU08 – DED-LB Process **[MTC; 4 days]**	The participants worked very well and were very engaged. The videos and case studies shown as well as the short quizzes at the end of a unit received positive feedback. Due to the online course, it was not possible to connect with all participants, especially if they did not engage themselves during the Q&A session. The size of the unit is considered too long by the trainers and it is recommended to reduce the recommended contact hours to 3x7, i.e. 21 hours. The inclusion of videos and industry examples should be maintained and extended even further in the future.
CU15 – PBF-LB Process **[IMR; 4 days]**	Pre-recorded sessions were used in the implementation of CU15. The interaction with the participants arose afterwards in a Q&A session and worked very well, especially the commitment, expertise and communication of the trainers were rated very positively by the participants. As an improvement, participants indicated that they would have liked subtitles under the videos.
CU25 – Post Processing **[LMS; 3 half days]**	Pre-recorded sessions were provided to the participants and an extensive Q&A-Session were used to implement the CU. The trainers indicated that participation was very high and the Q&A sessions were very interesting as many questions and productive discussions arose. The trainers felt that pre-recording the class courses was very useful as it increased the quality of the course and made the course itself less monotonous as the trainer could devote all his energy to the Q&A session. In addition, the same quality can be guaranteed if the event is repeated. Pre-recorded

	courses provided to participants also offer the ability to pause and rewind if content is not understood, each participant can watch the video at their own personal pace.
CU34 – Process selection **[EC Nantes; 4 days]**	For CU34, it was found that despite the online course, intensive interaction between students and teachers was possible. The use of different training tools improved the learning outcomes. The main challenge was seen in the different expectations and knowledge levels of the participants. The integration of industrial content and application examples was identified as a possible suggestion for improvement.
CU35 – Metal AM integration **[IDONIAL; 2.5 days]**	The extensive experience and expertise of the trainers was rated as very positive by the participants, as was the presentation/showing and explanation of real components via the camera of the online session and the discussion of case studies from industry. The trainers described the very extensive and sometimes redundant content in the guideline as less positive, and the possibility of being able to touch components directly in face-to-face courses could also make it easier for participants to understand the content. A bended approach might be useful.
CU36 – Coordination of AM **[MTC; 2 half days]**	For CU36, the trainers rated the high engagement of the participants as very positive. The self-test quiz provided by the trainers after each class session received very good feedback. Due to the large group, not all participants were equally active and it was difficult for the trainers to connect with the students. The trainers identified bringing in more industry case studies or other hands-on elements as ideas for improvement. According to the trainers, the exam questions on CU36 should be revised as they do not cover all the important course content.
CU72 – Metal Binder Jetting Process **[POLIMI and MTC; 3 days]**	Overall, the pilot course for CU72 was considered very positive by the participants. As areas for improvement, participants named the provision of teaching materials prior to the courses, the division into several smaller units to avoid intensive, very full training days, and the inclusion of more practical content and examples.

To sum up, the following results from the IMAM- C training course were found:

- CU08 should be reduced to 21 contact hours, assessment questions should be revised
- CU15 should be reduced to 28 contact hours (as piloted for the coordinator)
- CU72 should be kept with 28 contact hours
- The practical assessment for CU34 should be revised
- The assessment questions for CU36 should be revised
- Best practices identified:
    - Usage of quizzes after each session (is engaging for participants)
    - Usage of case studies, videos, practical examples from industry and invite guest speakers
    - Usage of pre-recorded sessions or parts of sessions combined with Q&A-sessions (the slot of watching recorded material and the live sessions for questions should be balanced, enable the trainers to better manage the effort)
    - Usage of a variety of resources (e.g., moocs allows to determine the time spent in the learning processes and to make it more interesting and more active, organize an assessment preparation session + to analyse possible Q&A – to add more trial assessment questions/assessment)

5. Conclusion

The objective of this report was to conclude the Metal AM Coordinator training activities performed within work package 6 (part 2 of Deliverable 6.3) which were done to test the revised Coordinator profile (D6.3 – part 1) and which also aimed to test the final methodology through the implementation of the IAMQS. Considering the results above, it was concluded that the **methodology applied to revise training programmes and professional profiles was suitable for their purpose**. The implementation of the full Metal AM Coordinator professional profile with reduced contact hours **was successful**. However, in the debrief meeting of the training course, few recommendations were achieved by the piloting trainers to consider the revision of some assessment questions (CU34, CU36, CU08) and to reduce some recommended contact hours (CU08 → 21 contact hours, CU15 → 28 contact hours, CU72 → 28 contact hours) in the guideline. All results and findings will be used for future courses of the IAMQS. Due to the interest of participants in tacking the course, allied to success of participants and the fact that the materials were developed, partners are considering conducting a 2nd edition of the course – a paying edition- in September 2023. This course will have the possibility of having face to face sessions (summer school format) for the more practical competence units which were requested by the participants after the first coordinator training course.

A total of 9 full competence units at advanced level were implemented within the activities for the Metal Additive Manufacturing Coordinator training course from November 2022 to May 2023. The piloting included the implementation of the training courses with a final assessment supervised by the IAMQS and the collection of feedback using an online questionnaire. The online courses were given in English language by 8 partners of the consortium – 175 contact hours embedded in 29 online sessions. To start and to close the Metal AM Coordinator course, a kick-off meeting and a closure session were conducted.

An overwhelming majority of the attendees (97%) stated that they are satisfied with the course as it met their expectations. The overall feedback was very positive, and the quality of all sessions was rated high. It is no surprise that 96% of the participants would also recommend the course accordingly. Trainers identified the following best practices in the courses: the usage of quizzes after each session; the usage of case studies, videos, practical examples from industry or invite guest speakers; the usage of pre-recorded sessions or parts of sessions combined with Q&A-sessions and the usage of a variety of resources.

58 participants started in the course, that was finished by 42 participants in May 2023. The overall performance of participants, independently of their profile and background, was quite positive, based on the assessment results. 93% to 100% of the examinations were passed by the participants. In total, 360 Record of Achievements on the single competence units and 38 Diplomas of the International Metal AM Coordinator (IMAM-C) were awarded.