D4.6 Pilot Activities Report

2nd Stage Pilots:

Qualification/Professional Profile:
AM Designer for Polymers

2 Competence Units /Units of learning outcomes:
CU 64 - Business for Additive Manufacturing and CU 63 - Certification, Qualification and Standardization in Additive Manufacturing

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WP5 Pilot Activities Report

Qualification/Professional Profile: Process Engineer PBF-LB | 2 Competence Units: Metal AM Designer

Project No. 601217-EPP-1-2018-1-BE-EPPKA2-SSA-B

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Executive summary

The 2nd stage of real case scenarios was implemented by 14 partners of the SAM consortium in June and July 2021. The goal of the implementation and following feedback collection was to test the implementation of the developed guidelines for the IAMQS (International Qualification System) and receive feedback on possible required improvements. The new developed (in D5.4) professional profile (PP) for Designers for Polymers and two completely new competence units on Certification, Qualification and Standardization and Business for AM were piloted by at least one SAM partner.

The implementation process encompassed the development of training materials, preparation of the assessment material, delivery of lectures, the conduction of the final assessment, collection of participants feedback, handing out certificates of completion to participants who passed the final assessment and development of a national report on the piloting activity. In total, 12 piloting activities were conducted by SAM partners.

After the lecture and assessment, participants were asked to answer a feedback survey to support the evaluation of the piloting activity. 280 from 292 participants of the lectures answered the feedback questionnaire. The results on the profile of attendees show that a broad group referring to age, professional background and country was reached. Most of the attendees (101 of 280) were between 26 and 35 years old. According to the feedback survey, nearly half of the participants were workers when attending the piloting course (117 of 264) or higher education students (110 of 264). The majority of 149 participants were engineers or had a Master's degree and all came from very different sectors but nearly all with a technological background. The feedback survey showed that participants from all over the world attended the pilot courses, such as India, China and Turkey in addition to the partner countries Portugal, Spain, UK, Germany and Ireland. 52 participants (19%) identified as female and 228 (81%) as male.

The overall feedback was very positive and the quality of all courses was very high. The majority of 92% stated that they are satisfied with the course as it met their expectations (255 from 278 answers). 56% were very satisfied with the content of the course in relation to their job activity. 95% would recommend the course to others.

During this second stage of piloting, the overall performance in the final assessment was quite positive. From the 271 final assessments carried out, 77% of the participants passed, while the remaining 23% failed.

These results enabled to conclude that independently of the participants profile and background, the designed courses are suitable to develop advanced AM skills for workers (which represent 41% of the participants replying to survey) and for higher education students (which represent 39% of the participants replying to survey). Still, no conclusion can be made regarding the adequacy for VET students, as they only represent 10% of the overall participants replying to survey. It might be also concluded that the skills and knowledge described in the CUs and taught in the lectures are suitable for being able to successfully complete the assessment, and ultimately the AM course.

1. Introduction

This document describes the results achieved with the piloting activities conducted in the 2nd stage of real case scenarios in June and July 2021. The evidences were collected in August and September 2021, and the findings were included in the national activity reports and the overall report.

This overall report is a deliverable of WP4 (Observatory in Additive Manufacturing), whereas the piloting activities were conducted under the scope of WP5 (Piloting of the methodology for creating and revising professional profiles and skills deployment → D5.5). The piloting stage included the implementation of the training courses with a final assessment and the collection of feedback using the feedback kit developed in WP2 (Forecast methodology: assessment of current and future skills in AM) across 14 project partners. AITIIP, EC Nantes, EWF, FA, GRANTA, IDONIAL, IMR, ISQ, LMS, LORTEK, MTC, POLIMI, UBRUN and LAK supported the 2nd stage of Real Case Scenarios.

The objective of the 2nd stage piloting activities was to test the methodology for creating professional profiles and skills, though the implementation of the International AM Qualification System, where the new developed guidelines for AM professional profiles and competence units are being 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.

2. Overview on 2nd stage Real Case Scenarios' piloting activities

2.1. Selection, distribution and development of piloting contents

The results of D4.5 (2nd report on the analysis and validation of needs) showed demands of the industry on technological skills on standardization /certification and design with polymer skills as well as in business development. In D5.4 (2nd Stage Real Case Scenarios – Revision or New Professional Profiles/Qualifications and Competence Units/ Training Modules) of work package 5, the development of a new professional profile (PP) for Designers for Polymers and two completely new competence units / units of learning outcomes on Certification; qualification and standardization and Business for AM took place. Please refer to D5.4 document.

These documents served as the basis for D5.5 (Piloting event of the 2nd Stage Real Case Scenarios – Revised/New Professional Profiles/Qualifications and Competence Units/Training Modules). The objective of the piloting activities, in the point of view of trainers, was to test the methodology through the implementation of the new guidelines, in order to validate whether the process, content, structure and recommended contact hours and conducted lessons are

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adequate to develop skills in AM or whether these require a revision process. While from the point of participants, it was tested, if these are able to pass the final exam after attending the lecture on a certain CU, when lecture and assessment were both prepared based on the guideline.

Below, the qualification structure with CUs and recommended contact hours are shown. The new CUs were already approved by the International Additive Manufacturing Qualification Council (IAMQC) and achieved an official CU-number. The CU00 as overview is already existing in the International Additive Manufacturing System (IAMQS).

New qualification/PP "AM Designer for Polymers":

- CU00 – Additive Manufacturing Process Overview (3.5 hours)
- CU65 – Overview on polymer materials and properties (3.5 hours)
- CU66 – Designing Polymers Parts (21 hours)
- CU67 – Post Processing for Polymers (3.5 hours)
- CU71 – Design for Material Jetting (10.5 hours)
- CU68 – Design for Material Extrusion (10.5 hours)
- CU69 – Design for PBF Polymer (10.5 hours)
- CU70 – Design for VAT Photopolymerization (7 hours)

New Competence Units / Units of Learning Outcomes (CUs/ULOs):

- CU63 – Certification, Qualification & Standardization in AM
- CU64 – Business for Additive Manufacturing

All CUs above marked in green were implemented in D5.5 in June and July 2021 by at least one partner. The CU71 – Design for Material Jetting was not piloted since it has not yet been considered as a priority by industry, but was developed for completeness of the Qualification. Table 1 shows how the piloting activities were distributed amongst the partners and in which way, country and language the CUs were implemented. The CU70 – Design for VAT Photopolymerization was implemented in September 2021. One pilot course for CU63 had a deviation in the timeframe as it was implemented already in March 2021. The implementation process linked to the pilots encompassed the following activities:

- development of training materials,
- inviting participants,
- conducting a lecture based on the guideline of the CU,
- preparing 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 or an independent expert certified by EWF),
- participants answering to the 2.7 (Kit to collect feedback on the qualifications and training modules) survey,
- handing out certificates of completion to participants who passed the final assessment
- writing of a national report on the piloting activity.

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Table 1: Distribution of piloting activities among partners

Number of CU	Title of CU	SAM Partner who piloted the CU	Country	Language of pilot	Way of implementation
CU63	Certification, Qualification and Standardization in Additive Manufacturing	LORTEK	ES	Spanish	Virtual
CU63	Certification, Qualification and Standardization in Additive Manufacturing	FA	PT	English	Virtual
CU63	Certification, Qualification and Standardization in Additive Manufacturing	IMR with support of MTC	IR/ UK	English	Virtual
CU64	Business for Additive Manufacturing	EC Nantes with support of POLIMI	FR	English	Virtual
CU65	Overview on polymer materials and properties	UBRUN with support of GRANTA	UK	English	Virtual
CU65	Overview on polymer materials and properties	ISQ	PT	Portuguese	Virtual
CU66	Designing Polymers AM Parts	MTC with support of AITIIP	UK/ES	English	Virtual
CU67	Post Processing for Polymers	LAK	DE	German	In-person
CU68	Design for Material Extrusion	LMS	GR	English	Virtual
CU68	Design for Material Extrusion	FA	PT	Portuguese	Virtual
CU69	Design for PBF Polymer	LMS	GR	English	Virtual
CU70	Design for VAT Photopolymerization	FA	PT	Portuguese	Virtual

2.2. Piloting activities according to the AM Designer for Polymers guideline

Seven piloting activities to implement the AM Designer for Polymers guideline, were conducted by seven SAM partners in June and July 2021, one was conducted in September. The subject titles and recommended contact hours of every CU are shown in the following figures (Figure 1 - Figure 6). Table 2 shows key information and results of these piloting courses. Further information on the particular piloting activities is described in the Annexes 6.1.5 to 6.1.12 and 6.2.5 to 6.2.12 .

CU/ULO Overview on polymer materials and properties	RECOMMENDED CONTACT HOURS
SUBJECT TITLE	
Type of Polymer materials	0.5
Polymer Materials properties	2
Case study on materials applications	1
Total	**3.5**
WORKLOAD	**7**

Figure 1: Subject titles and recommended contact hours for CU65 – Overview on polymer materials and properties

CU/ULO Designing Polymers Parts	RECOMMENDED CONTACT HOURS
SUBJECT TITLE	
Think Additively	6
Design principles for AM	6
CAD files in AM	0.5
Simulation tools	5.5
Case study	3
Total	**21**
WORKLOAD	**42**

Figure 2: Subject titles and recommended contact hours for CU66 – Designing Polymers Parts

CU/ULO Post Processing for Polymers	RECOMMENDED CONTACT HOURS
SUBJECT TITLE	
General considerations	0.5
Depowdering, cleaning and support removal methods	0.5
Surface smoothing methods	1
Coating operations	1
Practical application	0.5
Total	**3.5**
WORKLOAD	**7**

Figure 3: Subject titles and recommended contact hours for CU67 – Post Processing for Polymers

CU/ULO Design for Material Extrusion	RECOMMENDED CONTACT HOURS
SUBJECT TITLE	
Overview of Machines, Process Capabilities and Limitations	1.5
Process related Materials	1
Specific Design Considerations	6
Case study	2
Total	**10,5**
WORKLOAD	**21**

Figure 4: Subject titles and recommended contact hours for CU68 – Design for Material Extrusion

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CU/ULO CU Design for PBF Polymer	RECOMMENDED CONTACT HOURS
SUBJECT TITLE	
Overview of Machines, Process Capabilities and Limitations	1.5
Process related Materials	1
Specific Design considerations	6
Case study	2
Total	**10,5**
WORKLOAD	**21**

Figure 5: Subject titles and recommended contact hours for CU69 – Design for PBF Polymer

CU/ULO CU Design for Vat Photopolymerization VPP	RECOMMENDED CONTACT HOURS
SUBJECT TITLE	
Overview of Machines, Process Capabilities and Limitations	1.5
Process related Materials	1
Specific Design Considerations	6
Case study	2
Total	**10.5**
WORKLOAD	**21**

Figure 6: Subject titles and recommended contact hours for CU70 – Design for VAT Photopolymerization

Table 2: Key data on the piloting activities of the AM Designer for Polymers PP/qualification

Number of CU	Period of implementation	Number of trainers	Number of participants	Results of assessment	Participants replying to feedback survey
CU65 (UBRUN)	1st to 22nd June 2021	2	43 (95 registrations)	43 of 43, 100% passed	53*
CU65 (ISQ)	28th and 30th June 2021	1	19 (34 registrations)	6/10, 60% first try; 5/5, 100% passed second	12
CU66 (MTC)	5th, 7th, 12th, 14th, 19th, 22nd July 2021	4	28	23 of 28, 82% passed	27
CU67 (LAK)	2nd July 2021	2	9	8 of 9, 89% passed	9
CU67 (LAK)	9th July 2021	2	13	8 of 13, 62% passed	13
CU68 (LMS)	22nd and 23rd June 2021	3	10	6 of 7, 86% passed	11*
CU68 (FA)	6th, 7th, 8th July 2021	1	11 (21 registrations)	11 of 11, 100% passed	11
CU69 (LMS)	20th and 21st July 2021	3	6	5 of 5, 100% passed	5*

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CU 70 (FA)	6th, 7th, 9th, 16th September	1	15	13 of 15, 87% passed	15

*There were participants that completed the course with feedback survey but did not take the assessment. The number of participants gives the number of attendees who completed the whole course with lecture, feedback survey and assessment and could be smaller than the participants who answered to the feedback survey.

About 31 trainers from seven different countries prepared the piloting activities in 4 different languages (English, Spanish, Portuguese and German).

In the overall, the expected number of participants in the AM Designer Polymers Qualification was exceeded (154), although not all partners achieved the requested minimum number of 15 participants. LAK conducted the piloting course twice as they piloted in-person and had to kept the safety restrictions. But by combining both events, the performance indicator of at least 15 participants were achieved. Most partners with virtual lectures and assessments saw a lot of drop-outs leading to deviations between the overall participants and the attendees at the exam. A lot of virtual meetings during the pandemic, exams on other days as the lecture and the fact that the offered courses were for free might be reasons for the drop outs and the difficulties to reach the planned minimum number of participants.

2.3. Piloting activities according to the new developed CUs

The two new competence units were also implemented within D5.5 during the period for testing in June and July 2021. In addition, the CU63 was piloted in March 2021. The CU64 on Business for AM was implemented by the SAM partner EC Nantes and the CU63 on Certification, Qualification and Standardization was implemented three times, the SAM partner IMR implemented the CU in English language, the SAM partner LORTEK in Spanish and the SAM partner FA in English language. Figure 7 and Figure 8 show the recommended contact hours and subject titles of the respective CUs. More information on the particular piloting activities on the new CUs can be seen in Table 3 and in the Annexes 6.1.1 to 6.1.4 and 6.2.1 to 6.2.4.

CU Certification, Qualification & Standardisation in Additive Manufacturing:	RECOMENDED CONTACT HOURS
SUBJECT TITLE	
Certification and Qualification in AM	2
Standardisation in AM	2
Applicability of Certification, Qualification and Standardisation (CQS) to the AM enabled process chain	3
Total	**7**
WORKLOAD	**14**

Figure 7: Subject titles and recommended contact hours for CU63 – Certification, Qualification & Standardization in AM

.CU /ULOs Business for Additive Manufacturing: [Título]	RECOMMENDED CONTACT HOURS
SUBJECT TITLE	
Business strategies and models	7
Quality Management	1,5
AM workflow management	3,5
Health Safety, Environment and Sustainability	2,5
Policy and governance	1,5
Budgeting and Costs	5
Total	21
WORKLOAD	42

Figure 8: Subject titles and recommended contact hours for CU64 – Business for Additive Manufacturing

Table 3: Key data on the piloting activities of the CUs for Business for AM and Certification, Qualification and Standardization in AM

Number of CU	Period of implementation	Number of trainers	Number of participants	Results of assessment	Participants replying to feedback survey
CU63 (FA)	10th March	4	16 (76 in lecture)	14 of 18, 78% passed	16
CU63 (LORTEK)	29th June and 6th July 2021	4	42	23 of 33, 70% passed	32
CU63 (IMR)	30th June, 7th and 14th July 2021	5	32	18 of 32, 56% passed	33*
CU64 (ECN)	15th, 16th, 17th July 2021	6	48	26 of 42, 62% passed	43

*There were participants that completed the course with feedback survey but did not take the assessment. The number of participants gives the number of attendees who completed the whole course with lecture, feedback survey and assessment and could be smaller than the participants who answered to the feedback survey.

3. Final assessment

As described in 2.12.1, as part of the implementation of the IAMQS, all participants were asked to attend a final assessment after visiting the lecture, thus in compliance with the system's quality assurance requirements. The final assessment tools were prepared by each partner before the piloting event, then submitted to review and approval process by the International AM Qualification Council (IAMQC), mediated by EWF. The assessment was supervised by EWF or another authorized body, such as the AM ANB to ensure the IAMQS Quality Assurance System procedure and a harmonized assessment.

The trainees had 1 minute per single choice question to answer it and needed to have at least 60% of correct answer to pass the final assessment of the CU. Due to the situation caused by the coronavirus, 11 of 12 (92%) of the exams were carried out virtually. The results of the final assessments can be found in Table 2 and Table 3. Some partners saw deviations between the number of attendees in the lectures, the final assessment and the feedback survey. This is the

reason why the numbers of participants are given in the tables for the overall participants, the assessment and the feedback survey. Some partners conducted a second final assessment so that participants who failed first could try a second time to pass the exam. The attendees who passed the exam received a certificate of completion from SAM project referring to the IAMQS as an added value for the participants.

The overall performance in the final assessment was quite positive. From the 271 final assessments carried out, 77% of the participants passed (corresponding to 209 participants), while the remaining 23% failed (corresponding to 62 participants).

. Thus, it was shown that lectures developed according to the developed guidelines led to successful passed exams that were also developed according to these guidelines.

There are various reasons why an attendee fails an exam, e.g. he/she is not paying enough attention, being nervous or unconcentrated or the questions are too difficult or the topic was not presented detailed enough during the lecture. There is a difference in the average between CUs of the Designers for Polymers profile and the new CUs on Standardization and Business for AM. The average "assessment-pass-rate" is 87% for the CUs from the new profile, whereas the rate for CU63 and CU64 is clearly decreased to 66%. A useful future action could be to check and revise CU63 and CU64 according to the difficulty of exam questions and description of CU in order to be able to improve this rate for future implementations of these CUs.

4. Feedback results and recommendations

At the end of the piloting activity, 280 (96%) from 292 participants filled out the satisfaction/ feedback survey. Not all questions were answered by every participant. The main results are presented below.

Regarding the profiles of the attendees, the results show a broad number of different participants was reaching the pilot course offer.

Participants from all ages attended the piloting courses of the 2nd stage. **The most attendees (101 of 280) were between 26 and 35 years old.** The second biggest group with 98 of 280 participants were younger than 26 years, 77 attendees were between 36 and 55 years old. Only 4 participants were older than 55 years. The data is illustrated in Figure 9.

Nearly half of the participants were workers when attending the piloting course (117 of 264) or higher education students (110 of 264). 28 answered to be VET trainees, 9 said they are unemployed. Data on background can also be seen in Figure 10. Not all of the 280 persons who answered to the survey, answered to this question.
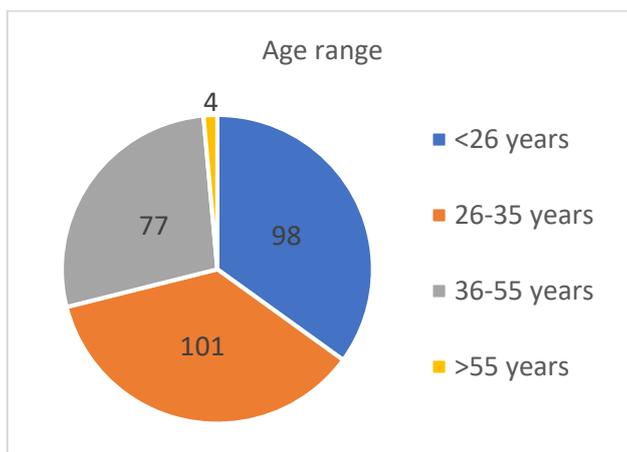
Figure 9: Distribution of age range of piloting course participants
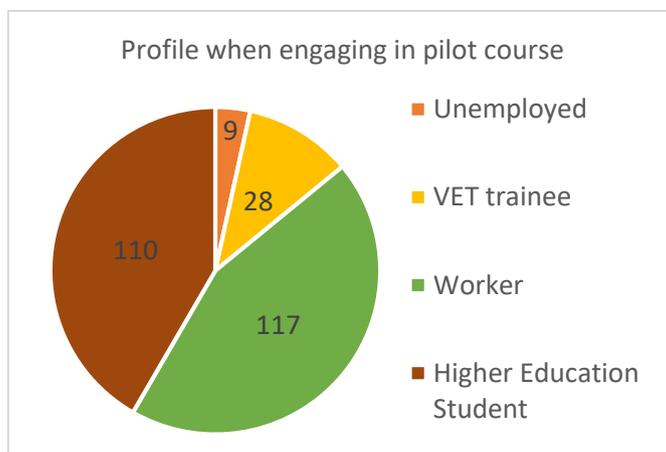
Figure 10: Job profile of participants who attended the piloting courses
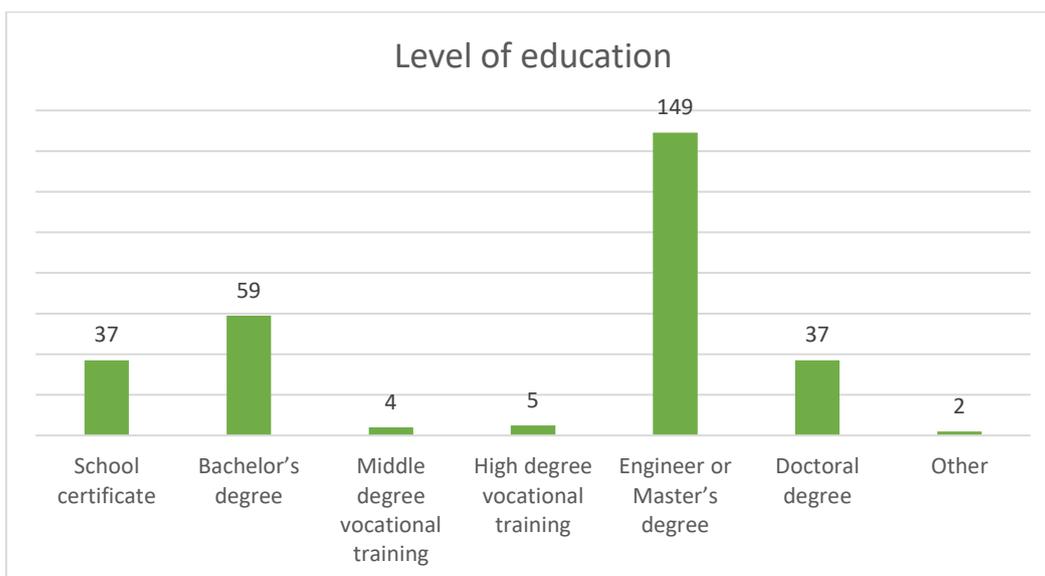
Figure 11: Level of education of participants who attended the piloting courses

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The data of the profiles matches with the level of education of participants. **The majority of 149 participants were engineers or had a Master's degree.** 59 of them had a Bachelor's degree, 37 had a school certificate and further 37 a doctoral degree. 5 attended high degree vocational training at the moment of the pilot course and 4 of them middle degree vocational training (please see also Figure 11).

The survey asked for the main sector, if the answer "worker" was given to the question above. 249 answers were achieved, although only 117 stated to be workers. One reason could be that several sectors were chosen in the question or as another reason, people who are not workers answered with their field of work or expertise. The majority of the answers (68) could not choose from the given possibilities and ticked others. They specified to work in education and research in most cases but also in **AM, railway, testing, inspection and certification, electrical, business consultancy, trade association, quality control, jewelry, industrial inspections, VET, Maritime and some others**. 53 were engaged in industrial equipment and tooling, 31 in aerospace. 25 answered the are not working at an organization at the moment. Figure 12 show further data on the responses achieved.
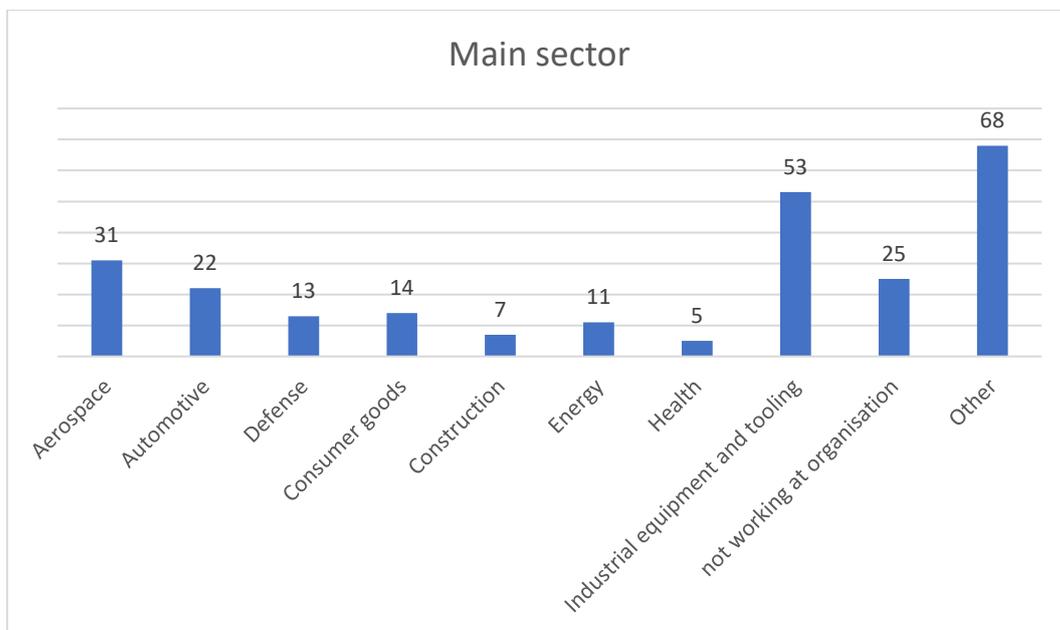
Figure 12: Main sectors of work of participants who attended the piloting courses

The survey also asked in which country the AM training takes place. These should be one of the partners countries or in the country from another ATB. Nevertheless, it seems that participants answered with the country they live in. Since the majority of pilot courses was given virtually, it was possible to reach people from all over the world to attend a pilot course of the 2nd stage of real case scenarios. **The majority of participants came from the partners' countries such as Portugal (45), Spain (43), UK (41), Germany (29) and Ireland (17).** 19 came from Italy and 11 Greece. 51 persons stated to come from a country outside Europe. Most countries specified were India, Norway, China, Turkey and Mexico. Further data can be found in Figure 13.

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Country of participant

Austria	Belgium	Bulgaria	Czech Republic	France	Germany	Greece	Hungary	Ireland	Italy	Poland	Portugal	Spain	Sweeden	UK	Other (Please Specify)
6	5	1	1	5	29	11	1	17	19	3	45	43	2	41	51
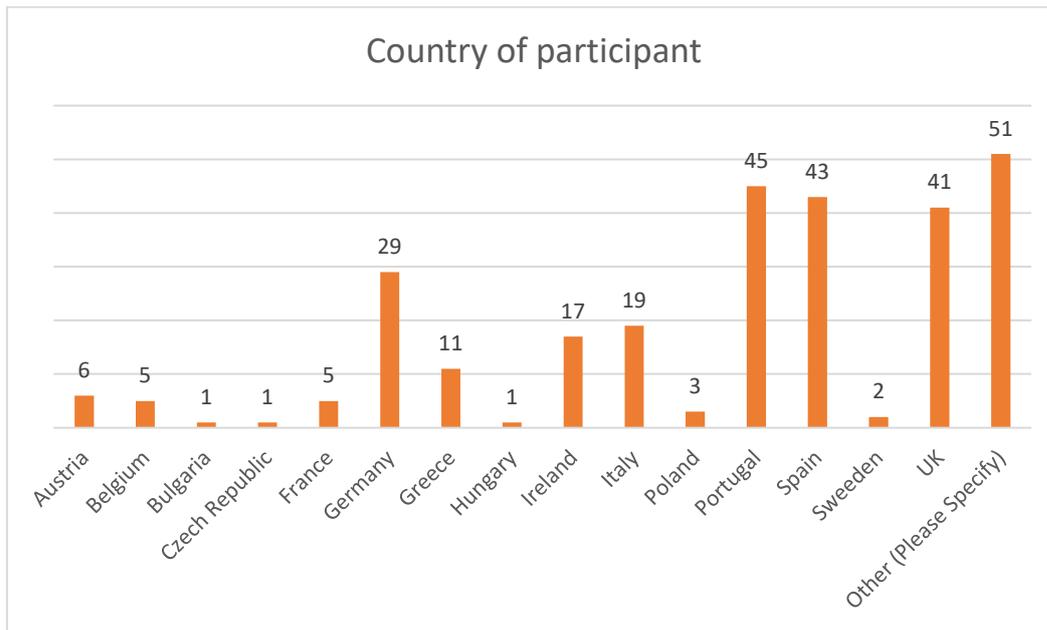
Figure 13: Countries of participants who attended the piloting courses

According to the stratification feedback survey, 52 participants (19%) identified as female and 228 (81%) as male. So, the gender balance wasn't reached, despite partners efforts in attracting both genders. For the 3rd stage of pilots, a gender balance should be kept as aim to reach, e.g. by involving networks/ initiatives such as Woman in 3D printing or similar in the dissemination of the courses and training delivery. The majority of **92% stated that they are satisfied with the course as it met their expectations** (255 from 278, see also Figure 14).
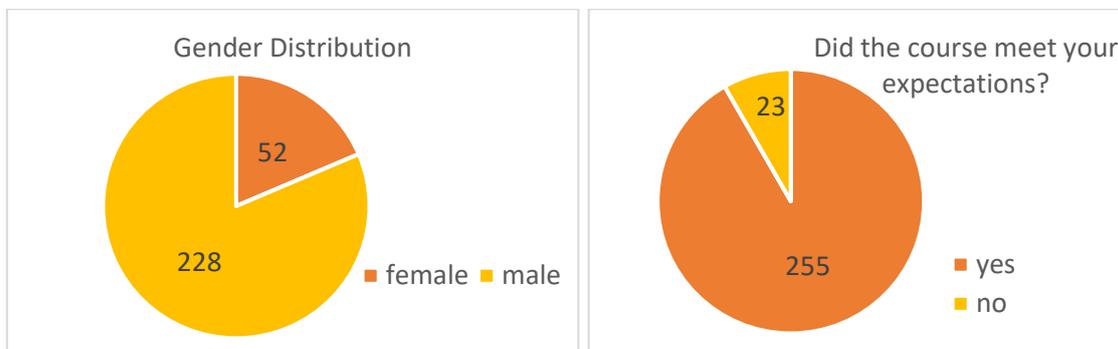
Figure 14: Gender distribution in 2nd stage of piloting (left) and distribution if the course met the expectations of attendees (right)

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 piloting was very positive. When asked about the dynamic and configuration of the lecture, 92 participants (33%) strongly agreed that the training sessions were quite dynamic instead of being just expositive. 143 of 280 attendees (51%) also agreed, 36 (13%) disagreed and only 9 (3%) disagreed strongly (see also Figure 15).

The training sessions were quite dynamic, in the sense that they were engaging and involved interactive moments - such as problem-based learning, project-based learning, gamication, augmented reality,virtual reality, collaborative learning,etc. - instead

strongly disagree	disagree	agree	strongly agree
9	36	143	92
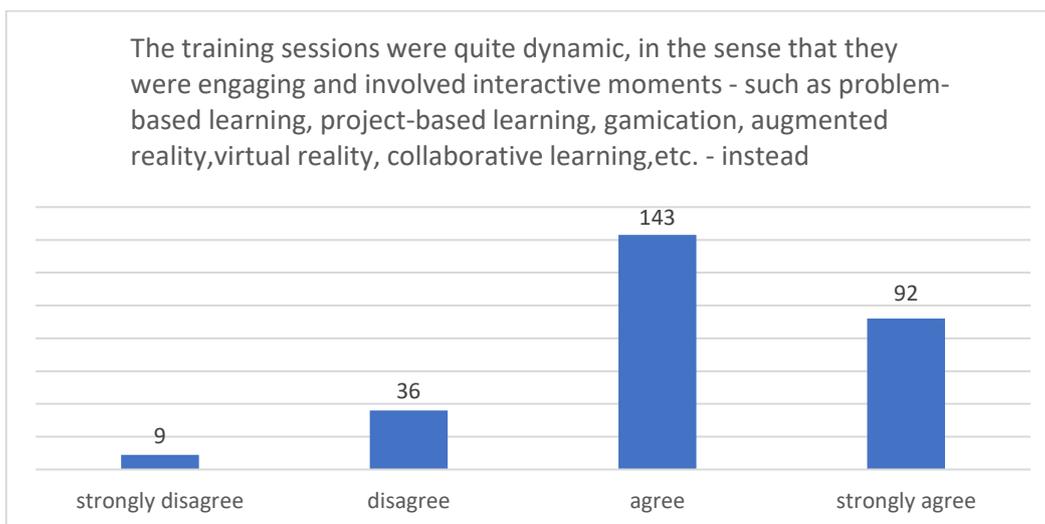
Figure 15: Opinions of attendees on the dynamic and configuration of the piloting courses

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, 279 answers were given to this question. The majority of 156 participants **(56%) were very satisfied with the content of the course in relation to their job activity**. Also 88, which are 32%, say that are satisfied enough with the relevance (see also Figure 16). 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 10 persons (4%) did not answer, 5 (2%) rated the relevance as poorly satisfied and 20 (7%) as not satisfied enough.

The relevance of the course to your job activities...

poorly satisfied	not satisfied enough	satisfied enough	very satisfied	N/A
5	17	89	158	10

Figure 16: Relevance of the course

The **overall feedback was very positive and the quality of all courses was very high**, as 265 of 278 (95%) participants stated that they would recommend the course to others (see also Figure 17). Only 13 participants (5%) would not recommend it.

Figure 17: Distribution of statements if participants would recommend the course to others

All partners wrote national reports on their conducted piloting activity. Further information on the feedback given can be seen in the Annexes 6.1 and 6.2. Partners met on 8th September via TEAMS and presented the main results and recommendations achieved from the piloting activity. Compared to the 1st stage of piloting the overall feedback was even more positive.

The main comments, lessons learned, and recommendations that emerged during the session are summarised in the following table:

Competence Unit	Comments, lessons learned, recommendations in discussion of debrief meeting
CU63 – Certification, Qualification and Standardization in Additive Manufacturing **[IMR with MTC, LORTEK, FA]**	- CU63 on standardization and certification is very metal focused, more content on polymers was requested by the attendees, trainers recommended to underline a practical approach by using more case studies for different areas, the recommended contact hours were seen as quite short, whereas a prolongation by 3.5 hours was seen critical and as too long, more homework or prework, prescribed in the guideline was discussed - It was agreed that CU63 is focussing on the development of market and standardization and requires regular revision and check-ups
CU64 – Business for Additive Manufacturing **[EC Nantes]**	- CU64: some drop-outs were seen, the reason might be a period of exams at the university, in the future, this should be recognized when scheduling the lectures and EC Nantes will try to focus a blended approach of teaching next time
CU65 – Overview on polymer materials and properties **[UBRUN]**	- CU65, UBRUN: the course was conducted virtually and in English language, therefore, a lot of attendees from all over the world could attend, the certificates of competition were appreciated by the participants and shared via social media, which increases the visibility of the course itself and the IAMQS; it is recommended to offer a 4 week long account to students next time, so that they could work with the presented

	software by their own, it was recommended to think on adding more contact hours to have time for more practical approaches
CU65 – Overview on polymer materials and properties **[ISQ]**	- CU65, ISQ: The CU was implemented in two sessions after work, which was seen as very positive by the attendees, after the first session, some attendees left the course, as they felt not experienced enough and had not enough technical background for the level of the course. **The topic of recycling was demanded by the attendees, it could be discussed to add it to the detailed knowledge. It was also stated that a more active and practical approach to teaching would demand more time.**
CU66 – Designing Polymers AM Parts **[MTC with AITIIP]**	- CU66: The CU with 21 recommended contact hours was implemented virtually in two 3.5 hours sessions per week. The participants had time for questions, quizzes, exercises and a mix of presenters might be the reason for good feedback in the end. Nonetheless, the attendees stated that they would prefer more hands-on and practical tasks.
CU67 – Processing for Polymers **[LAK]**	- CU67 was the only CU that was implemented face to face. A Positive feedback was achieved by most of the participants, few would have preferred more information on the processes than on post processing, this aspect will be solved as participants chose their modules later on them on and this only affects the period of testing. The group work, the videos on the processes and the interaction with the trainers were seen as very positive. No changes were recommended on the CU content and guideline.
CU68 – Design for Material Extrusion **[FA]**	- CU68: the high number of drop-outs was also explained by an exam period of students, the interaction with the slicing software, the free training and the e-learning approach were rated very positively although some would have preferred in-person training, the level of assessment questions were rated as quite high, although every participant passed the exam in the first try.
CU68 and CU69 – Design for PBF Polymer **[LMS]**	- CU68 and CU69 by LMS: positive feedback was received on the certification awarded and the interactive polls during the lecture - The contact hours for CU68 and CU69 (Design for Process CU) were estimated as very much as the focus is on design and not on aspects of the process itself
CU70 – Design for VAT Photopolymerization	This CU was implemented after the debrief meeting with all partners. The piloting partner identified the following aspects:

[FA]	- Trainees and trainer identified the need for hands-on training sections in the course for more dynamic - more time in-between sections should be considered to enable the consolidation of knowledge - an introduction of a slicer software achieved very positive feedback
General	- The majority of partners achieved the feedback, that the participants wished to see more live processes or work more practical. This could be solved if in-face to face courses are allowed again and the attendees can visit the machine directly. - All partners had difficulties to achieve gender balance. One reason might be that there are still more men in technical areas than women.

It seems that the deviation between attendees in lecture, assessment and feedback survey, as well as drop-outs (292 attendees of lecture, 271 final assessments and 280 answered feedback surveys) were reduced compared to the 1st stage of piloting. The reason for this improvement seems to be linked with the reinforcement of the information provided (e.g. in terms of procedure of the piloting activity, with final assessment, feedback survey and by presenting the background on the SAM project and the IAMQS) at the beginning of the courses and recalled through the implementation.

Another recommendation from the results of the 1st stage was to have more breaks and shorter sessions if the piloting courses are conducted virtually, which was recognized by the partners in the 2nd stage. This might be another reason for the positive feedback achieved. In the 1st stage a more practical approach was wished by the attendees, which was also accommodated by the partners when delivering the courses during the 2nd stage. Because of the ongoing situation caused by the coronavirus, 11 from 12 pilots were conducted as virtual sessions. Being aware of the feedback and recommendations achieved in the first stage they tried to design the lectures even more actively with group work, presentations, discussions etc. which was appreciated by the participants.

5. Conclusion & Outlook

The objective of this report was to conclude all piloting events of the 2nd stage of real case scenarios (D5.5) which aimed to test the methodology though the implementation of the IAMQS, which include the new developed PP/qualification "AM Designer for Polymers" and the two newly developed CUs (CU63 – Certification, Qualification & Standardization in AM and CU64 – Business for Additive Manufacturing). Considering the results above, it was concluded that the methodology applied to designed training programmes for each CU was suitable for their purpose. In terms of specific content of the CU no changes will be introduced, except for CU 65 which will include the reference to materials recycling.

A total of 8 completely new developed CUs were implemented with correspond assessment in the 2nd stage of real case scenarios of the SAM project from March to September 2021.

The overall performance of participants, independently of their profile and background, was quite positive, based on the assessment results. From the 271 final assessments carried out, 77% of the participants passed, while the remaining 23% failed.

These results enabled to conclude that the designed courses, either the new AM Designer for Polymers Qualification and CUs, are suitable to develop advanced AM skills for workers (which represent 41% of the participants replying to survey) and for higher education students (which represent 39% of the participants replying to survey). Still, no conclusion can be made regarding the adequacy for VET students, as they only represent 10% of the overall participants replying to survey.

Finally, the results also revealed that lectures developed according to the developed guidelines led to successful passed exams that were also developed according to these guidelines.

Since most of the piloting activities had to be carried out virtually because of the COVID-19 situation, the attendees rated that more hands-on and practical activities would improve the lectures. But by applying recommendations from the first stage as the information on the piloting procedure, the SAM project and the IAMQS, to split the lectures into shorter virtual sessions and to train the contents of the guidelines in a more interactive way led to very positive overall feedback and less drop-outs. The outcomes and recommendations for improvement will be considered for the newly developed guideline and the testing period in the 3rd stage on a short-term scenario.

6. Annex

The following sections provide more detailed information on the feedback achieved from trainers and participants in the national context during the 2nd stage of Real Case Scenarios in the SAM project.

6.1. Feedback achieved from participants' feedback survey

After attending a piloting course and the final assessment, all participants were asked to answer a feedback survey. The national results are presented below. The survey was developed within WP2 of the SAM project (D2.7 – Kit to collect feedback on the qualifications /training modules).

6.1.1. Feedback from participants on CU63: Certification, Qualification and Standardization in Additive Manufacturing piloted by IMR

Section 1: General information on the participant

Age range

Age ranges largest groups were aged 26-35 (Yellow) to 36-55 (Green) years of age with almost 84% of the attendees falling within these age groups.

1. **Gender and age balance: 6% Female 94% Male.**

Female (Blue) Male (Green) Attendees

Age Ranges largest groups were aged 26-35 (Yellow) to 36-55 (Green) years of age with almost 84% of the attendees falling within these age groups.

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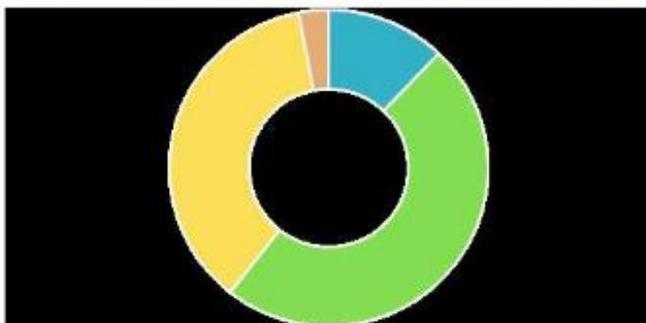
2. Participant countries of origin: Ireland and the UK, Portugal were highly represented. Other countries included Venezuela, Tunisia, Iran, India, Australia, Turkey and Norway.

3. 58% of attendees are working in industry illustrated in the workplace type distribution in the diagram below, 28% Higher Ed Student with other being VET trainees and 12% were unemployed.

4. The majority 67% had an engineering degree or masters and with an additional 21% having doctoral level.

Country

36% (12) Ireland, 24% (8), Other (Please Specify) 15% (5) UK 9% (3) Portugal 3% (1) Belgium 3% (1) Germany 3% (1) Hungary 3% (1) Poland 3% (1)

Attendee Profile

58% (19) Worker

27% (9) Higher Education Student

3% (1) VET trainee

12% (4) Unemployed

What would you say is your profile when engaging in this course?
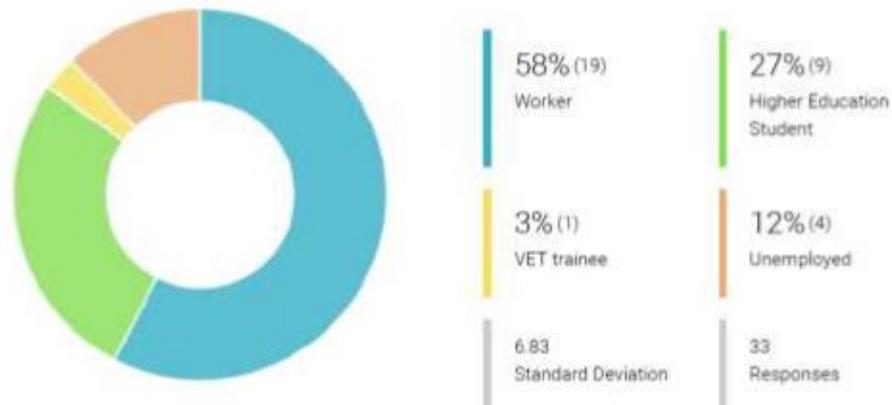
58% (19) Worker	27% (9) Higher Education Student
3% (1) VET trainee	12% (4) Unemployed
6.83 Standard Deviation	33 Responses

WP5 Pilot Activities Report

Qualification/Professional Profile: Process Engineer PBF-LB | 2 Competence Units: Metal AM Designer
Project No. 601217-EPP-1-2018-1-BE-EPPKA2-SSA-B

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16% (4) Aerospace	16% (4) Automotive	12% (3) Defense	4% (1) Consumer goods
4% (1) Construction	4% (1) Energy	0% (0) Health	36% (9) Industrial equipment and tooling
44% (11) Other (Please Specify)			
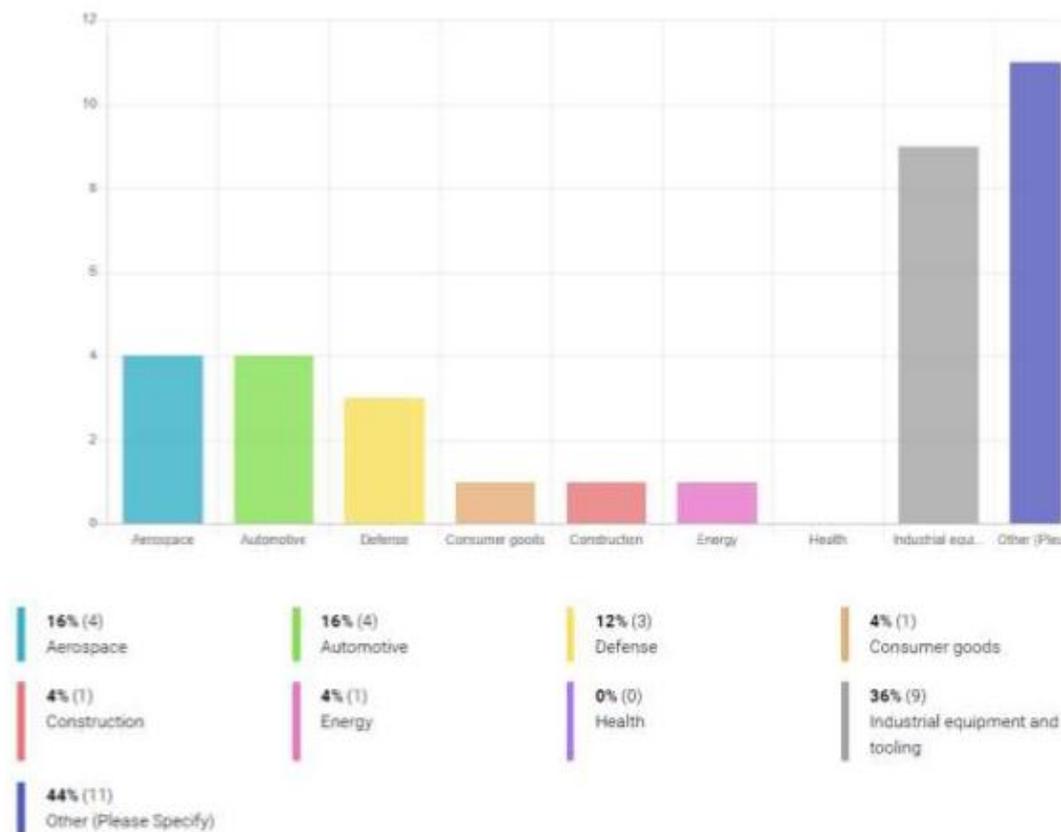
Broad range of attendees attracted

Many attendees had a broad professional background/previous additive manufacturing experience and ranged from very basic level knowledge to those working in AM for years, including those who lecture in the field of engineering and AM. Ranges included mechanical engineer with little experience with AM, to an AM Lead for a large engineering firm to R+D Engineering and R+D management, manager of AM research team and other examples below:

- Research fellow in laser powder metal AM/ 4 years.
- Owner of an AM company for 9 years.
- Research assistant at Nanjing university of science and technology AM laboratory (China).
- Working as an Additive Manufacturing Technician.

6.1.2. Feedback from participants on CU63: Certification, Qualification and Standardization in Additive Manufacturing piloted by LORTEK

Out of the 32 people who gave their feedback, 11 were feminine and 21 masculine. 7 people were in the range 15-25 years, 11 people were in the 26-35 range and 14 people belonged to the age range 36-55. 94% of the students were younger than 26 years and 6% (1) was between age 26-35. All participants were from Spain, except for one presenter. The profile when engaging in this course was 23 people classified themselves as workers and 8 people came from Higher

education. 1person classified themselves as unemployed. Out of the workers, 4 are working in aerospace and 5 in automotive. 1 person is working in defence and one each in construction, energy and health. 9 people classified themselves as working in the industrial sector and 8 in other areas (mobility, research, testing). 25 people held an engineer's degree, 3 a bachelor's degree, 3 a doctoral degree and 1 had a higher degree.

32 people stated that the pilot course was e-learning and b-learning.

The background of the people translates to the following:

- *Few parts in our business have been manufactured under this technology. I have attended several speeches and seminars about the topic. Finally, I have visited MIZAR Company in Gasteiz.*
- *NDT applied to AM, mainly*
- *I am application specialist of welding and cutting gases, I work with a different company, visit and recommended the best gases for additive manufacturing*
- *Sector de la ingenieria y construcción*
- *I am working in a robotic WAAM cell*
- *My professional background was in the field of chemical coatings. Specifically, coatings produced via sol-gel technique and applied by dip-coating. They were used in solar panels in order to decrease water consumption during their cleaning process.*
- *Nowadays, I work in a company, which use additive manufactured*
- *Wire Arc Additive Manufacturing (WAAM)*
- *I carried out my doctoral studies at the University of Texas at Austin. The Selective Laser Sintering process was developed and patented by my research group. Since then I have participated in some AM initiatives in various jobs. Currently I am head of special processes in CAF and we are starting to design (and qualify suppliers) using AM process. Very interested in knowing applicable standards.*
- *AM educator and AM researcher*
- *I'm working as a Quality manager in an AM industry component for rails.*
- *I´ve done some projects related to AM during the master degree*
- *DESIGN ENGINEER Y AERONAUTICS*
  - *year of experience as applications engineer in additive manufacturing.*
- *Design and manufacture 3D printers*
- *Mechanical Project Engineer*
- *Industrial inspector*
- *I know 3d printing since 2013, I design and manufacture 3d printers*
- *None, I started directly into the AM world. I'm Mechanical Engineer, then master into AM.*
- *10 years of AM experience*
- *I'm doing the master's degree of industrial additive manufacturing in Mondragon*
- *Engineer in Mechanical Testing Laboratory*
- *NONE*
- *Expert*
- *Topology Optimization*
- *MASTER IN ADDITIVE MANUFACTURING TECHNOLOGIES - PROFESSIONAL EXPERIENCE IN DEVELOPING WAAM PROCESS*
- *R&D Projects*

- *Automotive systems development*
- *mechanical engineering and development of new materials (AM)*
- *Student of a master in Industrial Additive Manufacturing*
- *Design for AM, process engineer in Wire and Arc Additive Manufacturing*
- *Experiencia en fabricación aditiva en plástico y metal. FDM, SLS, SLM*

As can be seen in Figure 18, 84 % of the participants were very satisfied with the support provided by the staff and the communication channels used during the training. As it was an online course the question about the infrastructure seemed a bit odd which can be seen in a higher number of N/A answers 28%). The same goes for the equipment – with 22% non-applicable.

	Poorly satisfied	Not satisfied enough	Satisfied enough	Very satisfied	N/A	Standard Deviation	Responses	Weighted Average
a) The infrastructure conditions provided by the training provider (furnishing, heating, lighting, sanitation, etc.)	0 (0%)	1 (3%)	5 (16%)	**17 (53%)**	9 (28%)	6.18	32	3.7 / 4
b) The support provided by the staff (other than trainers)	0 (0%)	0 (0%)	4 (13%)	**27 (84%)**	1 (3%)	10.4	32	3.87 / 4
c) The communication channels used during the training	0 (0%)	0 (0%)	5 (16%)	**27 (84%)**	0 (0%)	10.48	32	3.84 / 4
d) The equipment used in the practical training	0 (0%)	1 (3%)	6 (19%)	**18 (56%)**	7 (22%)	6.41	32	3.68 / 4
								3.77 / 4

Figure 18: Question 10: Satisfaction training conditions

	Poorly satisfied	Not satisfied enough	Satisfied enough	Very satisfied	N/A	Standard Deviation	Responses	Weighted Average
a) The structure of the course	0 (0%)	2 (6%)	13 (41%)	**17 (53%)**	0 (0%)	7.17	32	3.47 / 4
b) The contents addressed during the course	0 (0%)	2 (6%)	**19 (59%)**	11 (34%)	0 (0%)	7.5	32	3.28 / 4
c) The coherence of the course with the training programme (did the training provider respect the order of contents established in the training programme?)	0 (0%)	0 (0%)	**16 (50%)**	15 (47%)	1 (3%)	7.45	32	3.48 / 4
d) The contact hours allocated to the course, considering the amount and nature of the course contents	0 (0%)	1 (3%)	11 (34%)	**20 (63%)**	0 (0%)	7.96	32	3.59 / 4
e) The balance between theoretical and practical training	1 (3%)	4 (13%)	**13 (41%)**	8 (25%)	6 (19%)	4.03	32	3.08 / 4
f) The transparency/communication of the learning outcomes associated to the course	0 (0%)	1 (3%)	12 (38%)	**19 (59%)**	0 (0%)	7.76	32	3.56 / 4
g) The match between learning outcomes foreseen for the course and what the course covered	0 (0%)	2 (6%)	11 (34%)	**19 (59%)**	0 (0%)	7.5	32	3.53 / 4
h) The relevance of the course to your job activities	0 (0%)	3 (9%)	13 (41%)	**16 (50%)**	0 (0%)	6.77	32	3.41 / 4
								3.43 / 4

Figure 19: Question 11: Satisfaction with the Content of the curse

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As can be seen from Figure 19, 94% of the participants were satisfied or very satisfied with the structure of the curse. However, only 59% were satisfied with the content. 50% were rating the coherence as sufficient. 63% of the participants voted that the allocated contact hours were sufficient. However, 54% were not content with the allocated practical /theoretical hours. 59% found that the communication of the learning outcomes matched the learning out comes in the course. Another 50% rated the relevance of the course to the job activities as important.

	Strongly Disagree	Disagree	Agree	Strongly Agree	Standard Deviation	Responses	Weighted Average
a) The learning materials (i.e. slide shows, handbooks, videos, samples) were useful	1 (3%)	2 (6%)	**21 (66%)**	8 (25%)	7.97	32	3.13 / 4
b) The training sessions were quite dynamic, in the sense that they were engaging and involved interactive moments - such as problem-based learning, project-based learning, gamification, augmented reality, virtual reality, collaborative learning, etc. - instead of being just expositive)	2 (6%)	5 (16%)	**17 (53%)**	8 (25%)	5.61	32	2.97 / 4
c) The training sessions promoted the use of digital tools	0 (0%)	1 (3%)	12 (38%)	**19 (59%)**	7.91	32	3.56 / 4
d) There was a good balance of knowledge among the participants and no big discrepancies in the background knowledge were noticed	0 (0%)	2 (6%)	**15 (47%)**	15 (47%)	7.04	32	3.41 / 4
e) The trainer(s) showed a good performance (good time management, ability to communicate clearly)	1 (3%)	4 (13%)	12 (38%)	**15 (47%)**	5.7	32	3.28 / 4
f) The trainer(s) was well prepared and showed a good understanding of the subject	0 (0%)	0 (0%)	13 (41%)	**19 (59%)**	8.28	32	3.59 / 4
g) The support provided by the trainer(s) was good and a good management of questions and answers was done	0 (0%)	1 (3%)	13 (41%)	**18 (56%)**	7.71	32	3.53 / 4
							3.35 / 4

Figure 20: Question 12: Satisfaction with the training

91% agreed that the learning materials were useful (see Figure 20). 53% agreed that the training sessions were dynamic. And 59% strongly agreed that the training session provided the use of digital tools. 94% agreed that the knowledge of the participants was quite coherent. 85% of the participants agreed that the trainers showed sufficient knowledge about their topics and performed well. 100% agreed and strongly agreed that the trainers were well prepared. 56% stringy agreed that the questions were in relation to the content.

	Poorly satisfied	Not enough satisfied	Satisfied enough	Very satisfied	N/A	Standard Deviation	Responses	Weighted Average
a) The knowledge acquired in the training	0 (0%)	4 (13%)	13 (41%)	**14** (**44%**)	1 (3%)	5.95	32	3.32 / 4
b) The skills acquired in the training	0 (0%)	2 (6%)	**19** (**59%**)	10 (31%)	1 (3%)	7.23	32	3.26 / 4
c) The evaluation methods used	0 (0%)	1 (3%)	**14** (**44%**)	11 (34%)	6 (19%)	5.46	32	3.38 / 4
								3.32 / 4

Figure 21: Question 13: Overall evaluation

85% of the participants were satisfied and very satisfied with the knowledge acquired. 90% stated that the skills acquired were satisfying or very satisfying. 78 % were happy with the evaluation method. 84 % stated that the course was reaching their expectations and 97% would recommend the course for other people wanting to learn about the topic (see also Figure 21).

The most positive aspects were selected as the following:

- Applicability on several sectors. Standards used. Time control.
- I have learned about normalization and qualification
- To know the actual stage of the certification and standardization in the additive manufacturing field. Additionally, to observe different examples of certified samples manufactured by additive manufacturing.
- Experiencia muy cercana al entorno industrial y de fabricación
- The experience of the speakers
- In my opinion the best part has been to get information about the AM global industry
- El tema de la estandarización en la fabricación aditiva, porque es muy importante para el sector de mi trabajo que es el ferroviario
- to give light about standardization issues
- Knowledge of the speakers
- The variety of sights from the same topic and the examples showed
- The examples because they are very representatives.
- Knowledge about current standards and real cases.
- CURRENT STANDARDS NEEDED FOR ADDITIVE MANUFACTURING
- Focused on AM
- Knowing the certification schemes applicable to AM, and the coherency that has been applied to this process, with respect to the qualification and management, in relation to other special processes. For example, personnel training per EWF schemes.
- Update on the current status of the regulations
- The knowledge of the participants. It's really interesting to listen their experience.
- practical cases
- Was well focused in Additive Manufacturing
- to understand and learn from certificates and standards
- Information regarding certification and qualification because I need it for my work
- Insights about inflight aerospace components
- Oral presentations

- The people who presented

What was the least positive aspect of the training course?
- I have missed some real examples about AM.
- A little short. More time would be appreciated
- For me there were no negative aspects.
- Transparencias muy densa en algunas presentaciones difíciles de leer en formato online
- For my company, obtaining the ISO 9001:2015 have been enough to comply with the client requirements, so other standards are currently unknown for clients.
- difficulty of following standards numbers due to online meeting and speed
- No access to documentation and training material of the course
- The organization of the certifications, there are many and you get lost.
- I would prefer more real cases be imparted during the webinar.
- A LOT OF REGULATORY AND MESSY
- Too much info for the amount of time given
- Hay muchos puntos que no me han quedado claros. Me ha parecido que faltaba explicar conceptos básicos claves para comprender las presentaciones.
- I am still wondering if we will receive the course material in pdf format. Still no answer to that question. I would have taken more notes!
- Sometimes quite intense information, maybe too deep if you're not working on these areas.
- Too much information for the hours that the course took

Further comments and suggestions:
- More practical examples would be welcome
- In my opinion, it was very useful the use of Slido
- Try to improve the order of the explanations
- Please send course material to participants in pdf format, if possible!!! If not, at least the contact information of the people who presented.
- I found the use of the surveys very useful and dynamic
- More practical content and examples.

Analysis of results:

The results seem very promising. People were happy with the support they received from the provider and found the equipment useful.

In general, with regards to the content provided, most answers were ranging from satisfied to very satisfied. Hence, people were overall satisfied with the content and learning outcomes. As the topics for certification, qualification and standardization are quite similar, it was found that the contents were sometimes not structured or overlapping or repeating. This is somehow in the nature of the topic. Furthermore, people seemed confused about the vast amount of input in too little hours. Here, it could be useful to focus on less topics and concentrate on just a few

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Qualification/Professional Profile: Process Engineer PBF-LB | 2 Competence Units: Metal AM Designer

Project No. 601217-EPP-1-2018-1-BE-EPPKA2-SSA-B

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applications. On the other hand, people seemed very happy with the examples that were provided from aerospace and from certification in general.

One positive aspect is that people acknowledged that all trainers showed an immense amount of knowledge about their topics. Another positive aspect was, that the participants seemed happy with the

As was seen for the other piloting studies, the number of practical hours (practical content) was again rated very low. However, the topic does not leave a lot of room for practical work.

6.1.3. Feedback from participants on CU63: Certification, Qualification and Standardization in Additive Manufacturing piloted by FA

The feedback report provided by ISQ has shown that only 16 attendees out of the 76 that participated in the pilot, responded to feedback survey. Those that responded to the survey were male, spanning the following age range: 19% under 26y, 38% between 26-35y, 38% between 36-55 and the finally 6% more than 55y.

Out of the responses it is possible to observe that the attendees were from different countries including Portugal, Belgium, Spain, UK, Austria, Germany, Greece, South Africa, India, Canada and Norway. Moreover, the results show that the sectors of the organization of the attendees were very diverse as shown in the image bellow. The "other" were from R&D.

31% (5) Aerospace	**13%** (2) Automotive	**6%** (1) Defense	**6%** (1) Consumer goods
13% (2) Construction	**13%** (2) Energy	**0%** (0) Health	**31%** (5) Industrial equipment and tooling
25% (4) At the moment, I am not working at any organisation	**19%** (3) Other (Please Specify)		
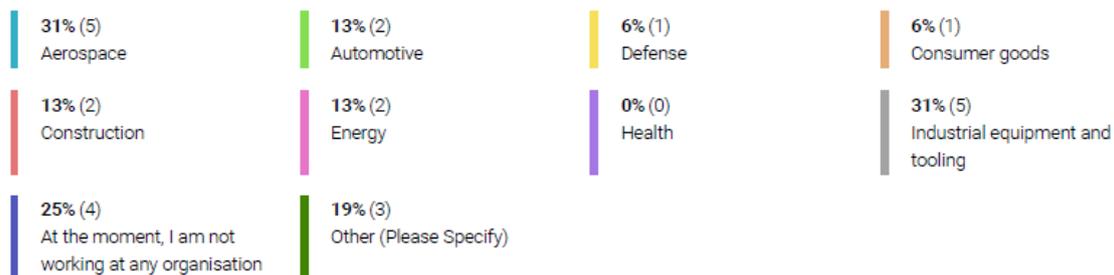
Figure 22 Sectors from the attendee's organizations

Most of the attendees had a higher education background being 75% with Engineering Degree or master's degree and 19% Doctoral degree. The knowledge of the attendees regarding Additive Manufacturing was very high as most of them were actively evolved in the field of AM.

Overall, the level of satisfaction regarding the conditions of the training scored **3,39/4** as shown in image below:
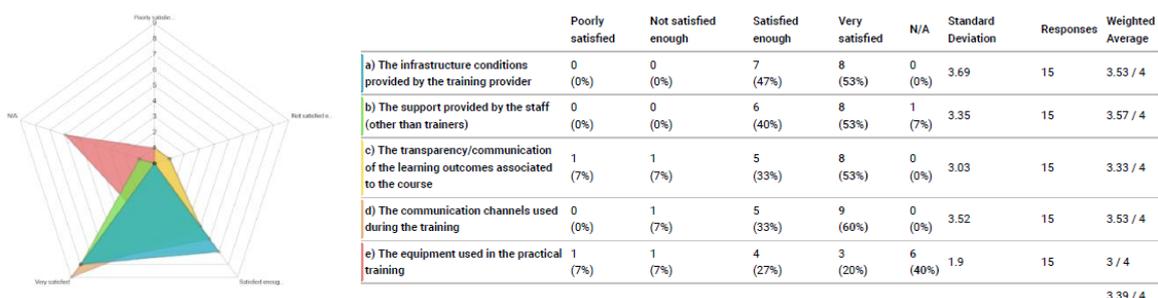
	Poorly satisfied	Not satisfied enough	Satisfied enough	Very satisfied	N/A	Standard Deviation	Responses	Weighted Average
a) The infrastructure conditions provided by the training provider	0 (0%)	0 (0%)	7 (47%)	8 (53%)	0 (0%)	3.69	15	3.53 / 4
b) The support provided by the staff (other than trainers)	0 (0%)	0 (0%)	6 (40%)	8 (53%)	1 (7%)	3.35	15	3.57 / 4
c) The transparency/communication of the learning outcomes associated to the course	1 (7%)	1 (7%)	5 (33%)	8 (53%)	0 (0%)	3.03	15	3.33 / 4
d) The communication channels used during the training	0 (0%)	1 (7%)	5 (33%)	9 (60%)	0 (0%)	3.52	15	3.53 / 4
e) The equipment used in the practical training	1 (7%)	1 (7%)	4 (27%)	3 (20%)	6 (40%)	1.9	15	3 / 4
								3.39 / 4

Figure 23 - Satisfaction stats regarding conditions of the training

Regarding the level of satisfaction of the entire training the score was **3.18/4** as shown in the following image:

	Poorly satisfied	Not satisfied enough	Satisfied enough	Very satisfied	N/A	Standard Deviation	Responses	Weighted Average
a) The structure of the course	0 (0%)	0 (0%)	9 (56%)	7 (44%)	0 (0%)	3.97	16	3.44 / 4
b) The contents addressed during the course	0 (0%)	1 (6%)	7 (44%)	8 (50%)	0 (0%)	3.54	16	3.44 / 4
c) The coherence of the course with the training programme (was the order of contents presentation respected by the training provider?)	0 (0%)	0 (0%)	6 (38%)	9 (56%)	1 (6%)	3.66	16	3.6 / 4
d) The number of contact hours	0 (0%)	4 (25%)	5 (31%)	7 (44%)	0 (0%)	2.79	16	3.19 / 4
e) The balance between theoretical and practical training	2 (13%)	1 (6%)	5 (31%)	1 (6%)	7 (44%)	2.4	16	2.56 / 4
f) The number of contact hours allocated to practical training	1 (6%)	1 (6%)	3 (19%)	2 (13%)	9 (56%)	2.99	16	2.86 / 4
g) The relevance of the course to your job activities	0 (0%)	0 (0%)	6 (38%)	10 (63%)	0 (0%)	4.12	16	3.63 / 4
h) The match between learning outcomes foreseen for the course and what the course covered	0 (0%)	0 (0%)	7 (44%)	7 (44%)	2 (13%)	3.19	16	3.5 / 4
i) The amount of time to train with an AM machine	3 (19%)	0 (0%)	4 (25%)	1 (6%)	8 (50%)	2.79	16	2.38 / 4
								3.18 / 4

Assessing the feedback of the training course, the results show that the less positive marks are related to the practical content of the training course.

Figure 24 - Satisfaction scores of the training course

Taking into consideration the content and scope of the Competence Unit it is expected teaching method focusing on more theoretical content, thus, questions addressing practical training fall out of the expected activities off the training. Nevertheless, some replies are less positive in those. Also, the number of contact hour received a lower mark, unfortunately no further comments were made.

Addressing the training sections, the overall score was **3,32/4** as shown in the image below.

	Strongly Disagree	Disagree	Agree	Strongly Agree	Standard Deviation	Responses	Weighted Average
a) The learning materials (i.e. slide shows, handbooks, videos, samples) were useful	0 (0%)	1 (6%)	8 (50%)	7 (44%)	3.54	16	3.38 / 4
b) The training sessions were quite dynamic, in the sense that they were engaging and involved interactive activities, instead of being just expositive)	0 (0%)	4 (25%)	8 (50%)	4 (25%)	2.83	16	3 / 4
c) The training sessions promoted the use of digital tools	1 (6%)	2 (13%)	8 (50%)	5 (31%)	2.74	16	3.06 / 4
d) There was space for active learning methodologies, such as problem-based learning, project-based learning, gamification, augmented reality, virtual reality, collaborative learning, etc.	1 (6%)	5 (31%)	8 (50%)	2 (13%)	2.74	16	2.69 / 4
e) The contact hours allocated to the course was adequate to the amount and nature of the course contents	0 (0%)	2 (13%)	11 (69%)	3 (19%)	4.18	16	3.06 / 4
f) There was a good balance of knowledge among the participants and no big discrepancies in the background knowledge were noticed	0 (0%)	2 (13%)	10 (63%)	4 (25%)	3.74	16	3.13 / 4
g) The trainer(s) showed a good performance (good time management, ability to communicate clearly)	0 (0%)	0 (0%)	8 (50%)	8 (50%)	4	16	3.5 / 4
h) The trainer(s) was well prepared and showed a good understanding of the subject	0 (0%)	0 (0%)	5 (31%)	11 (69%)	4.53	16	3.69 / 4
i) The support provided by the trainer(s) was good and a good management of questions and answers was done	0 (0%)	0 (0%)	9 (56%)	7 (44%)	4.06	16	3.44 / 4
							3.22 / 4

The marks received are positive and provide an overview of the training sections. The results are aligned with the previous results, there are less positive feedback regarding the practical and more digital part of the training. The feedback regarding the trainers and the way the

Figure 25 – Satisfaction scores regarding the training section

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sections were carried are extremely positive with scores higher than 3.5/4. No further comments were given.

The last section addressing the overall satisfaction of the efficiency of the course ranked **3,21/4** as shown in the next image.

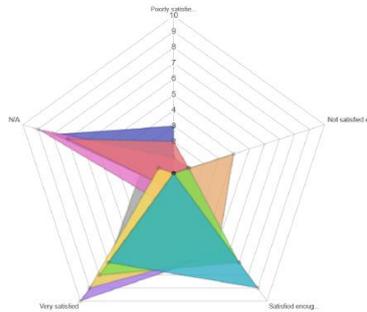|	Poorly satisfied	Not enough satisfied	Satisfied enough	Very satisfied	N/A	Standard Deviation	Responses	Weighted Average
a) The knowledge acquired in the training	0 (0%)	2 (13%)	8 (50%)	6 (38%)	0 (0%)	3.25	16	3.25 / 4
b) The skills acquired in the training	0 (0%)	1 (6%)	11 (69%)	3 (19%)	1 (6%)	4.02	16	3.13 / 4
c) The evaluation methods used	1 (6%)	0 (0%)	9 (56%)	6 (38%)	0 (0%)	3.66	16	3.25 / 4
								3.21 / 4
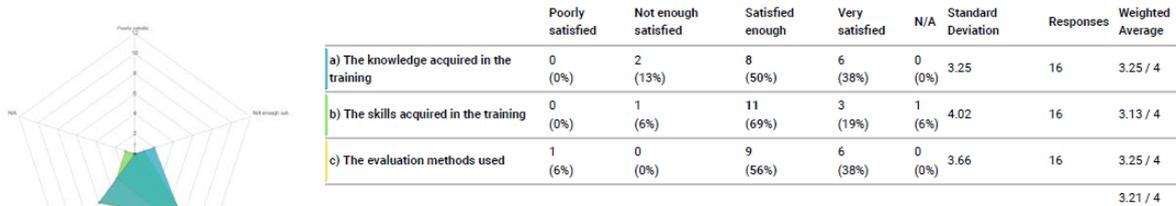
Figure 26 – Satisfaction scores regarding the overall training course

Also, it is important to highlight that the training course have met the expectations of all that responded to the feedback questionnaire and all of them would recommend it to others.

The remarks and comments provided by the trainees about the most positive aspect of the course were:

- Knowledge and expertise of the trainers from prestigious institutions
- Content and information shared
- Clear and valuable content/information

In terms of things that could be improved the comments follow:

- More in-depth information about practical examples
- More engaging on-line activities (e.g. game session)
- When possible, have face-to-face training
- Confusion on initial communications

Overall, the comments were quite positive in regard to the training. The fact that the training was provided virtually (on-line) was a less positive aspect, but the knowledge and expertise of the trainers elevated the quality of the training and were capable of delivering and sharing valuable knowledge and content to the attendants.

6.1.4. Feedback from participants on CU64: Business for Additive Manufacturing piloted by EC Nantes

General information on the participants:

Totally 43 participants completed the survey, including 9 female (21%) and 34 male (79%). Regarding the participants' age range, around half of them (21 out of 43) were between 26-35 years old, while 18% were under 26 years old and only 9% were over 35 years old.

Most of participants took this course from Europe, the highest one was Italy where 17 students (40%) stayed there. In addition, some participants joined from India, Saudi Arabia, and Nigeria.

Regarding the profession of the participants, there were 32 university students (74%) and 11 works (26%). Among workers, 28% of them worked at Industrial equipment and tooling sector, 22% at Aerospace. Also 56% indicated other sectors, mostly from R&D department. On the other hand, 26 participants (60%) studied at engineering programs in Master level, followed by Bachelor students (21%) and PhD candidate (16%), in respective.

The results revealed a big diversity in professional background and pervious experience of students in AM domain. Some participants stated they have been working in AM field for more than 20 years, while some students joined this course only with basic knowledge in AM.

Level of satisfaction with the training conditions:

In overall, the results show the participants were satisfied with the training conditions, the weighted average for all items was 3.73 out of 4, all were higher than 3.65. Interestingly, 74% of participants selected "Very satisfied" option, the highest score, for the support provided by staff and trainers, and the communication channels used during the training.

Level of satisfaction with the course:

The results indicate that the course could satisfy the participants where the weighted average of all items was 3.35 out of 4. While, it was revealed less satisfaction in the balance between theoretical and practical training, 25% of participants selected either Poorly satisfied or Not satisfied enough options. It was the only item with a score of less than 3, which was 2.89 out of 4. This result was not surprising because virtual training gave less possibility to practical exercises. In addition, the result showed that participants had conflicting opinions about the contact hours allocated to the course, while 40% indicated Very satisfied, 24% selected either Poorly satisfied or Not satisfied enough options. In contrast, as an outstanding result, 58% of participants indicated that they were Very satisfied about the contents of the course, whereas there were only 1 participant who selected Poorly satisfied option.

Table 4: The results of the two least satisfied items
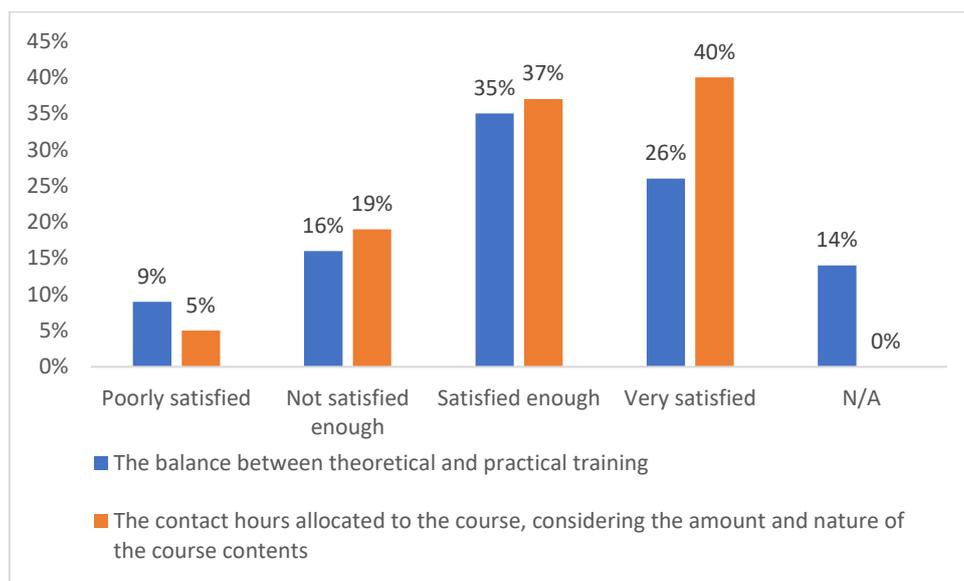
Blue: The balance between theoretical and practical training

Orange: The contact hours allocated to the course, considering the amount and nature of the course contents

	Poorly satisfied	Not satisfied enough	Satisfied enough	Very satisfied	N/A
The balance between theoretical and practical training	9%	16%	35%	26%	14%
The contact hours allocated to the course, considering the amount and nature of the course contents	5%	19%	37%	40%	0%

Level of satisfaction with the course:

In general, it was seen a good level of satisfaction with the course among the participants, the weighted average of all items was 3.32 out of 4. The highest levels of satisfactions were associated with trainers' qualities. 65% of participants were Strongly agree that the trainers were well prepared and showed a good understanding of the subject, followed by good performance of the trainers where 60% of the participants selected Strongly agree option. While, regarding the dynamic and interactionon of the training session, 26% of the participants rated to either Strongly disagree or Disagree. It was the only item with a score of less than 3, which was 2.81 out of 4. Again, less possibility to use collaborative learning methods such as group discussion and problem-based-learning, which was due to virtual training, may have caused the sense of less engagement and involvement in the learning process.

Global evaluation of the course effectiveness:

Interestingly, the results showed that the participants were satisfied with knowledge and skill they acquired with this course. Expectedly, they were more satisfied with knowledge they achieved rather than the acquired skills. Namely, 51% of the participants rated Very satisfied with the knowledge acquired in the training, while it was 37% for the acquired skills. In addition, most of the participants (56%) rated to Satisfied enough for the evaluation method used in this course.

On the other hand, 37 participants (86%) stated that this course fulfilled their expectations and only 6 participants (14%) believed this course didn't meet their expectations. In addition, 41 participants (95%) would have liked to recommend this course to others.

Table 5: The weighted average score for four pillars of satisfaction
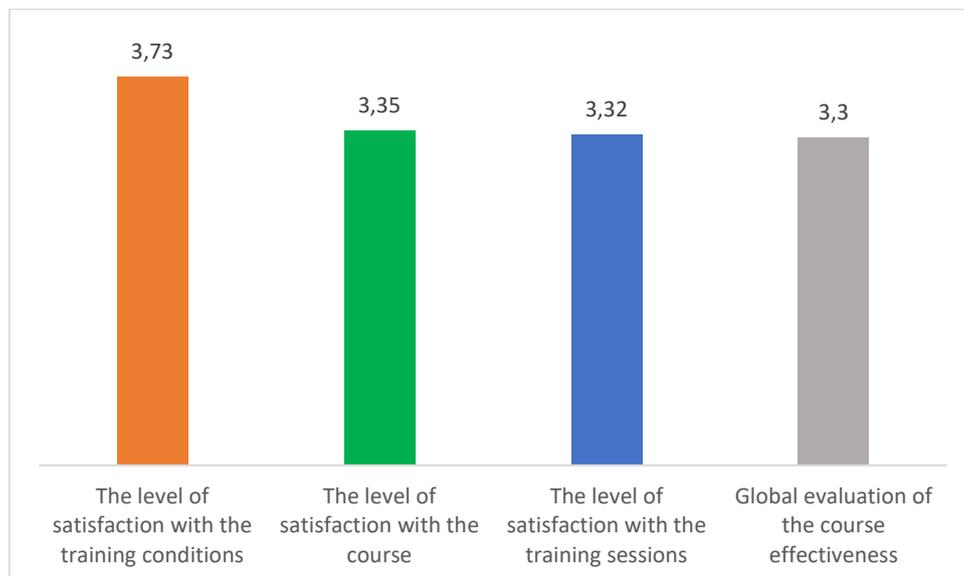
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6.1.5. Feedback from participants on CU65: Overview on polymer materials and properties piloted by URUN

Figure 27 shows the survey results of the level of satisfaction for the course from the participants. The results showed that the participants were generally satisfied with the course. However, it is worth noting that a small proportion (two – five out of 53) of the participants were not satisfied with the contents addressed during the course and the relevance of the course to their job activities.

Figure 27: Level of satisfaction with the course

Figure 28 shows the level of satisfaction with the training sessions. A substantial proportion of the participants agreed and strongly agreed with the learning materials and contents of the training sessions. On the other hand, out of the 53 survey responses, two – three participants did not agree that the course was dynamic, used digital tools and had a good balance of knowledge among the participants.

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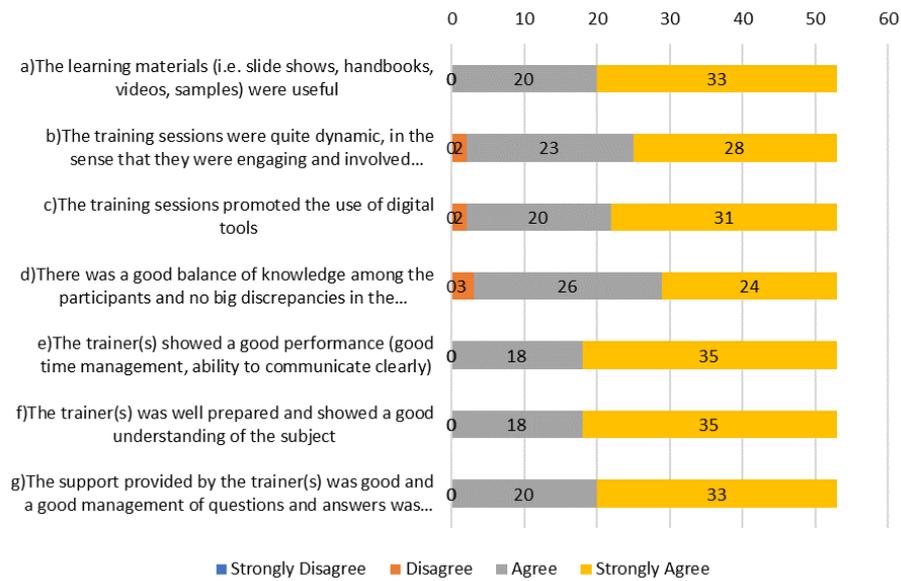
Figure 28: Level of satisfaction with the training sessions

Figure 29 shows the global evaluation of the course effectiveness. All the 53 responses were satisfied with the knowledge acquired during the training and the evaluation methods used during the course. In addition, 49 participants were satisfied with the skills acquired, however, 2 participants were not satisfied with the skills acquired.

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Figure 29: Global evaluation of the course effectiveness

Figure 30 and Figure 31 show that 94% of the participants stated that the course met their expectations, and 98% of the participants will recommend it to others.

Figure 30: Course expectation
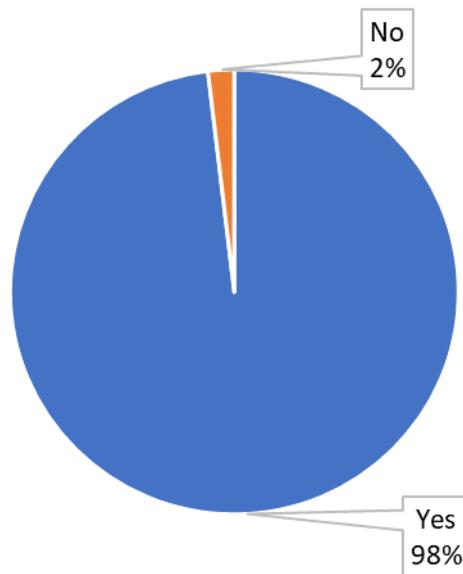
Figure 31: Course recommendation

Some of the **positive aspects and comments** of the course from the participants are summarised below:

- Content of the course (i.e., introduction to AM polymers, AM polymers and their properties, AM polymers across different sectors, AM processes)
- Delivery and engagement of the course, for example:
  - o The use of Slido, Vevox platforms to promote interactivity and engagement
  - o Use of good visuals (e.g., images, charts and videos)
- The use of real-life and practical examples, for example:
  - o The use of Ansys software platforms for real-life examples and charts
- Timing and structure of the course (i.e., short and straightforward, relevant and up-to-date information about AM)
- Free availability and provision of teaching materials and resources (e.g., presentation files, links for further learning)
- Knowledge of the trainers

On the other hand, **details of the aspects of the course that can be improved** are summarised below:

- Inaccessibility and lack of practice on the Ansys software platform
- Lack of provision of hands-on practical sessions
- Short duration of the course
- Lack of in-depth and covering of more advanced topics
- Time zone clashes for some participants

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6.1.6. Feedback from participants on CU65: Overview on polymer materials and properties piloted by ISQ

In this e-learning course, 12 trainees – 9 men and 3 women - went through the exam and filled out the (D2.7) feedback survey. Most of them were aged between 36 and 55, but there was also one in the age range of 15-25, and another one 26-35. Except for one participant, who was a university student, all trainees were workers. This data is shown in the charts below:

Age of the participants

- 15 - 25
- 26 - 35
- 36 - 55
- 56 - 99

Profile when engaging in the course

- Worker
- Higher Education Student
- VET trainee
- Unemployed

Main activity/sector of "workers" organisations

In the "Other" option, trainees specified:

- *Quality control*
- *Jewellery*
- *Education*
- *Industrial inspections*
- *Production of Cork Stoppers*

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- *VET course coordinator and professor of polymers and polymer transformation techniques*
- *Inspection of equipment in the factory (paper industry and tanks). Certification of welders.*

In terms of education background, the next figure shows the picture:
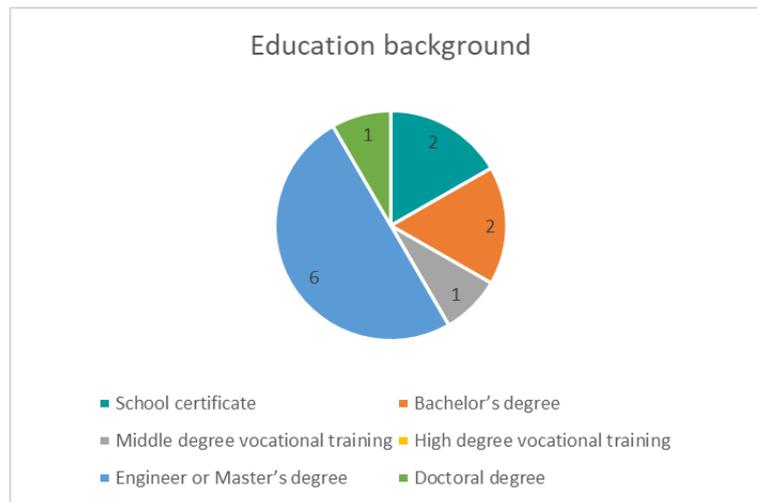
As to the trainees' satisfaction with the training conditions, it was quite positive, as can be seen in the next chart:
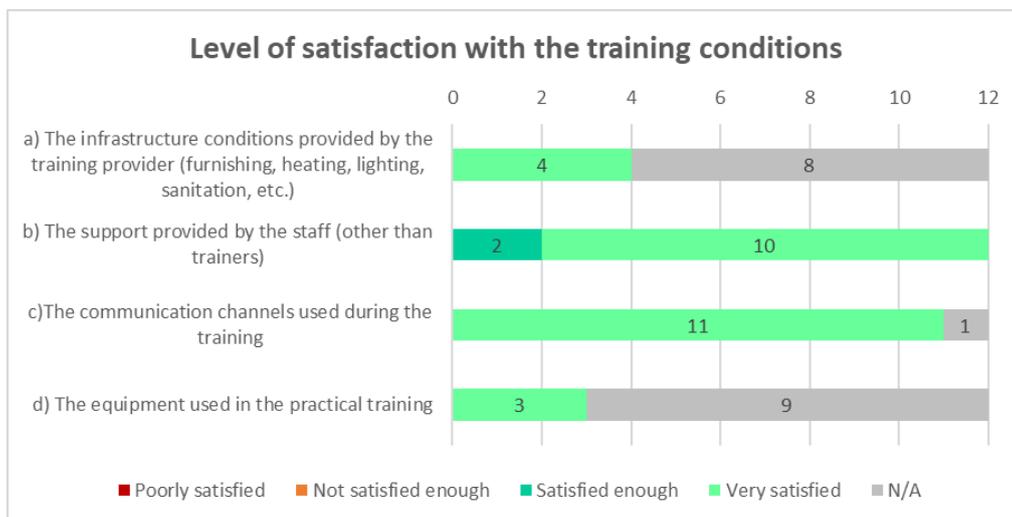
Also, the satisfaction with the training course was high, as can be seen in the next chart. Nonetheless, two trainees believe the course is not that relevant for their job activities (at least at their current job).

We would like to highlight the fact that the trainees could identify the learning outcomes of the CU65 and match them with what the course covered. This is due to an effort in making it clear exactly what the learning outcomes were – in the beginning of the course and at the end (before the exam) – and preparing the learning materials accordingly.
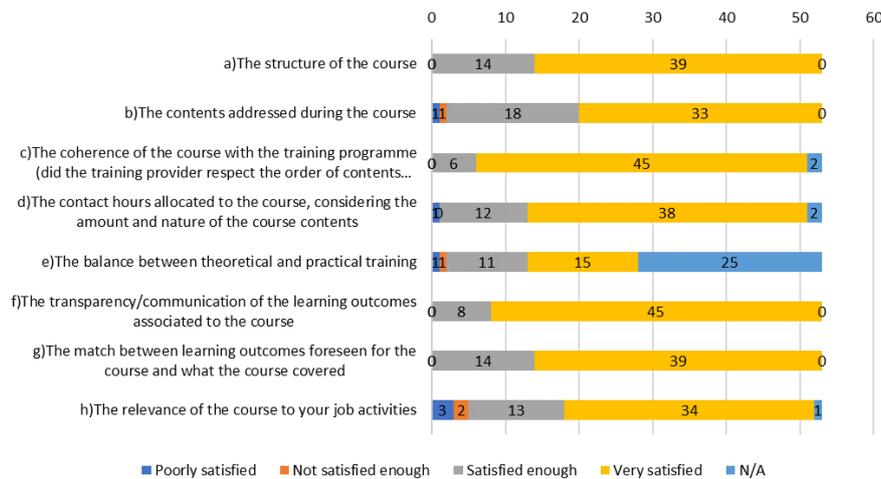
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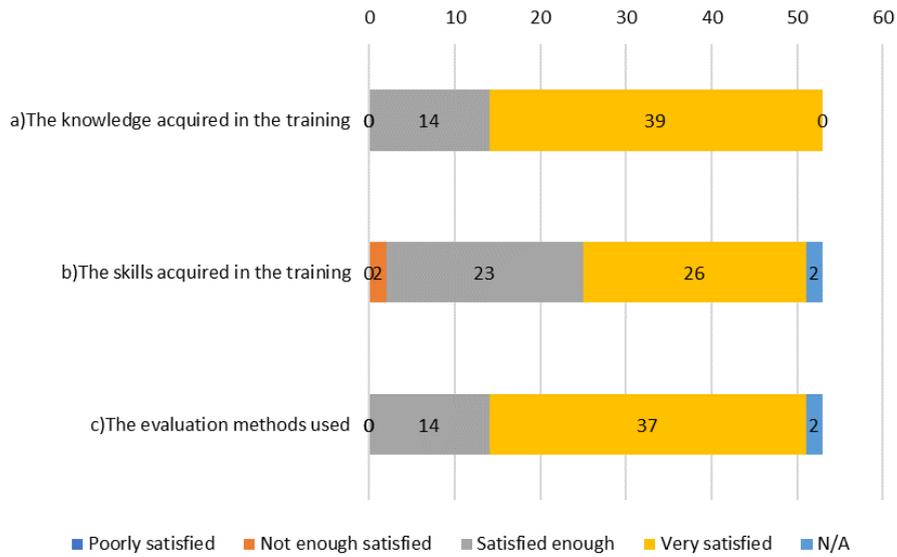
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Level of satisfaction with the course
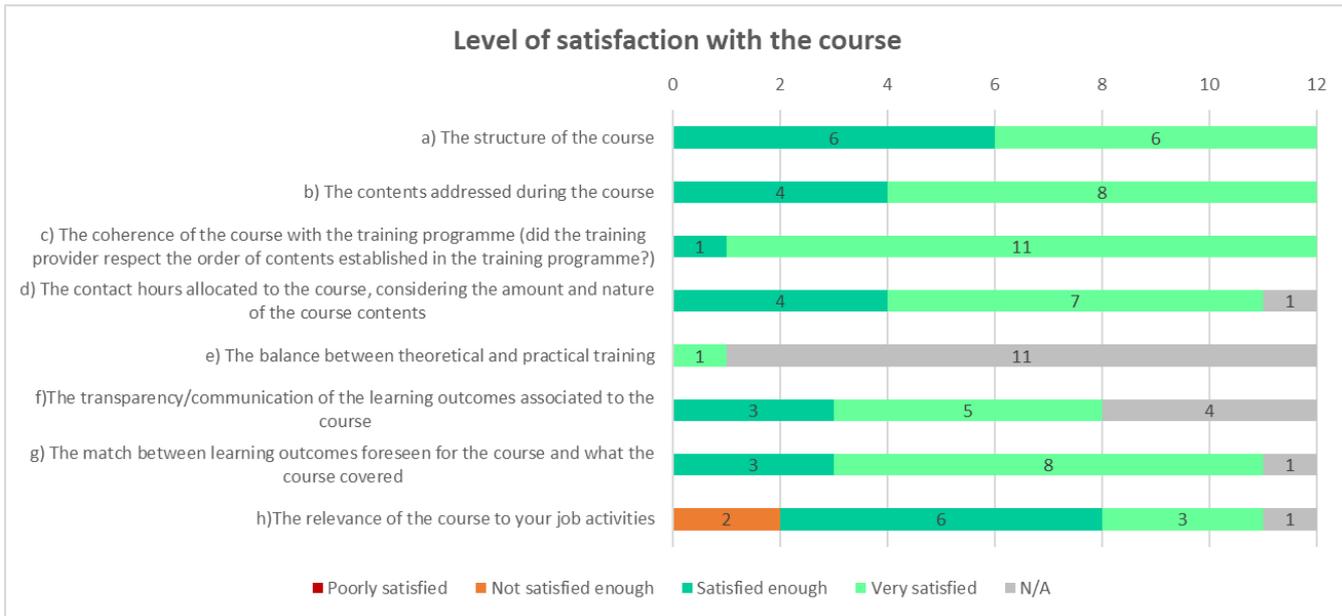
Regarding the training sessions, some fewer positive points were pointed out by trainees and we analyse each of them:

- The great majority of trainees (11 out of 12) thought the training sessions were dynamic, even if there was no use of PBL, AR or AR, as it was not just expositive and there was space for participants to present, themselves and one by one, the result of their assignment.

Level of satisfaction with the training sessions

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- Two participants don't think the training sessions promoted the use of digital tools, while the other 10 think there was. Maybe some considered being an online course and requiring the preparation of a presentation (assignment) corresponds to "using digital tools" and some others were expecting more, in terms of digital tools to be used.
- One trainee recognized a somewhat discrepancy among the knowledge of the audience and this was, in fact, noticed in the first session – those who didn't have the necessary background knowledge ended-up dropping out from the first to the second training session.
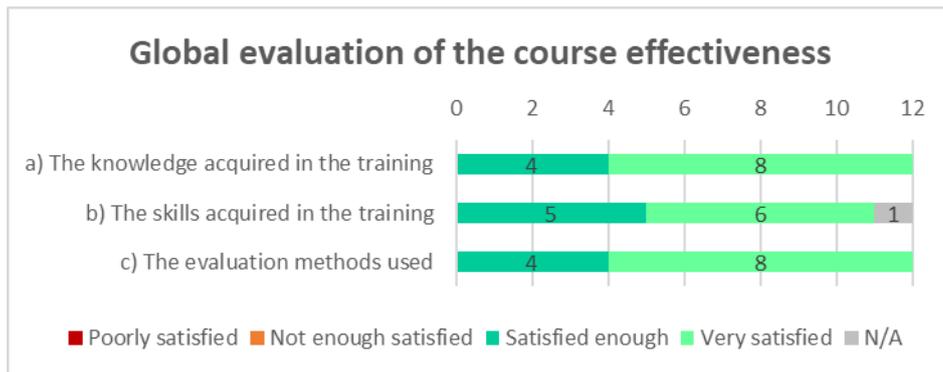
Trainees were satisfied, in a greater or lesser extent, with the course effectiveness. All trainees said the course met their expectations and they would recommend the course to others.

6.1.7. Feedback from participants on CU66: Designing Polymers AM Parts piloted by MTC

The analysis of the results of the student feedback survey are given in the appendix and are summarised below.

Background of Participants

Demographics of participants (Questions 1, 2, 3 and 4):

- 70% male and 30% female

- 63% of the participants were less than 35 years old

- 93% of the attendees were from the UK with the remaining 7 % split evenly Greece & Austria

Professional Profile (Question 5):

74% of the participants were workers within an industry, whilst the remaining 26% were Higher Education Students.
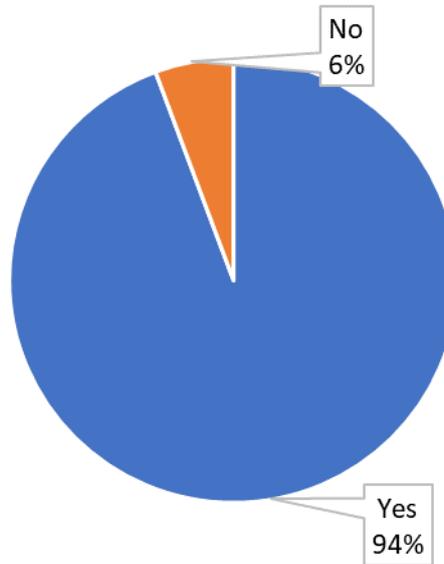
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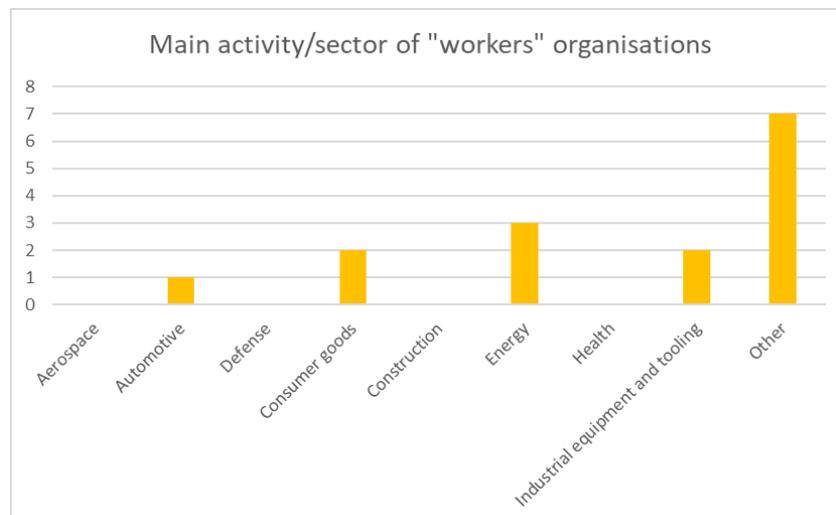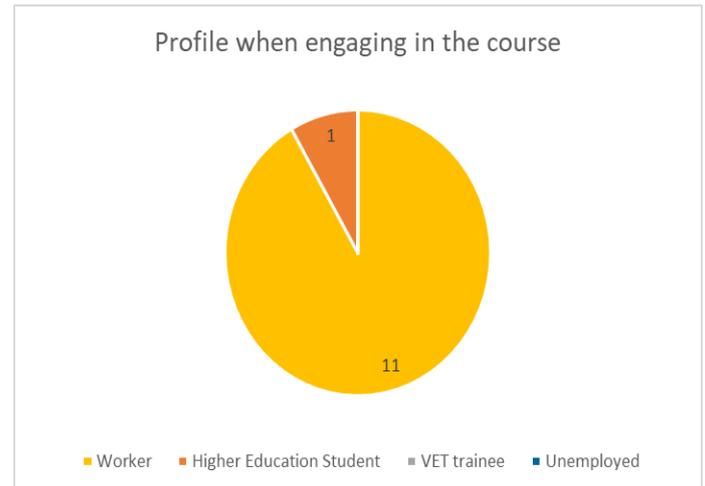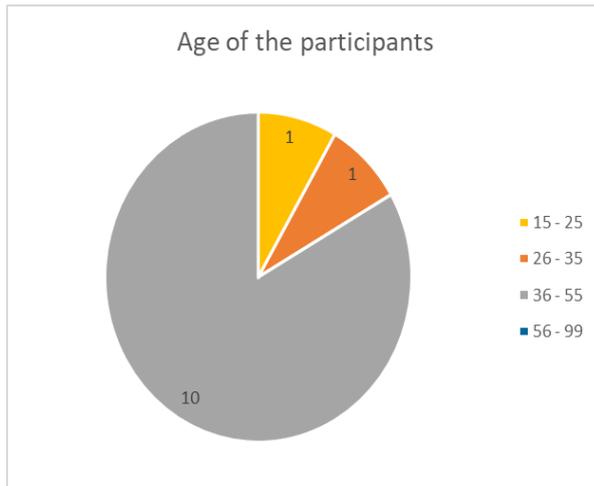Qualification/Professional Profile: Process Engineer PBF-LB | 2 Competence Units: Metal AM Designer
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Industrial Background (Question 6):

33% from Aerospace, 19% from automotive, 29% from defense, 5% from health, 5% from energy, 10% from industrial equipment & tooling whilst the remaining 24% were in others including manufacturing, research, maritime for example.

Educational Background (Question 7):

- 11% had a Doctoral degree

- 41% had a Master's degree

- 44% had a Bachelor's degree

- 7% had School certificates

- 4% had High degree vocational training

Previous Additive Manufacturing Experience (Question 7):

Some quotes directly from the participants themselves are provided below:

- I am currently studying for a PhD (CDT in Topological Design), where I am working between maths and engineering in the attempt to exploit analogies between 3D plant growth and AM to aid Design for AM. My only experience comes from the literature I have read around additive manufacture (particularly extrusion-based AM).

- Design and manufacture of about a dozen small polymer components as part of masters group project at university. Limited experience during working career however I've designed a single concept piece for manufacture by metal additive manufacture.

- I have a number of consumer-level MEX (FDM) polymer 3D printers at home and also use FDM in my research. I'm very familiar with preparing, printing and post-processing polymer FDM parts, and am very comfortable with editing G-code etc. However, my knowledge of polymer AM starts and ends there. I have no experience/little knowledge of resin and powder-based poly AM technologies. Taking this course has been very eye-opening in that regard.

- Led company effort on Wire Arc Additive Manufacturing (WAAM) at previous company, participated in several conferences and contributed to the MASAAG (Military Airworthiness Guidelines) on AM from a metal/wire perspective. Am now part of the AM team at my current company.

- No previous additive manufacturing experience

- Personal interest in the area, as well as R&D work involving AM. Still relatively new to the field and looking to expand my knowledge further

- Indirect, have worked in Automotive for last 15 years, and around a decade of that within the Prototype and Development areas of the industry and been exposed early on to AM technologies we had in the business. I have drifted closer and closer to design until joining the Prototype Design team a year ago including developing parts specifically

for AM. Outside of work I have spent some time designing parts for extrusion (FDM) and have recently acquired a VPP resin device which I hope to start using soon.

- I have a long-held interest in additive manufacture and am currently in the process of setting up an Elegoo Saturn MSLA printer at home - with a soon-to-be-released FDM printer also on pre-order.

- CNC Programmer / Setter from school to now with no AM experience

- I work in the Materials department and have responsibility for coordinating the testing and qualification of polymer AM parts for aerospace applications

- Little to no previous experience. Designed parts for creation using AM technologies which is being utilised more frequently

- Developed interest in AM out of that and have gradually got more involved in it on the R&D side and some limited support to production. Materials focus more than designer

- Additive manufacturing experience with university's lab FDM 3d printers for research

- Basic use of FDM printing for university projects. designing components for AM, design proving of tooling

- I have only had 3 months experience in the sector and am widening my understanding of materials engineering by exploring additive manufacture.

- I don't have much previous experience in AM, only some information at University.

- Limited experience of AM other than previous discussions with MTC

- I have a lot of experience with AM having used it for part production for around 8 years to create complex design models.

- University and personal maker/prototyping

- Zero experience with AM before this training.

- None

- Had a small experience working with AM machines

- Student, still learning industrial design

Participants feedback on the level of satisfaction with the training conditions

Overall, the feedback on the training conditions were very positive with the majority of people being very satisfied and in other cases satisfied with this aspect of the course. Some questions were not relevant as the training course was conducted online, therefore some of the questions received a high number of N/A responses.

Infrastructure conditions (Question 10a)

This training course was conducted online, therefore this question is not relevant.

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Staff Support (Question 10b)

70% of participants were very satisfied by the support offered by MTC staff, 22% satisfied and the other 7% ticked N/A.

Communication Channels (Question 10c)

100% of the participants were either satisfied or very satisfied by the communication channels used.

Equipment used in practical training (Question 10d)

This question was not applicable as there were no equipment used during the practical training.

Participants feedback on the level of satisfaction with the training course

Course structure (Question 11a)

74% were very satisfied whilst 26% were satisfied.

Course content (Question 11b)

70% very satisfied with 30% satisfied.

Coherence of course with training programme (Question 11c)

85% very satisfied with 11% satisfied.

Contact hours allocated (Question 11d)

85% very satisfied with 15% satisfied.

Balance between theoretical and practical training (Question 11e)

A large majority of N/A responses. Although there were a large number of practical exercises and quizzes, this question may have confused the attendees in their responses with physical training.

Transparency of learning outcomes (Question 11f)

81% very satisfied with 19% satisfied.

Meeting the initially stated course/learning outcomes (Question 11g)

81% very satisfied with 19% satisfied.

Relevance of course to job activities (Question 11h)

59% very satisfied with 33% satisfied and 4% not satisfied.

Participants feedback on the level of satisfaction with the training sessions

Learning material (Question 12a)

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56% strongly agreed with 44% agreed.

Level of engagement and interaction (Question 12b)

37% strongly agreed with 63% agreed.

Prompting digital tools (Question 12c)

41% strongly agreed with 59% agreed.

Participants knowledge consistency (Question 12d)

48% strongly agreed with 44% agreed and 4% disagreeing.

The trainer's performance in terms of management and communication (Question 12e)

78% strongly agreed with 19% agreed and 4% disagreeing.

Level of subject understanding from the trainers (Question 12f)

96% strongly agreed with 4% agreeing

Support provided and ability to answer questions (Question 12g)

93% strongly agreed whilst 7& agreed

Global Evaluation of the course effectiveness

Knowledge acquired in the training (Question 13a)

78% very satisfied with 22% satisfied

Skills acquired in the training (Question 13b)

44% very satisfied with 44% satisfied

Evaluation methods used (Question 13c)

63% very satisfied with 33% satisfied

Extent to which the course met their expectations (Question 14)

100% of the participants agreed that the course did meet their expectations

Extent to which the course met their expectations (Question 15)

100% of the participants agreed that they would recommend this course to others.

Participants feedback on the most positive aspect of the training course

Some quotes directly from the feedback survey are provided below in bullet point format.

- The lecture on the different systems of photopolymerization

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- The fact that the course effectively started from first principles, was perfect for my level of experience. That being, someone with an interest in AM, and some level of understanding re the basics, but limited knowledge of printing technology beyond SLA and FDM. One aspect of the course which stands out, was the emphasis on design for AM, something which I had not particularly considered prior to the training.

- It was good to see all the information revolving around DfAM brought together and being able to see how they all link together - the order of the sections worked well.

- Very broad overview explaining the entire process and how each part of the process connects to each other.

- The depth of knowledge and detail presented on each subject. very thorough presentation. trainers very knowledgeable and able to answer questions well.

- Course was very informative. Learned a lot from this course.

- The early stages of the course, learning the basics of AM because of our current situation at work.

- I enjoyed the exercises as it allowed me to practically think about the content that we were learning and apply it to an example scenario. I think that the course covered a lot of material so was a great overview of the basics for someone who does not know much about additive manufacture. Sufficient number of breaks and a good amount of content over the 6 sessions, so it was easy to remain involved and focused.

- A better appreciation of technologies that fall outside of the most commonly known (that is to say other that material extrusion, Vat Photopolymerization and Powder) because that tells us where the industry is going. That said, it's hard to pick one thing, the materials section was enlightening and so was design considerations for the tech we use less often.

- The way the course was presented: excellent clear speakers and slides, illustrative simulations, discussion groups, quiz sessions, timed breaks etc. Very engaging. The breadth and depth of subjects covered. Although I am still not an expert in polymer materials, it has given me a very clear foundation and I think I understand what questions to ask and what gaps in my knowledge need to be filled with a further course or experience.

- This training provided a great insight into AM, starting with the basics in order to give everyone a good grounding, (which was incredibly useful for me as I have only been exposed to one or two types of AM technologies), before building up to the more complicated things. However, at no point did I feel like I was in over my head, and the content gave me new enthusiasm, especially around FE modelling, something I'd previously dismissed and didn't want to learn prior to this course. The trainers were supportive and clear; a winning combination.

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- Engagement and multiple different group discussions enabled multiple perspectives from different people

- The breadth of content - it really makes you appreciate the various steps in the DfAM process

- The interactive part of taking AM decisions about 3d printing, including material and methods selections

- The wealth of knowledge and expertise that was shared, ease of asking questions and having them answered

- Excellent overview of the capabilities of Polymer AM plus good information on the steps required for Design for Manufacture.

- The knowledge the course presenters had, they were able to work together as well, if a question was asked then a member of the team was able to give a detailed response.

- Gave me a good understanding of the additive manufacturing process and the problems that may be experienced during the development stages

- Course was delivered clear and the duration was about perfect any longer would have hindered the processing of the information.

- Vastly enhanced my knowledge with regards to designing for AM manufacture and the strengths and weaknesses of the various technologies and materials available.

- Build methodology & theory. As a business we're only beginning our journey into AM & this element has provided the foundation 'first principle' steps to allow us to proceed.

- I have come in with zero knowledge of additive manufacture and feel I now appreciate the different methods of polymer AM and can apply this in the business. I am able to understand the design stages and materials for different applications.

- A very wide range of knowledge and examples in professional additive manufacture.

- The whole course content gave a good overview of AM from basic topics to more advanced considerations

- A very wide range of AM considerations were covered

- The understanding of how to integrate theoretical knowledge with the actual and practical needs of designing for AM

Participants feedback on the less positive aspect of the training course

Some quotes directly from the feedback survey are provided below in bullet point format.

- I would rate my satisfaction with the course as positive - especially considering it was provided to me at no cost. If I were a paying customer, I would have wanted the course

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materials to be have been made available, for future reference. I would have also liked to have seen a list of "further reading" and a framework for ongoing study established. As it is, the content of the course is provided by means of slides, none of which are accessible once the course tutors move past them. This can be frustrating when trying to cross-reference information or being unable to refer back to previous slides as desired.

- I felt sometimes the information was presented too fast and I struggled to keep up.

- Technical difficulties experienced with the use of presentation software. Explanation of generative design wasn't explained very clearly.

- Initial IT issues caused confusion at the start, but issues fixed quickly during the training. a lot information to take in over 3.5-hour sessions.

- The fact it was an online course with no hands-on practical elements.

- Some more interaction and examples could be useful in understanding the content and having context that could be related to in industry. Occasionally the sessions overran and the information was run through very quickly.

- Would have preferred face to face presentations as I find these more interactive. Also, attendance at the MTC would perhaps support more 'Hands-on' practical examples too.

- Feel mean saying this but some of the discussions were accompanied by very fast transition of slides which made it harder to keep track of both speaker and what was being graphically presented. Llyr was probably the gold standard for presentation as he tended to flick through slides at a slower rate and spoke clearly which gave the students more time to digest the information. But that's not to be critical of anybody else in a negative way. The demonstrations of software were perhaps a little more in depth than needed as everybody will be left with a unique software solution so only an overview was needed, whereas actual design practices are most essential to attendees. Much time was given to design optimization, but it was only really on the last day that it pressed home the need to consider what material properties to assign to CAE activities based on the directional strength dependent on the material strata, and that most software can on deal with homogenous structure materials, this would have been quite important early on I feel to bake into the part design

- Microsoft Teams was used and we generally had problems when moving into small group sessions, some people lost connection or audio for example so missed things. This is not really the fault of the training provider, however!

- There were several issues with Microsoft teams throughout the course, however this was not down to the trainers running it. They handled what they were dealt well, and the course was able to continue successfully.

- Sometimes content may be gone over too quickly, could go slower for beginners. Model answer for group discussions.

- Trainers were finding their way with aspects of MS Teams so there was a lack of "polish" in places. This can provide some distraction/disruption to the flow, but understood in the nature of the course (trial) and the joys of working in a COVID-19 situation.

- Not all the participants had the ability to participate actively because more experienced participants were taking the lead or answering the questions firstly, and trainers did not manage to give priority or ask other participants.

- Breakout room tasks at times were quite awkward, with people not really wanting to speak up. Probably just a result of it being remote and over Teams.

- Initially, the attempt to split into different rooms for the first break-out session didn't work well. Better understanding of the capabilities of "Teams" meant this was much improved from Day 2 onwards.

- Would have been beneficial to have covered more design principals and more on the design optimization.

- Would have been nice to have the in-house training but due to covid this was not possible probably that it could not be delivered face to face.

- Some aspects of the course we're not necessarily suited towards the activities I will carry out within my role (simulation etc.) however, this is not to say that they weren't interesting and helped to round out the understanding of the processes involved.

- More practical sessions would be good maybe some more videos to split up the sessions. This would have been good to break the different sessions up as sometimes there was a lot of long periods of just listening.

- The online nature of the course. It would have been good to see some of the equipment/techniques discussed in person.

- No permanent course information was given for later reference

- There were no fewer positive aspects of the course

Further Comments & Suggestions

Other comments and suggestions from participants provided below:

- Full course contents should be made available to download

- Audio + Visual recordings of the sessions should be made available

- Further research + training should be sign-posted

- There were acronyms used throughout and not having much first-hand experience in AM I was not sure what they stood for. It would be good to at least have what they stood for on the slide even if they are not used verbally.

- For the design guidelines a reference sheet or go to document for basic design information would be beneficial. (So minimum wall thickness, max overhand angles, other considerations etc.) reference material to be provided, either the slides or a reference booklet.

- I would have liked to see some more examples of what the possibilities are from a design point of few with AM, potentially with regards to complex geometries and heat transfer, but overall the course was really informative and interesting. I would like to thank the trainers and the MTC! Great job!

- Some of the presenting could have been a bit clearer - simple things like not covering mouth while talking.

- Keep it up, a great pilot, very relevant, and enjoyable.

- A brilliant course, thoroughly enjoyed and learnt a lot. Keep up the good work!

- A list in designated area for further reading/ resources for all material used. Highlight key and most important info.

- More interaction and practical exercise throughout all the sections would be useful for the best compensation of the information.

- The trainers seemed exceptionally knowledgeable and were very willing to engage in questions and help others with their specific scenarios

- Could even send a pack to houses for the sessions such as little handbooks etc. This would be good to flip to when unsure rather than excessive amount of note taking

6.1.8. Feedback from participants on CU67: Post Processing for Polymers piloted by LAK

The feedback from the students of both piloting events is divided into the two individual pilots and described separately below.

Pilot 1:

The attendees were 22% female, 78% male. 22% were 26 to 35 years old, 78% were between 15 and 26 years old. All 9 attendees were VET trainees, 8 of them had a school certificate and 1 a middle degree of vocational training.

The majority of students were satisfied enough or very satisfied with the training conditions provided. Only one student out of nine was not satisfied with the infrastructure conditions, the support of the staff or the communication channels used. One student each was unfortunately poorly satisfied with the infrastructure conditions and the equipment used.

Most students were satisfied enough or very satisfied with each aspect of the course. In particular, the aspects were rated well. Individual students were not satisfied enough with the structure and the transparency of the course. The greatest dissatisfaction was found at the point

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of the balance in theoretical and practical training. Here, three students were not satisfied enough.

With a single exception, all statements regarding satisfaction with training session were mostly agreed or strongly agreed. The good preparation of the trainers was particularly noticeable here. However, eight out of nine students disagreed or strongly disagreed that digital tools were used.

Overall, students' expectations were mostly met (six out of eight), so they would recommend the course to others.

In the open-ended questions, the following points were mentioned by the students as particularly positive:

- Learning strategy S(pupil) O(oriented) L(learning)
- Working together in a group
- Good and easy to understand learning material
- You could discuss the topic in detail and expand the knowledge
- The exchange between the participants allows for a wide range of different opinions and knowledge
- The independent elaboration of the information, as it has led to dealing with the subject matter
- To get to know new methods that are currently used in coating technology, the topic was thematically new for me
- Group work, division within the groups

The question about particularly negative points was answered as follows:
- Illegible illustration of the documents (color missing), Plus de couleurs, s'il vous plaît!
- Presentations of the other groups were not as clear, concentration of both presentations is slackening after the hours you have worked on yourself beforehand
- No illustrative material (real models), different processes (coatings) - different models
- Too little use of digital means
- Very outdated work with posters
- The information materials were unfortunately not comprehensive enough to answer questions that arose
- Partially strong overlap with contents from the lessons
- Dependence on other course participants - sometimes the presentations of others were incomplete or difficult to follow

Pilot 2:

The attendees were 46% female and 54% male, gender balance was nearly reached. 12 out of 13 were between 15 and 26 years old, only one was between 26 to 35 years old. All 13 attendees were VET trainees, 12 of them had a school certificate and 1 a high degree of vocational training.

The level of satisfaction with the training conditions was again predominantly well rated here. However, five out of thirteen students were not satisfied enough with the infrastructure offered.

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One student was even barely satisfied with the equipment used. The support provided by the staff, on the other hand, was rated as satisfactory.

The level of satisfaction with the course was particularly high in the points of coherence of the course with the trainings program and the allocated contact hours, where all students were satisfied or very satisfied. But here again the dissatisfaction in the balance of theoretical and practical training was evident.

Satisfaction with the training sessions was particularly evident in the performance and preparation of the trainers, while dissatisfaction with the dynamic of the training sessions and the digital tools used was noticeable.

Again, the expectations of most students (nine out of thirteen) were met, so that they would recommend the event to others.

In the open-ended questions, the following points were mentioned by the students as particularly positive:

- The communication was good, the exercises you can participate in are great as the knowledge remains better
- There are many pictures and little text on the poster. Everyone contributed about the same amount to the group work
- The trainers, because they were friendly and easy-going
- Varied imparting of information
- group work
- Illustrative material -> 3D printed parts
- 3D printing topic at the beginning
- Relaxed atmosphere
- The knowledge could be expanded again and built up
- The atmosphere between each other, everyone was able to say something about the questions.
- The knowledge was explained to us in an understandable way and we had enough time to work on the tasks

The question about particularly negative points was answered as follows:

- The most negative point for me was that you cannot have direct contact with the 3D printer and what you have learned
- That it took us a long time to find a good beginning
- Group work and presentation
- Presenting because I generally don't like to present standing up.
- Factual/specialist words in the group work, i.e. in the text we were given, not understood
- Flip chart slips of paper
- Little illustrative material and too much theory
- The presentation and it was hardly about 3D printing. Post-processing is boring and not important for my job.

- That you had to read into the topics yourself
- Many slides, too much advertising by the participating companies. One quickly lost the focus. In addition, it was not so descriptive (PowerPoint).
- The long wait until the last group has finished the poster

6.1.9. Feedback from participants on CU68: Design for Material Extrusion piloted by LMS

<u>Section 1: General information on the participants</u>

- All of the participants to the survey were males.

2 Please select the gender you identify better with (for gender balance reporting duties, only):

0% (0) Female	100% (11) Male
5.5 Standard Deviation	11 Responses
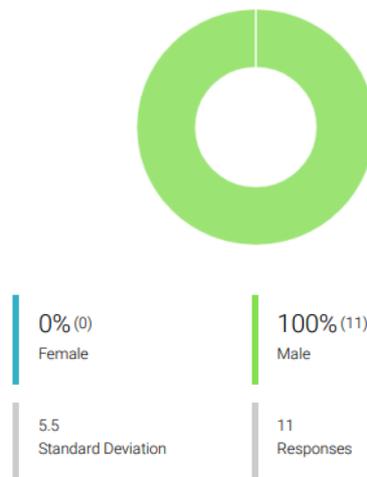
- From the 11 repliers 5 of them belong to the age range 15-25, 2 of them to the age 26-35 and 4 of them to the age 36-55 years old.

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3 Please select the age range you are in:

45% (5)		**18%** (2)	
15 - 25		26 - 35	
36% (4)		**0%** (0)	
36 - 55		56 - 100	
1.92		11	
Standard Deviation		Responses	
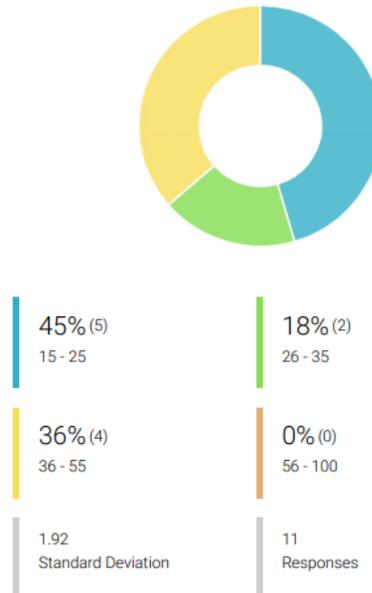
- Participants were taken the course from Austria, Greece, INDIA, China, and Norway. Most of them were in Greece.

4 In which country are you taking this course?

36% (4) Greece	**36%** (4) Other (Please Specify)	**18%** (2) Austria	**9%** (1) Belgium
0% (0) Bulgaria	**0%** (0) Croatia	**0%** (0) Republic of Cyprus	**0%** (0) Czech Republic
0% (0) Denmark	**0%** (0) Estonia	**0%** (0) Finland	**0%** (0) France
0% (0) Germany	**0%** (0) Hungary	**0%** (0) Ireland	**0%** (0) Other
1.36 Standard Deviation	11 Responses		

INDIA

China

Norway

INDIA

- To the question regarding their current position 10 from the 11 replies answered that they are Higher Education Students and 1 of them answered that he is a worker.

5 What would you say is your profile when engaging in this course?

9% (1) Worker	**91%** (10) Higher Education Student
0% (0) VET trainee	**0%** (0) Unemployed
4.21 Standard Deviation	11 Responses

- The one who has replied worker to the previous question has answered to the following question: what is the main activity/sector of your organization? Has answered that the main activity/sector of his organization is the industrial sector as a research assistant.

6 If you selected "Worker" in the previous question, what is the main activity/sector of your organisation? (you can select more than one option)

0% (0) Aerospace	**0%** (0) Automotive	**0%** (0) Defense	**0%** (0) Consumer goods
0% (0) Construction	**0%** (0) Energy	**0%** (0) Health	**50%** (1) Industrial equipment and tooling
0% (0) Other	**50%** (1) Other (Please Specify)		

2
Responses
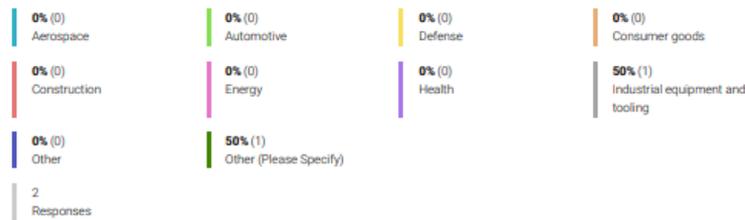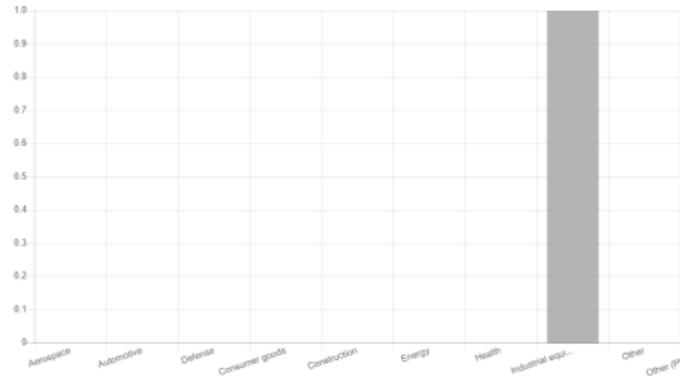
Research Assistant

- Following question: what is your level of education? 7 of the repliers answered Engineer or Master's degree, 2 answered Bachelor's degree, and 1 Doctoral.

7 What is your level of education? (you may select more than one option)

9% (1) School certificate	**18%** (2) Bachelor's degree	**0%** (0) Middle degree vocational training	**0%** (0) High degree vocational training
64% (7) Engineer or Master's degree	**9%** (1) Doctoral degree		

11
Responses

Section 2: General information on the pilot course

- To the question, what is your professional background/previous additive manufacturing experience? We received the below answers showing that we have experienced audience but also non experienced participants: No previous professional experience, engineering/ Intermediate, Research Scholar, been doing research about AM during past 5 years, One is in masters and bachelor's degree, Hobby sector, working with AM for 3 years, Research on post-processing of additive manufactured parts, worked on my Dissertation / Project on printing process parameters of FDM Printed parts of material ABS, PLA, PETG, PC PLA etc. to optimize the mechanical properties, Energy/Materials Engineer, Moderate and have worked only with FDM and SLA processes.

- To the question regarding the theme of what was the regime in your pilot course? The received answers was 9 of the 11 replied E-learning (distance learning), and 2 of them B-learning (face-to-face and online sessions).

9 What was the regime in your pilot course?

0% (0)
Face-to-face session(s)

18% (2)
B-learning (face-to-face and online sessions)

82% (9)
E-learning (distance learning)

3.86
Standard Deviation

11
Responses

Section 3: Information on the level of satisfaction with the training

- The rate of level of satisfaction with: a) The infrastructure conditions provided by the training provider (furnishing, heating, lighting, sanitation, etc.) 6 the repliers selected N/A, 4 Of them declared Very satisfied and finally 1 of them declared Satisfied enough. b) The support provided by the staff (other than trainers) the majority of the repliers 7 of them answered Very satisfied, 3 Satisfied enough, and 1 selected N/A. c) The communication channels used during the training the majority of the repliers 8 of them answered Very satisfied, 2 Satisfied enough, and 1 selected N/A. Finally, d) The equipment used in the practical training the majority of the repliers 5 of them answered

Very satisfied, 2 Satisfied enough, and 4 selected N/A. In general, the level of satisfaction as we can assume 3,75/4 is a Very satisfied audience. Although we can consider the less satisfied fields for the future.

10 How would you rate your level of satisfaction with...
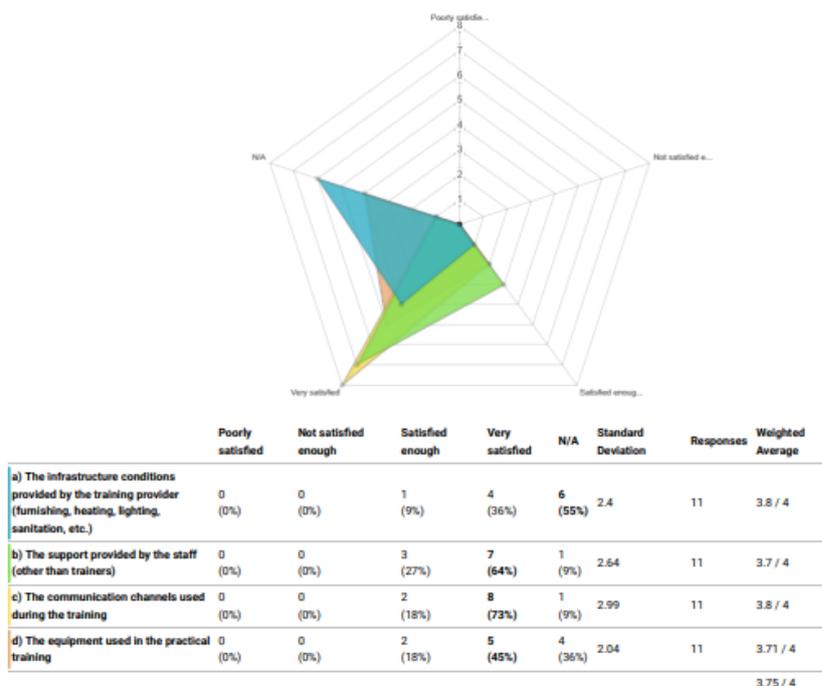
	Poorly satisfied	Not satisfied enough	Satisfied enough	Very satisfied	N/A	Standard Deviation	Responses	Weighted Average
a) The infrastructure conditions provided by the training provider (furnishing, heating, lighting, sanitation, etc.)	0 (0%)	0 (0%)	1 (9%)	4 (36%)	6 (55%)	2.4	11	3.8 / 4
b) The support provided by the staff (other than trainers)	0 (0%)	0 (0%)	3 (27%)	7 (64%)	1 (9%)	2.64	11	3.7 / 4
c) The communication channels used during the training	0 (0%)	0 (0%)	2 (18%)	8 (73%)	1 (9%)	2.99	11	3.8 / 4
d) The equipment used in the practical training	0 (0%)	0 (0%)	2 (18%)	5 (45%)	4 (36%)	2.04	11	3.71 / 4
								3.75 / 4

Section 4: Information on the level of satisfaction with the course

- The rate of level of satisfaction with: a) The structure of the course, the majority of the repliers 8 of them answered Very satisfied, 2 Satisfied enough, and 1 selected N/A. b) The contents addressed during the course the majority of the repliers 10 of them answered Very satisfied, and 1 selected N/A. c) The coherence of the course with the training program (did the training provider respect the order of contents established in the training program? the majority of the repliers 9 of them answered Very satisfied, 1 Satisfied enough, and 1 selected N/A. d) The contact hours allocated to the course, considering the amount and nature of the course contents, the majority of the repliers 10 of them answered Very satisfied, and 1 selected N/A. e) The balance between theoretical and practical training, ? the majority of the repliers 5 of them answered Very satisfied, 3 Satisfied enough, and 3 selected N/A. f). The transparency/communication of the learning outcomes associated to the course, the majority of the repliers 9 of them answered Very satisfied, 1 Satisfied enough, and 1 selected N/A. g) The match between learning outcomes foreseen for the course and what the course covered, the majority of the repliers 7 of them answered Very satisfied, 3 Satisfied enough and 1 selected N/A. h) The relevance of the course to your job activities, the majority of the repliers 7 of them answered Very satisfied, 3 Satisfied enough and 1 selected N/A. Also, In general the level of satisfaction 3,83/4 as we can assume is a Very satisfied audience in the

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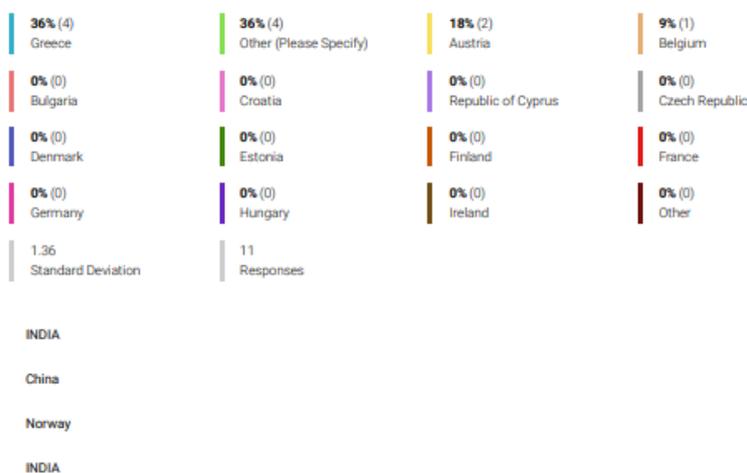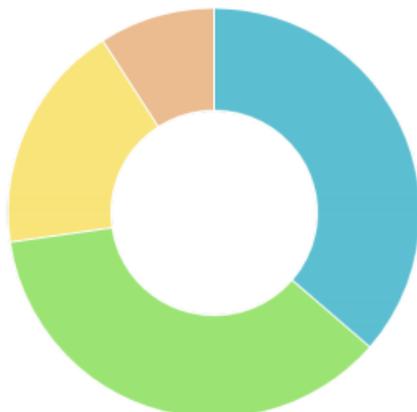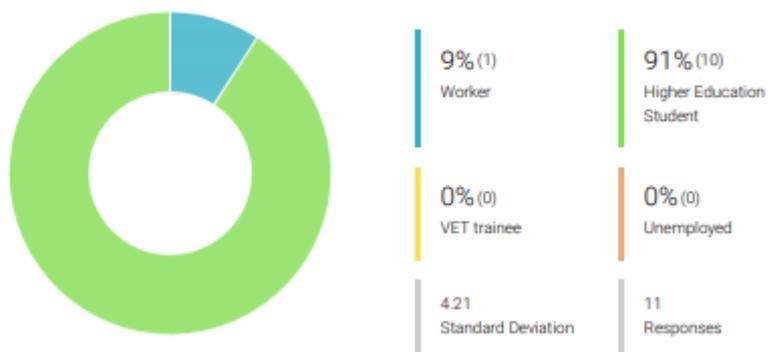*Project No. 601217-EPP-1-2018-1-BE-EPPKA2-SSA-B*

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majority of the above fields, although we can take into account the less satisfied fields for the future.

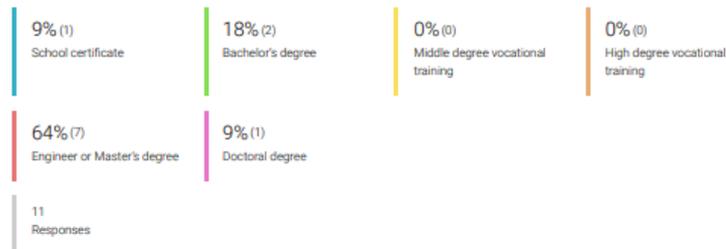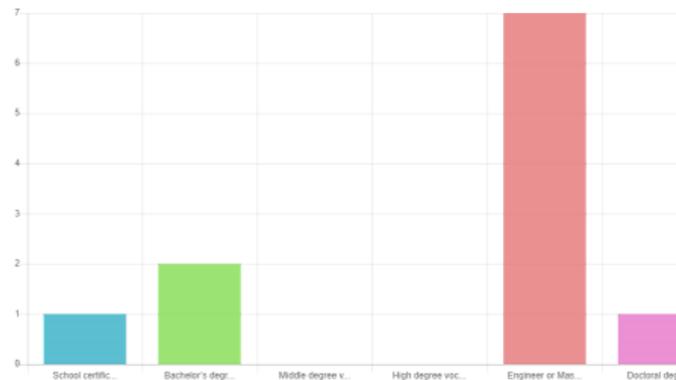**11** How would you rate your level of satisfaction with...

	Poorly satisfied	Not satisfied enough	Satisfied enough	Very satisfied	N/A	Standard Deviation	Responses	Weighted Average
a) The structure of the course	0 (0%)	0 (0%)	2 (18%)	8 (73%)	1 (9%)	2.99	11	3.8 / 4
b) The contents addressed during the course	0 (0%)	0 (0%)	0 (0%)	10 (91%)	1 (9%)	3.92	11	4 / 4
c) The coherence of the course with the training programme (did the training provider respect the order of contents established in the training programme?)	0 (0%)	0 (0%)	1 (9%)	9 (82%)	1 (9%)	3.43	11	3.9 / 4
d) The contact hours allocated to the course, considering the amount and nature of the course contents	0 (0%)	0 (0%)	0 (0%)	10 (91%)	1 (9%)	3.92	11	4 / 4
e) The balance between theoretical and practical training	0 (0%)	0 (0%)	3 (27%)	5 (45%)	3 (27%)	1.94	11	3.63 / 4
f) The transparency/communication of the learning outcomes associated to the course	0 (0%)	0 (0%)	1 (9%)	9 (82%)	1 (9%)	3.43	11	3.9 / 4
g) The match between learning outcomes foreseen for the course and what the course covered	0 (0%)	0 (0%)	3 (27%)	7 (64%)	1 (9%)	2.64	11	3.7 / 4
h) The relevance of the course to your job activities	0 (0%)	0 (0%)	3 (27%)	7 (64%)	1 (9%)	2.64	11	3.7 / 4
								3.83 / 4

<u>Section 5: Information on the level of satisfaction with the training sessions</u>

- To the question what is your opinion regarding the following statements? a) The learning materials (i.e. slide shows, handbooks, videos, samples) were useful, the majority of the repliers answered 9 of them Strongly Agree, and 2 answered Agree. b) The training sessions were quite dynamic, in the sense that they were engaging and involved interactive moments - such as problem-based learning, project-base, the majority of the repliers answered 6 of them Strongly Agree, and 5 answered Agree. c) The training sessions promoted the use of digital tools, the majority of the repliers answered 8 of them Strongly Agree, 2 answered Agree and finally 1 Disagree. d) There was a good balance of knowledge among the participants and no big discrepancies in the background knowledge were noticed, the majority of the repliers answered 5 of them Strongly Agree, and 6 answered Agree. e) The trainer(s) showed a good performance (good time management, ability to communicate clearly) the majority of the repliers answered 6 of them Strongly Agree, and 5 answered Agree. f) The trainer(s) was well prepared and showed a good understanding of the subject, the majority of the repliers answered 7 of them Strongly Agree, and 4 answered Agree. g) The support provided by the trainer(s) was good and a good management of questions and answers was done, the majority of the repliers answered 7 of them Strongly Agree, and 4
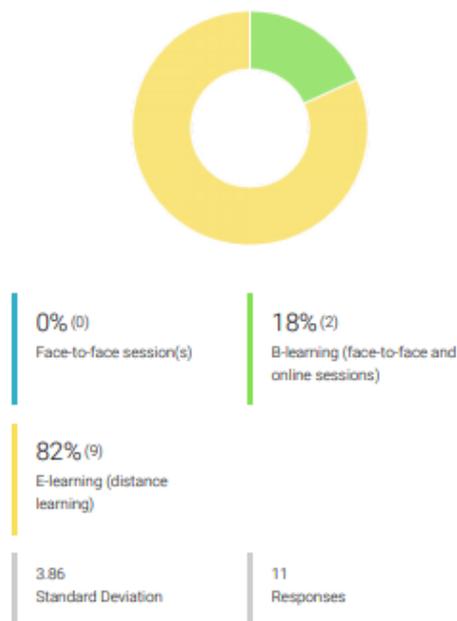
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answered Agree. As we can see, in general we can assume that the audience was is a very satisfied in a level of 3.61/4. Although we can consider the less satisfied fields for the future.

12 What is your opinion regarding the following statements?

	Strongly Disagree	Disagree	Agree	Strongly Agree	Standard Deviation	Responses	Weighted Average
a) The learning materials (i.e. slide shows, handbooks, videos, samples) were useful	0 (0%)	0 (0%)	2 (18%)	9 (82%)	3.7	11	3.82 / 4
b) The training sessions were quite dynamic, in the sense that they were engaging and involved interactive moments - such as problem-based learning, project-based learning, gamification, augmented reality, virtual reality, collaborative learning, etc. - instead of being just expositive)	0 (0%)	0 (0%)	5 (45%)	6 (55%)	2.77	11	3.55 / 4
c) The training sessions promoted the use of digital tools	0 (0%)	1 (9%)	2 (18%)	8 (73%)	3.11	11	3.64 / 4
d) There was a good balance of knowledge among the participants and no big discrepancies in the background knowledge were noticed	0 (0%)	0 (0%)	6 (55%)	5 (45%)	2.77	11	3.45 / 4
e) The trainer(s) showed a good performance (good time management, ability to communicate clearly)	0 (0%)	0 (0%)	5 (45%)	6 (55%)	2.77	11	3.55 / 4
f) The trainer(s) was well prepared and showed a good understanding of the subject	0 (0%)	0 (0%)	4 (36%)	7 (64%)	2.95	11	3.64 / 4
g) The support provided by the trainer(s) was good and a good management of questions and answers was done	0 (0%)	0 (0%)	4 (36%)	7 (64%)	2.95	11	3.64 / 4
							3.61 / 4

Section 6: Global evaluation of the course effectiveness

- To the question of rate your level of satisfaction with:

  a) The knowledge acquired in the training, the majority 9 of the repliers declared Very satisfied, 1 satisfied enough and 1 selected N/A.

  b) The skills acquired in the training, the majority 8 of the repliers declared Very satisfied, 2 satisfied enough and 1 selected N/A.

  c) The evaluation methods used, the majority 6 of the repliers declared Very satisfied, 4 satisfied enough and 1 selected N/A.

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SECTOR SKILLS STRATEGY
IN ADDITIVE MANUFACTURING

13 How would you rate your level of satisfaction with...
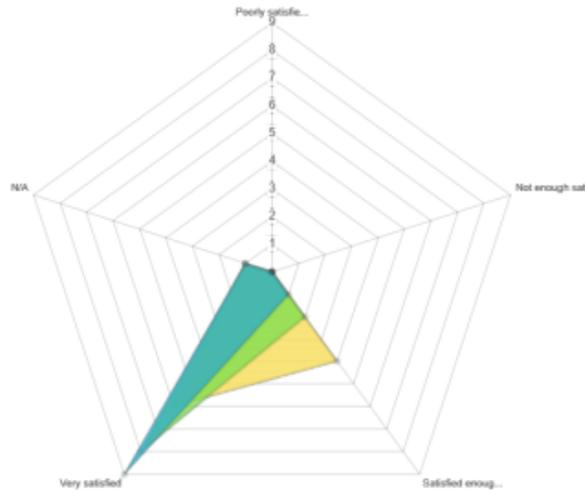
	Poorly satisfied	Not enough satisfied	Satisfied enough	Very satisfied	N/A	Standard Deviation	Responses	Weighted Average
a) The knowledge acquired in the training	0 (0%)	0 (0%)	1 (9%)	9 (82%)	1 (9%)	3.43	11	3.9 / 4
b) The skills acquired in the training	0 (0%)	0 (0%)	2 (18%)	8 (73%)	1 (9%)	2.99	11	3.8 / 4
c) The evaluation methods used	0 (0%)	0 (0%)	4 (36%)	6 (55%)	1 (9%)	2.4	11	3.6 / 4
								3.77 / 4

- To the question did the course meet your expectations? The total number of the participants answered Yes.

14 Did the course meet your expectations?

100% (11)
Yes

0% (0)
No

5.5
Standard Deviation

11
Responses

WP5 Pilot Activities Report
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Project No. 601217-EPP-1-2018-1-BE-EPPKA2-SSA-B

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- If they recommend this course to others, also the total number of the participants answered Yes.

15 Would you recommend this course to others?
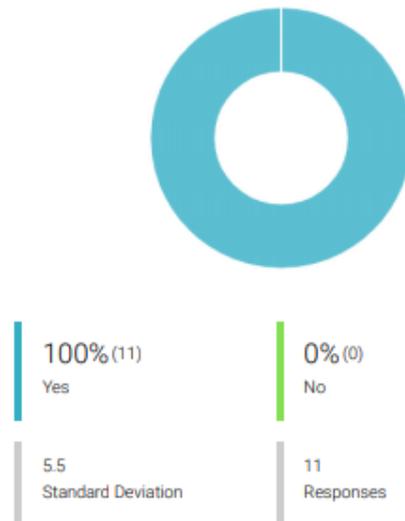
100% (11)	0% (0)
Yes	No
5.5	11
Standard Deviation	Responses

- To the question what was the most positive aspect of the training course? Why? We received the following answers from the participants, the ability to learn a new field that is currently gaining widespread use among many applications, the excel file exercise was great. In depth knowledge In-depth presentation of the topic backed-up from comprehensible slides In depth design considerations for Mex, the most positive aspect of the course is that it provided practical guidelines for amateurs in Material Extrusion process to set up their machines efficiently and improve their prints. In deep details. It explained a lot of concepts. The structure of the presentation as a tutorial for every person who would like to purchase a 3d printer. As we see there are mentioned several positive points of the pilot course, mainly specified in the content and the course structure.

- To the question what were the less positive aspect of the training course? Why? We received the following answers I cannot currently think of any fewer positive aspects, Nothing, N/A, Sound quality was not too good, the less positive aspect is that Day 1 and Day 2 were not balanced, timewise, Nothing, Not applicable. The duration of the two days course seems to be a field of the pilot which could be improved in the future as we can understand from the participant's answers.

- Finally, some of the further comments and suggestions we have asked for, we received the following answers like, introducing animation in some parts would be great! The training should be of less time. It should be divided in days not in long hours. Very good organization and structure of the content. Highly qualified personnel. The final comments of the participants to the survey shows that the majority of them were really satisfied with the course.

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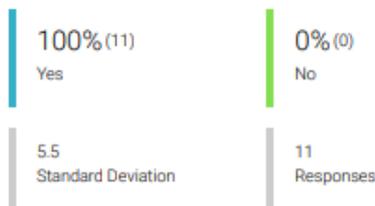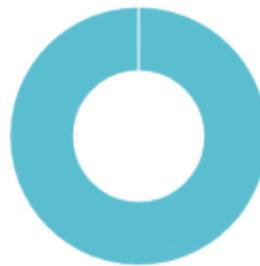
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6.1.10. Feedback from participants on CU68: Design for Material Extrusion piloted by FAN3D

The feedback report provided by ISQ has shown that all attendees of the pilot have provided their inputs and feedback. In terms of gender balance, unfortunately the objective of reaching an even balance was not achieved, with 100% attendees being male. Out of those, 91% had the age between 15-25y and the rest between 36-55y. Most of the attendees, 82% were university student, while 18% were active workers involved in industrial equipment and tools.

The knowledge of the attendees before the course, regarding Additive Manufacturing varied from none/beginning to extensive knowledge having some attendees with small desktop printer at home. Also, there was one attendee developing his master's thesis with AM.

Overall, the level of satisfaction regarding the conditions of the training scored **3,45/4** as shown in image below:

	Nada satisfeito	Pouco satisfeito	Satisfeito o suficiente	Muito satisfeito	N/A	Standard Deviation	Responses	Weighted Average
a) As infraestruturas oferecidas pela entidade formadora (mobiliário, aquecimento, iluminação, condições higiénicas, etc.)	1 (9%)	0 (0%)	2 (18%)	3 (27%)	5 (45%)	1.72	11	3.17 / 4
b) O apoio prestado pelo pessoal (sem ser o(s) formador(es))	0 (0%)	0 (0%)	2 (18%)	4 (36%)	5 (45%)	2.04	11	3.67 / 4
c) Os canais de comunicação utilizados durante a formação	0 (0%)	0 (0%)	2 (18%)	9 (82%)	0 (0%)	3.49	11	3.82 / 4
d) O equipamento usado na componente prática	0 (0%)	1 (9%)	3 (27%)	2 (18%)	5 (45%)	1.72	11	3.17 / 4
								3.45 / 4

Figure 32 - Satisfaction stats regarding conditions of the training

Out of the results it is possible to identify that the infrastructure and equipment for practical components were the ones that scored the lowest scored. It is important to express that the training was provided virtually and that it was not expected to have practical equipment. Nevertheless, this will be taken into consideration for future activities and the work will be done to have more engaging and "practical" exercises.

Regarding the level of satisfaction of the entire training the score was **3.75/4** as shown in the image:

	Nada satisfeito	Pouco satisfeito	Satisfeito o suficiente	Muito satisfeito	N/A	Standard Deviation	Responses	Weighted Average
a) A estrutura do curso	0 (0%)	0 (0%)	1 (9%)	10 (91%)	0 (0%)	3.92	11	3.91 / 4
b) Os conteúdos abordados durante o curso	0 (0%)	0 (0%)	2 (18%)	9 (82%)	0 (0%)	3.49	11	3.82 / 4
c) A coerência do curso com o programa de formação (a ordem de apresentação dos conteúdos prevista na unidade foi respeitada pelo formador?)	0 (0%)	0 (0%)	0 (0%)	11 (100%)	0 (0%)	4.4	11	4 / 4
d) O número de horas de contacto alocadas ao curso, tendo em conta o volume e natureza dos conteúdos do mesmo	0 (0%)	0 (0%)	2 (18%)	9 (82%)	0 (0%)	3.49	11	3.82 / 4
e) O equilíbrio entre a formação teórica e a prática	0 (0%)	2 (18%)	5 (45%)	3 (27%)	1 (9%)	1.72	11	3.1 / 4
f) A transparência/comunicação dos resultados de aprendizagem associados aos curso	0 (0%)	0 (0%)	0 (0%)	10 (91%)	1 (9%)	3.92	11	4 / 4
h) A correspondência entre os resultados de aprendizagem previstos para o curso, e o que o curso cobriu	0 (0%)	1 (9%)	0 (0%)	9 (82%)	1 (9%)	3.43	11	3.8 / 4
g) A relevância do curso para a sua atividade profissional	0 (0%)	0 (0%)	4 (36%)	6 (55%)	1 (9%)	2.4	11	3.6 / 4
								3.76 / 4

Figure 33 - Satisfaction scores of the training course

Assessing the feedback of the training course, the results show that most of the marks are positive and above the 3.6 mark to exception from one with a 3.1 mark that has to do with the balance between the theoretical and practical training. Once again, the practical training is being identified as something that needs some attention. Also, there has been a less positive mark regarding the linkage between the expected learning outcomes and what was covered by the training course. Unfortunately, no further comments were given, and it is unknown what was missing.

It is important to highlight the feedback regarding the relevance of the training to the professional activity of the trainees. There is indeed relevance and that the knowledge acquired during the course will have an impact on the future workforce of the industry.

Addressing the training sections, the overall score was **3,47/4** as shown in the image below.

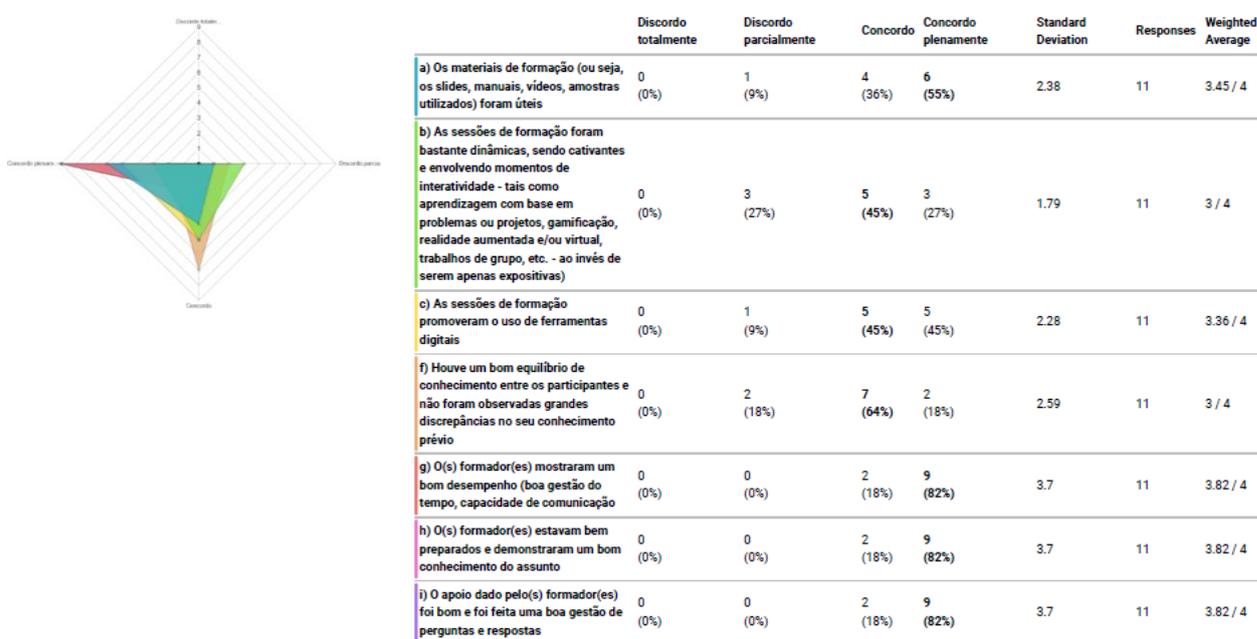|	Discordo totalmente	Discordo parcialmente	Concordo	Concordo plenamente	Standard Deviation	Responses	Weighted Average
a) Os materiais de formação (ou seja, os slides, manuais, vídeos, amostras utilizados) foram úteis	0 (0%)	1 (9%)	4 (36%)	6 (55%)	2.38	11	3.45 / 4
b) As sessões de formação foram bastante dinâmicas, sendo cativantes e envolvendo momentos de interatividade - tais como aprendizagem com base em problemas ou projetos, gamificação, realidade aumentada e/ou virtual, trabalhos de grupo, etc. - ao invés de serem apenas expositivas)	0 (0%)	3 (27%)	5 (45%)	3 (27%)	1.79	11	3 / 4
c) As sessões de formação promoveram o uso de ferramentas digitais	0 (0%)	1 (9%)	5 (45%)	5 (45%)	2.28	11	3.36 / 4
f) Houve um bom equilíbrio de conhecimento entre os participantes e não foram observadas grandes discrepâncias no seu conhecimento prévio	0 (0%)	2 (18%)	7 (64%)	2 (18%)	2.59	11	3 / 4
g) O(s) formador(es) mostraram um bom desempenho (boa gestão do tempo, capacidade de comunicação	0 (0%)	0 (0%)	2 (18%)	9 (82%)	3.7	11	3.82 / 4
h) O(s) formador(es) estavam bem preparados e demonstraram um bom conhecimento do assunto	0 (0%)	0 (0%)	2 (18%)	9 (82%)	3.7	11	3.82 / 4
i) O apoio dado pelo(s) formador(es) foi bom e foi feita uma boa gestão de perguntas e respostas	0 (0%)	0 (0%)	2 (18%)	9 (82%)	3.7	11	3.82 / 4

7 / 4

*Figure 34 – Satisfaction scores regarding the training section*

Overall, the marks are positive and provide an overview of the training sections. The results are aligned with the previous results, there are less positive feedback regarding the practical and more digital part of the training. Also, the different of prior knowledge of the topic addressed between the trainees is identified as something that should be taken into consideration in future activities. Moreover, the feedback regarding the trainer and the way the sections were carried are extremely positive all with 3.7/4 score. No further comments were given.

The last section addressing the overall satisfaction of the efficiency of the course ranked **3,48/4** as shown in the image next**.**

Also, it is important to highlight that the training course have met the expectations of 100% of the attendants and that all of the attendees would recommend it to someone else.
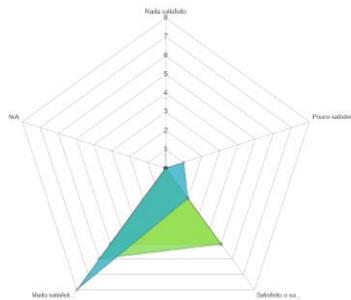
	Nada satisfeito	Pouco satisfeito	Satisfeito o suficiente	Muito satisfeito	N/A	Standard Deviation	Responses	Weighted Average
a) O conhecimento adquirido no curso	0 (0%)	1 (9%)	2 (18%)	8 (73%)	0 (0%)	2.99	11	3.64 / 4
b) As competências adquiridas no curso	0 (0%)	0 (0%)	5 (45%)	6 (55%)	0 (0%)	2.71	11	3.55 / 4
c) Os métodos de avaliação utilizados	1 (9%)	0 (0%)	5 (45%)	5 (45%)	0 (0%)	2.32	11	3.27 / 4
								3.48 / 4

Figure 35 – Satisfaction scores regarding the overall training course

Overall, the result is aligned with the previous results achieved. It is important to highlight the less positive feedback achieved in the evaluation method. Despite not having any additional feedback or message, this may be aligned with the issue during the examination, previously identified. Nevertheless, the results show that training course had a positive impact, and the knowledge transfer was made positively according to the trainee's feedback.

The remarks and comments provided by the trainees about the most positive aspect of the course were aligned with the fact that:

- it was free of charge;
- accessible for beginners on the topic;
- an introduction of the different existing processes was made;
- an overview of existing material for MEx;
- dynamic of the teacher.

In terms of things that could be improved the comments follow:

- Have an on-site training section with the equipment when the pandemic issue is solved.
- More in-depth training on practical training
- More interaction and in-depth training with the slicer software
- More questions in the exam

Even though not being expected to have training in a slicer software, some time was dedicated to showcase its workflow and functionalities. Moreover, more comments regarding expectations on more practical content were made.

6.1.11. Feedback from participants on CU69: Design for PBF Polymer piloted by LMS

Section 1: General information on the participants

- The participants to the survey were 4 males and 1 female.

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2 Please select the gender you identify better with (for gender balance reporting duties, only):

20% (1)	80% (4)
Female	Male
1.5	5
Standard Deviation	Responses
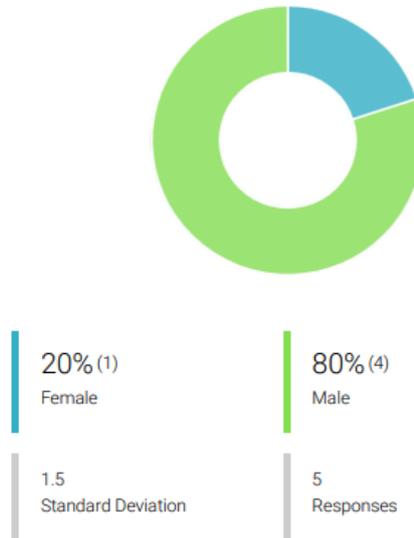
- From the 5 repliers 3 of them belong to the age range 26-35, 2 of them to the age 36-55 years old.

3 Please select the age range you are in:

0% (0)	60% (3)
15 - 25	26 - 35
40% (2)	0% (0)
36 - 55	56 - 100
1.3	5
Standard Deviation	Responses

- Participants were taken the course from Austria, Greece, and Ireland. Most of them were in Greece.

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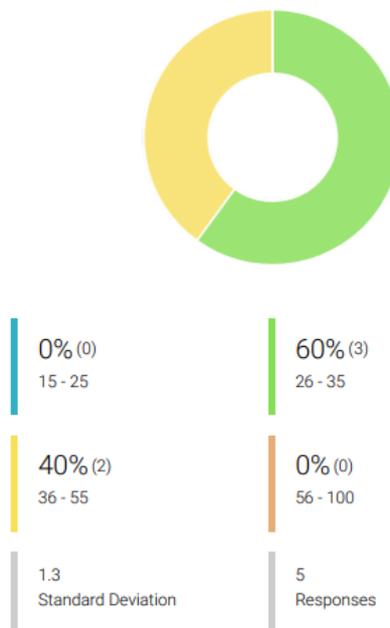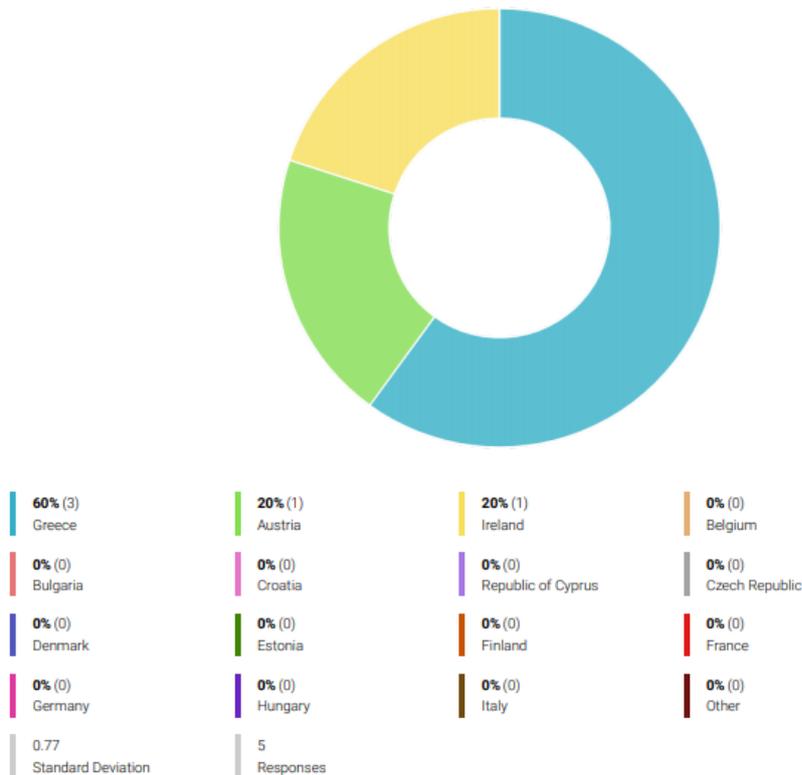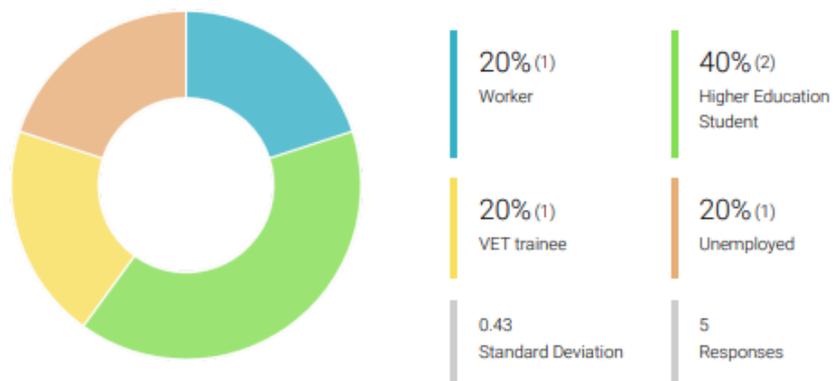
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4 In which country are you taking this course?

60% (3)	**20%** (1)	**20%** (1)	**0%** (0)
Greece	Austria	Ireland	Belgium
0% (0)	**0%** (0)	**0%** (0)	**0%** (0)
Bulgaria	Croatia	Republic of Cyprus	Czech Republic
0% (0)	**0%** (0)	**0%** (0)	**0%** (0)
Denmark	Estonia	Finland	France
0% (0)	**0%** (0)	**0%** (0)	**0%** (0)
Germany	Hungary	Italy	Other
0.77	5		
Standard Deviation	Responses		

- To the question regarding their current position 2 from the 5 replies answered that they are Higher Education Students and 1 of them answered that he is a worker, 1 answered VET trainee and 1 answered Unemployed.

5 What would you say is your profile when engaging in this course?

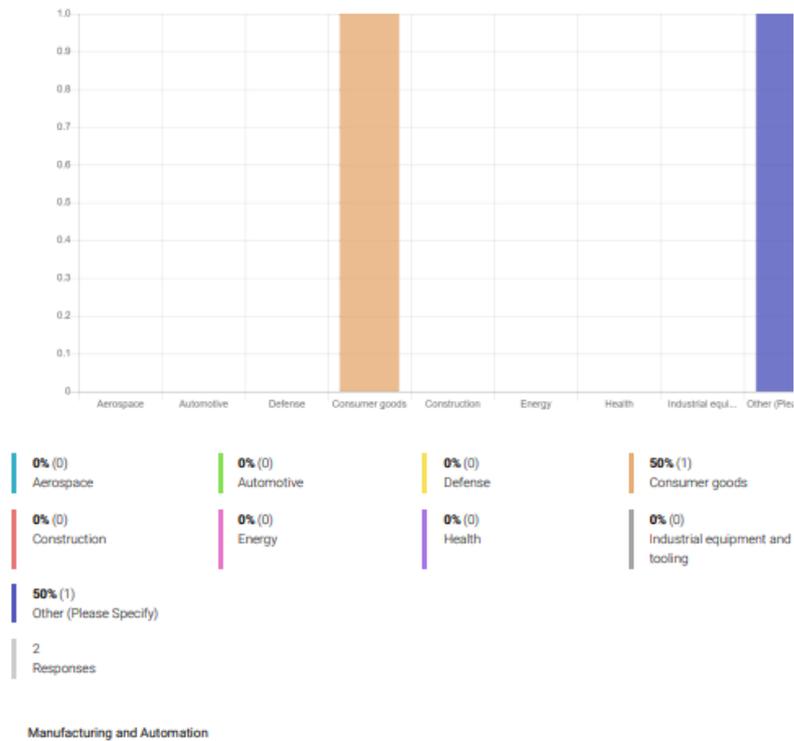| 20% (1) | 40% (2) |
Worker	Higher Education Student
20% (1)	20% (1)
VET trainee	Unemployed
0.43	5
Standard Deviation	Responses

- The one who has replied worker to the previous question has answered to the following question: what is the main activity/sector of your organization? Has answered that the main activity/sector of his organization is consumer goods more especially in the field of Manufacturing and Automation.

6 If you selected "Worker" in the previous question, what is the main activity/sector of your organisation? (you can select more than one option)

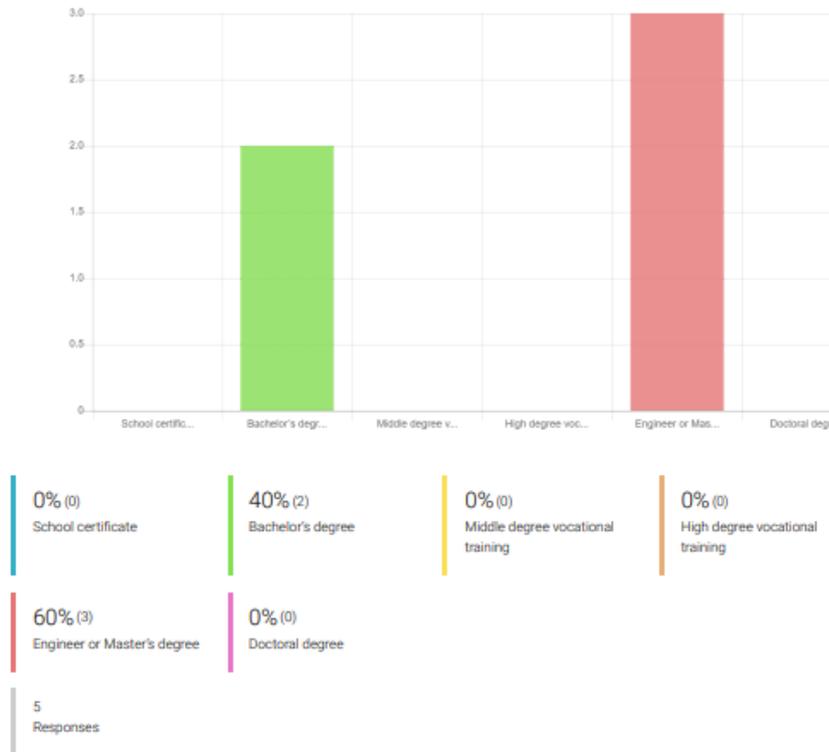|			
0% (0) Aerospace	**0%** (0) Automotive	**0%** (0) Defense	**50%** (1) Consumer goods
0% (0) Construction	**0%** (0) Energy	**0%** (0) Health	**0%** (0) Industrial equipment and tooling
50% (1) Other (Please Specify)			
2 Responses			

Manufacturing and Automation

- Following question: what is your level of education? 3 of the repliers answered Engineer or Master's degree and 1 Bachelor's degree.

7 What is your level of education? (you may select more than one option)

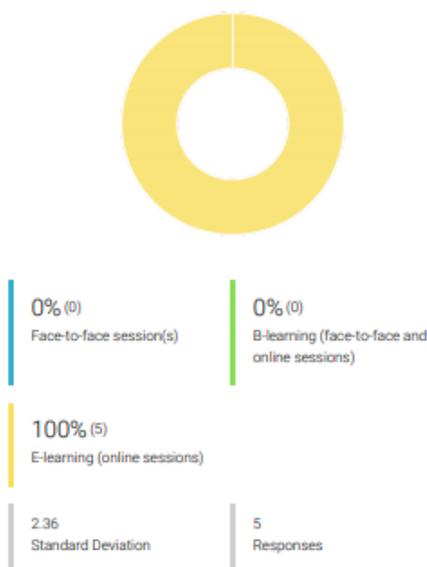|			
0% (0) School certificate	**40%** (2) Bachelor's degree	**0%** (0) Middle degree vocational training	**0%** (0) High degree vocational training
60% (3) Engineer or Master's degree	**0%** (0) Doctoral degree		

5
Responses

Section 2: General information on the pilot course

- To the question, what is your professional background/previous additive manufacturing experience? We received the below answers showing that we have experienced audience but also non-experienced participants: Additive Manufacturing Program Manager, being involved in previous additive manufacturing applications and concepts, no professional background until now but i have spent a few hours for research purposes in additive manufacturing field, low level, Engineer/Intermediate experience.
- To the question regarding the theme of what was the regime in your pilot course? The total received answers was E-learning (distance learning).

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9 What was the regime in your pilot course?

0% (0)
Face-to-face session(s)

0% (0)
B-learning (face-to-face and online sessions)

100% (5)
E-learning (online sessions)

2.36
Standard Deviation

5
Responses

Section 3: Information on the level of satisfaction with the training

- The rate of level of satisfaction with: a) The infrastructure conditions provided by the training provider (furnishing, heating, lighting, sanitation, etc.) All of the participants replied Very satisfied. b) The support provided by the staff (other than trainers) the majority of the repliers 3 of them answered Very satisfied, 1 Satisfied enough, and 1 selected N/A. c) The communication channels used during the training the majority of the repliers 4 of them answered Very satisfied and 1 selected N/A. Finally, d) the equipment used in the practical training 2 of them answered Very satisfied, 1 Satisfied enough, and 2 selected N/A. In general, the level of satisfaction 3.85/4 as we can assume is a Very satisfied audience. Although we can consider the less satisfied fields for the future. It is clear that the participants were satisfied with the overall circumstances of the course so this is really satisfying for the organizers and it can be motivational for future improvements.

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10 How would you rate your level of satisfaction with...

	Poorly satisfied	Not satisfied enough	Satisfied enough	Very satisfied	N/A	Standard Deviation	Responses	Weighted Average
a) The infrastructure conditions provided by the training provider (furnishing, heating, lighting, sanitation, etc.)	0 (0%)	0 (0%)	0 (0%)	5 (100%)	0 (0%)	2	5	4 / 4
b) The support provided by the staff (other than trainers)	0 (0%)	0 (0%)	1 (20%)	3 (60%)	1 (20%)	1.1	5	3.75 / 4
c) The communication channels used during the training	0 (0%)	0 (0%)	0 (0%)	4 (80%)	1 (20%)	1.55	5	4 / 4
d) The equipment used in the practical training	0 (0%)	0 (0%)	1 (20%)	2 (40%)	2 (40%)	0.89	5	3.67 / 4
								3.85 / 4

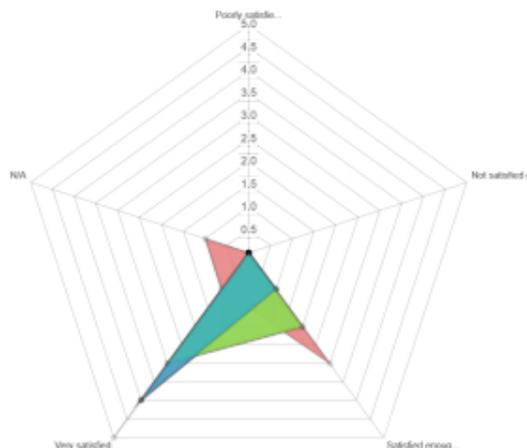## Section 4: Information on the level of satisfaction with the course

- The rate of level of satisfaction with: a) The structure of the course, the majority of the repliers 4 of them answered Very satisfied, and 1 Satisfied enough b) The contents addressed during the course the majority of the repliers 3 of them answered Very satisfied, and 2 selected Satisfied enough. c) The coherence of the course with the training program (did the training provider respect the order of contents established in the training program? All the repliers answered Very satisfied. d) The contact hours allocated to the course, considering the amount and nature of the course contents, the majority of the repliers 3 of them answered Very satisfied, and 2 selected Satisfied enough. e) The balance between theoretical and practical training? the majority of the repliers 3 of them answered Satisfied enough, 1 answered Very satisfied and 1 selected N/A. f) The transparency/communication of the learning outcomes associated to the course, the majority of the repliers 4 of them answered Very satisfied, and 1 Satisfied enough. g) The match between learning outcomes foreseen for the course and what the course covered, the majority of the repliers 4 of them answered Very satisfied, and 1 Satisfied enough. h) The relevance of the course to your job activities, the majority of the repliers 4 of them answered Very satisfied, and 1 Satisfied enough. Also, in general the level of satisfaction 3.71/4 as we can assume is a Very satisfied audience in the majority of the above fields, although we can consider the less satisfied fields for the future.

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11 How would you rate your level of satisfaction with...

	Poorly satisfied	Not satisfied enough	Satisfied enough	Very satisfied	N/A	Standard Deviation	Responses	Weighted Average
a) The structure of the course	0 (0%)	0 (0%)	1 (20%)	4 (80%)	0 (0%)	1.55	5	3.8 / 4
b) The contents addressed during the course	0 (0%)	0 (0%)	2 (40%)	3 (60%)	0 (0%)	1.26	5	3.6 / 4
c) The coherence of the course with the training programme (did the training provider respect the order of contents established in the training programme?)	0 (0%)	0 (0%)	0 (0%)	5 (100%)	0 (0%)	2	5	4 / 4
d) The contact hours allocated to the course, considering the amount and nature of the course contents	0 (0%)	0 (0%)	2 (40%)	3 (60%)	0 (0%)	1.26	5	3.6 / 4
e) The balance between theoretical and practical training	0 (0%)	0 (0%)	3 (60%)	1 (20%)	1 (20%)	1.1	5	3.25 / 4
f) The transparency/communication of the learning outcomes associated to the course	0 (0%)	0 (0%)	1 (20%)	4 (80%)	0 (0%)	1.55	5	3.8 / 4
g) The match between learning outcomes foreseen for the course and what the course covered	0 (0%)	0 (0%)	1 (20%)	4 (80%)	0 (0%)	1.55	5	3.8 / 4
h) The relevance of the course to your job activities	0 (0%)	0 (0%)	1 (20%)	4 (80%)	0 (0%)	1.55	5	3.8 / 4
								3.71 / 4

<u>Section 5: Information on the level of satisfaction with the training sessions</u>
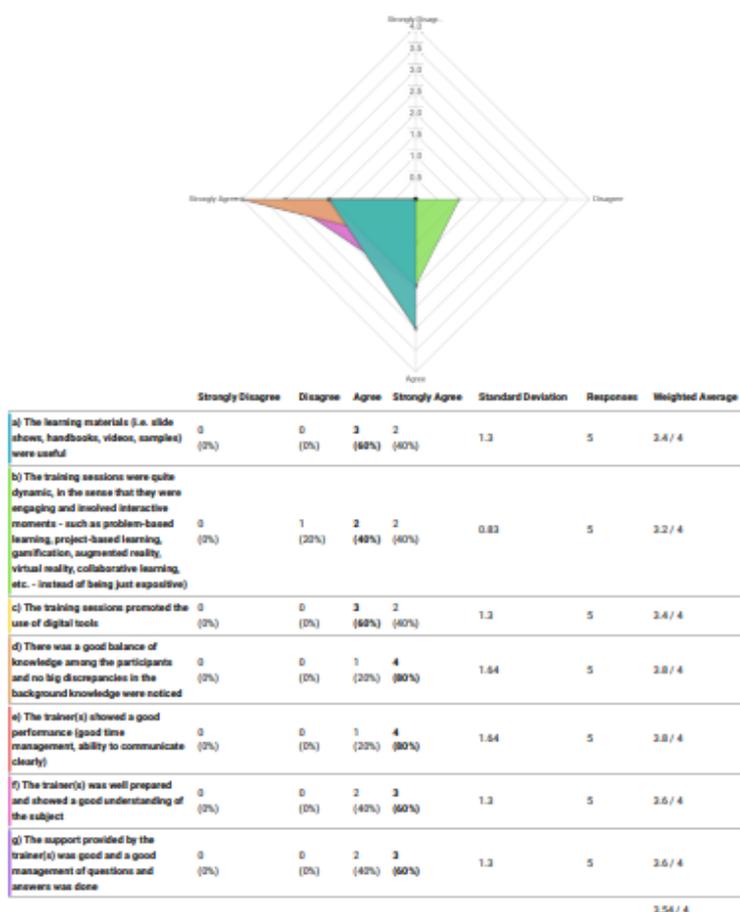
- To the question what is your opinion regarding the following statements? a) The learning materials (i.e. slide shows, handbooks, videos, samples) were useful, the majority of the repliers answered 3 of them Agree, and 2 answered Strongly Agree. b) The training sessions were quite dynamic, in the sense that they were engaging and involved interactive moments - such as problem-based learning, project-base, the repliers answered 2 of them Strongly Agree, 2 answered Agree and 1 Disagree. c) The training sessions promoted the use of digital tools, the majority of the repliers answered 3 of them Agree, and 2 answered Strongly Agree. d) There was a good balance of knowledge among the participants and no big discrepancies in the background knowledge were noticed, the majority of the repliers answered 4 of them Strongly Agree, and 1 answered Agree. e) The trainer(s) showed a good performance (good time management, ability to communicate clearly) the majority of the repliers answered 4 of

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them Strongly Agree, and 1 answered Agree. f) The trainer(s) was well prepared and showed a good understanding of the subject, the majority of the repliers answered 3 of them Strongly Agree, and 2 answered Agree. g) The support provided by the trainer(s) was good and a good management of questions and answers was done, the majority of the repliers answered 3 of them Strongly Agree, and 2 answered Agree. As we can see, in general we can assume that the audience is a very satisfied in a level of 3.54/4. Although we can consider the less satisfied fields for the future. We can conclude also that since the general overview of audience satisfaction is in a really good level, the courses offer knowledge and specialization in the participants.

12 What is your opinion regarding the following statements?

	Strongly Disagree	Disagree	Agree	Strongly Agree	Standard Deviation	Responses	Weighted Average
a) The learning materials (i.e. slide shows, handbooks, videos, samples) were useful	0 (0%)	0 (0%)	3 (60%)	2 (40%)	1.3	5	3.4 / 4
b) The training sessions were quite dynamic, in the sense that they were engaging and involved interactive moments - such as problem-based learning, project-based learning, gamification, augmented reality, virtual reality, collaborative learning, etc. - instead of being just expositive)	0 (0%)	1 (20%)	2 (40%)	2 (40%)	0.83	5	3.2 / 4
c) The training sessions promoted the use of digital tools	0 (0%)	0 (0%)	3 (60%)	2 (40%)	1.3	5	3.4 / 4
d) There was a good balance of knowledge among the participants and no big discrepancies in the background knowledge were noticed	0 (0%)	0 (0%)	1 (20%)	4 (80%)	1.64	5	3.8 / 4
e) The trainer(s) showed a good performance (good time management, ability to communicate clearly)	0 (0%)	0 (0%)	1 (20%)	4 (80%)	1.64	5	3.8 / 4
f) The trainer(s) was well prepared and showed a good understanding of the subject	0 (0%)	0 (0%)	2 (40%)	3 (60%)	1.3	5	3.6 / 4
g) The support provided by the trainer(s) was good and a good management of questions and answers was done	0 (0%)	0 (0%)	2 (40%)	3 (60%)	1.3	5	3.6 / 4
							3.54 / 4

Section 6: Global evaluation of the course effectiveness

- To the question of rate your level of satisfaction with:
  a)   The knowledge acquired in the training, all the repliers declared Very satisfied.
  b)   The skills acquired in the training, the majority 3 of the repliers declared Very satisfied, and 2 satisfied enough.
  c)   The evaluation methods used, the majority 3 of the repliers declared Very satisfied, and 2 satisfied enough.

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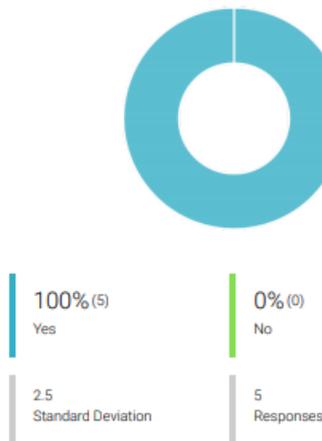*Project No. 601217-EPP-1-2018-1-BE-EPPKA2-SSA-B*

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13 How would you rate your level of satisfaction with…

	Poorly satisfied	Not enough satisfied	Satisfied enough	Very satisfied	N/A	Standard Deviation	Responses	Weighted Average
a) The knowledge acquired in the training	0 (0%)	0 (0%)	0 (0%)	5 (100%)	0 (0%)	2	5	4 / 4
b) The skills acquired in the training	0 (0%)	0 (0%)	2 (40%)	3 (60%)	0 (0%)	1.26	5	3.6 / 4
c) The evaluation methods used	0 (0%)	0 (0%)	2 (40%)	3 (60%)	0 (0%)	1.26	5	3.6 / 4
								3.73 / 4

- To the question did the course meet your expectations? The total number of the participants answered Yes.

14 Did the course meet your expectations?

100% (5)	0% (0)
Yes	No
2.5 Standard Deviation	5 Responses

- If they recommend this course to others, also the total number of the participants answered Yes.

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15 Would you recommend this course to others?

100% (5)
Yes

0% (0)
No

2.5
Standard Deviation

5
Responses

- To the question what was the most positive aspect of the training course? Why? We received the following answers from the participants, Q&A, the information that was provided and the way that was provided because it was quite enjoyable by the listener, The PBF design guidelines. From the one hand we assume that the content of the course has got really good reviews from the participants along with the interactive activities used as the Q&A parts of the course.

- To the question what were the less positive aspect of the training course? Why? We received the following answers, the balance between width and depth. Many topics were discussed so it was too shallow and quick on some occasions. As we see from the above answer there is one comment regarding the general structure of the course and we have to mention also that we received only one less positive aspect of the training course.

- Finally, we did not receive any further comments and suggestions from the participants, means that they were satisfied in general, and it is possible their suggestions were covered from all the previous survey questions.

6.1.12. Feedback from participants on CU70: Design for VAT Photopolymerization piloted by FA

The feedback report provided by ISQ has shown that all attendees of the pilot have provided their inputs and feedback. In terms of gender balance, unfortunately the objective of reaching an even balance was not achieved, with 80% attendees being male. Out of those, 13% had the age between 15-25y and, 33% between 26-35y and more than half, 53% between 36-55y.

The attendees were mainly from Portugal, being one from Ireland. 67% of the attendees were active workers, 13% university students, and other 13% are students in professional training, the remaining 7% were unemployed.

The knowledge of the attendees before the course, regarding Additive Manufacturing varied from none/beginning to more experienced ones with year of experience in the field.

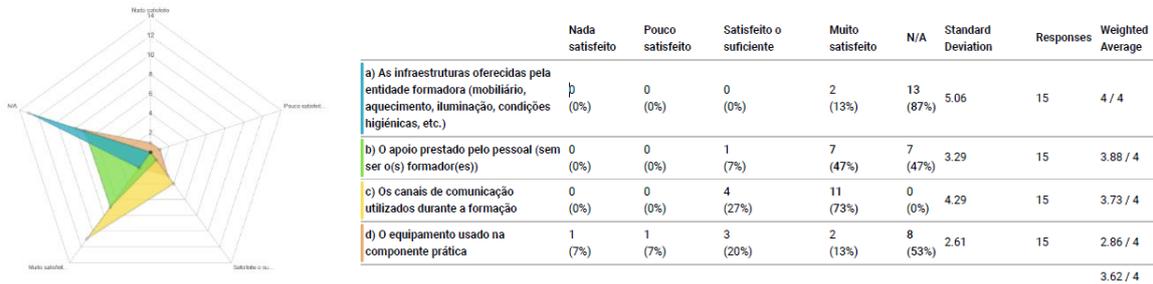Overall, the level of satisfaction regarding the conditions of the training scored **3,45/4** as shown in image below:

	Nada satisfeito	Pouco satisfeito	Satisfeito o suficiente	Muito satisfeito	N/A	Standard Deviation	Responses	Weighted Average
a) As infraestruturas oferecidas pela entidade formadora (mobiliário, aquecimento, iluminação, condições higiénicas, etc.)	0 (0%)	0 (0%)	0 (0%)	2 (13%)	13 (87%)	5.06	15	4 / 4
b) O apoio prestado pelo pessoal (sem ser o(s) formador(es))	0 (0%)	0 (0%)	1 (7%)	7 (47%)	7 (47%)	3.29	15	3.88 / 4
c) Os canais de comunicação utilizados durante a formação	0 (0%)	0 (0%)	4 (27%)	11 (73%)	0 (0%)	4.29	15	3.73 / 4
d) O equipamento usado na componente prática	1 (7%)	1 (7%)	3 (20%)	2 (13%)	8 (53%)	2.61	15	2.86 / 4
								3.62 / 4

Figure 36 - Satisfaction stats regarding conditions of the training

Regarding the level of satisfaction of the entire training the score was **3.33/4** as shown in the image:

	Nada satisfeito	Pouco satisfeito	Satisfeito o suficiente	Muito satisfeito	N/A	Standard Deviation	Responses	Weighted Average
a) A estrutura do curso	0 (0%)	1 (7%)	7 (47%)	7 (47%)	0 (0%)	3.29	15	3.4 / 4
b) Os conteúdos abordados durante o curso	0 (0%)	1 (7%)	7 (47%)	7 (47%)	0 (0%)	3.29	15	3.4 / 4
c) A coerência do curso com o programa de formação (a ordem de apresentação dos conteúdos prevista na unidade foi respeitada pelo formador?)	0 (0%)	0 (0%)	6 (40%)	9 (60%)	0 (0%)	3.79	15	3.6 / 4
d) O número de horas de contacto alocadas ao curso, tendo em conta o volume e natureza dos conteúdos do mesmo	1 (7%)	1 (7%)	4 (27%)	9 (60%)	0 (0%)	3.29	15	3.4 / 4
e) O equilíbrio entre a formação teórica e a prática	2 (13%)	0 (0%)	7 (47%)	3 (20%)	3 (20%)	2.28	15	2.92 / 4
f) A transparência/comunicação dos resultados de aprendizagem associados aos curso	0 (0%)	3 (20%)	6 (40%)	6 (40%)	0 (0%)	2.68	15	3.2 / 4
h) A correspondência entre os resultados de aprendizagem previstos para o curso, e o que o curso cobriu	0 (0%)	3 (20%)	6 (40%)	6 (40%)	0 (0%)	2.68	15	3.2 / 4
g) A relevância do curso para a sua atividade profissional	0 (0%)	0 (0%)	7 (47%)	8 (53%)	0 (0%)	3.69	15	3.53 / 4
								3.33 / 4

Figure 37 - Satisfaction scores of the training course

Assessing the feedback of the training course, the results show that most of the marks are positive and above the 3.4 mark to exception from one with a 2.92 mark that has to do with the balance between the theoretical and practical training. The practical training is being identified as something that needs some attention. On the other hand, the linkage between the expected learning outcomes and what was covered by the training course was the highest mark given on this section thus, the trainees were aware of what was expected out of the training.

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Addressing the training sections, the overall score was **3,32/4** as shown in the image below.

	Discordo totalmente	Discordo parcialmente	Concordo	Concordo plenamente	Standard Deviation	Responses	Weighted Average
a) Os materiais de formação (ou seja, os slides, manuais, vídeos, amostras utilizados) foram úteis	0 (0%)	1 (7%)	6 (40%)	8 (53%)	3.34	15	3.47 / 4
b) As sessões de formação foram bastante dinâmicas, sendo cativantes e envolvendo momentos de interatividade - tais como aprendizagem com base em problemas ou projetos, gamificação, realidade aumentada e/ou virtual, trabalhos de grupo, etc. - ao invés de serem apenas expositivas)	1 (7%)	3 (20%)	7 (47%)	4 (27%)	2.17	15	2.93 / 4
c) As sessões de formação promoveram o uso de ferramentas digitais	0 (0%)	2 (13%)	7 (47%)	6 (40%)	2.86	15	3.27 / 4
f) Houve um bom equilíbrio no conhecimento entre os participantes e não foram observadas grandes discrepâncias no seu conhecimento prévio	0 (0%)	2 (13%)	10 (67%)	3 (20%)	3.77	15	3.07 / 4
g) O(s) formador(es) mostraram um bom desempenho (boa gestão do tempo, capacidade de comunicação	0 (0%)	1 (7%)	7 (47%)	7 (47%)	3.27	15	3.4 / 4
h) O(s) formador(es) estavam bem preparados e demonstraram um bom conhecimento do assunto	0 (0%)	0 (0%)	5 (33%)	10 (67%)	4.15	15	3.67 / 4
i) O apoio dado pelo(s) formador(es) foi bom e foi feita uma boa gestão de perguntas e respostas	0 (0%)	1 (7%)	6 (40%)	8 (53%)	3.34	15	3.47 / 4
							3.32 / 4

Figure 38 – Satisfaction scores regarding the training section

Overall, the marks are positive and provide an overview of the training sections. The results are aligned with the previous results, there are less positive feedback regarding the practical and more digital part of the training. The feedback regarding the trainer and the way the sections were carried are extremely positive all with 3.7/4 score. No further comments were given.

The last section addressing the overall satisfaction of the efficiency of the course ranked **3,58/4** as shown in the image next**.**
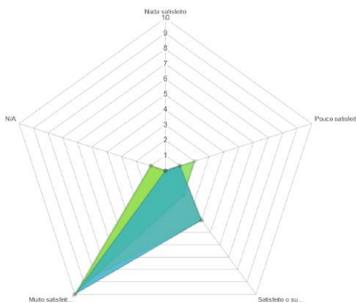
	Nada satisfeito	Pouco satisfeito	Satisfeito o suficiente	Muito satisfeito	N/A	Standard Deviation	Responses	Weighted Average
a) O conhecimento adquirido no curso	0 (0%)	1 (7%)	4 (27%)	10 (67%)	0 (0%)	3.79	15	3.6 / 4
b) As competências adquiridas no curso	0 (0%)	2 (13%)	2 (13%)	10 (67%)	1 (7%)	3.58	15	3.57 / 4
c) Os métodos de avaliação utilizados	0 (0%)	1 (7%)	4 (27%)	9 (60%)	1 (7%)	3.29	15	3.57 / 4
								3.58 / 4

Figure 39 – Satisfaction scores regarding the overall training course

Also, it is important to highlight that the training course have met the expectations of 80% of the attendants and that 87% would recommend it to someone else.

The remarks and comments provided by the trainees about the most positive aspect of the course were aligned with the fact that:

- it was free of charge;
- being online facilitates the participation. (Comment on not needing to leave the workspace to participate)
- level of detail of the topics addressed;
- the materials shared by the end;

- a detailed overview of existing material for VAT;
- availability of the teacher.

In terms of things that could be improved the comments follow:

- Have an on-site training section with the equipment
- Have more activities during training for the trainees (open questions and leave a problem by the end of each section to the trainees)
- More time in-between sections
- More interaction and in-depth training with the slicer software and design software
- More questions and time in the exam

Overall, the comments culminate in the extensiveness of the content lectured, a lot of information within the training timeline. Thus, it is important to reconsider the framework on how the training was prepared and given.

6.2. Feedback given by trainers after conducting a piloting course

An additional survey was developed for trainers to ask for feedback on the given course and possible recommendations or hints on the guideline and contents. The results of the questionnaire are given below.

6.2.1. Feedback from trainers on CU63: Certification, Qualification and Standardization in Additive Manufacturing piloted by IMR

Trainers' comments stated that the practice and application for the learner is of the utmost relevance and importance. Learners must be able to *apply learning* to case studies and that this is the essential element of the subject learning and requires improvement and resolution.

Irish Manufacturing Research (IMR) and MTC UK successfully attracted a large pool of attendees over double the required pilot numbers. Embracing the agile training design methodology of co-designing with stakeholders, this large cohort, is representative of different industries based in Ireland, UK and abroad. A responsive and interactive learning design approach demands a diverse team of subject experts, managers and attendees who can provide insight and design evaluation on iterations of the training design which was mentioned in IMR's first national report, and which was implemented throughout Pilot 2.

The cohort's educational backgrounds were either at degree level or beyond and included a high proportion of those who had an engineering degree/background. Gender distribution was majority male which is indicative of the current state of the subject statistically.

Results:

1. 97% responded that they were satisfied or very satisfied with the whole course.
2. 97% responded to say that the CPD hours x 6 was a very attractive aspect of sitting the whole course.
3. 100% of core 33 attendees returned to each session and answered the evaluation questionnaire.
4. Over 64% of learners said they *would be very likely* to follow the SAM project now that they had been on the pilot training programme and learned about it there.
5. 100% of attendee rated their trainers as knowledgeable and responsive.
6. 60% approx. of attendees passed the exam first round. This is reflective of the quality of content and trainers.
7. 100% of attendees responded to both the IMR/MTC survey and the EWF survey.

6.2.2. Feedback from trainers on CU63: Certification, Qualification and Standardization in Additive Manufacturing piloted by LORTEK

As can be seen from Figure 40, the trainers were very satisfied with the support provided by the provider (Lortek) of the content. Both trainers were satisfied with the structure of the course as well as the contents addressed. Both trainers were also very happy with the established contact hours.

...support provided by the training provider staff?

2

■ 1 = worst rating ■ 2 ■ 3 ■ 4 = best rating

Figure 40: Support provided by Provider

...balance between theoretical and practical training?

1   1

■ 1 = worst rating ■ 2 ■ 3 ■ 4 = best rating
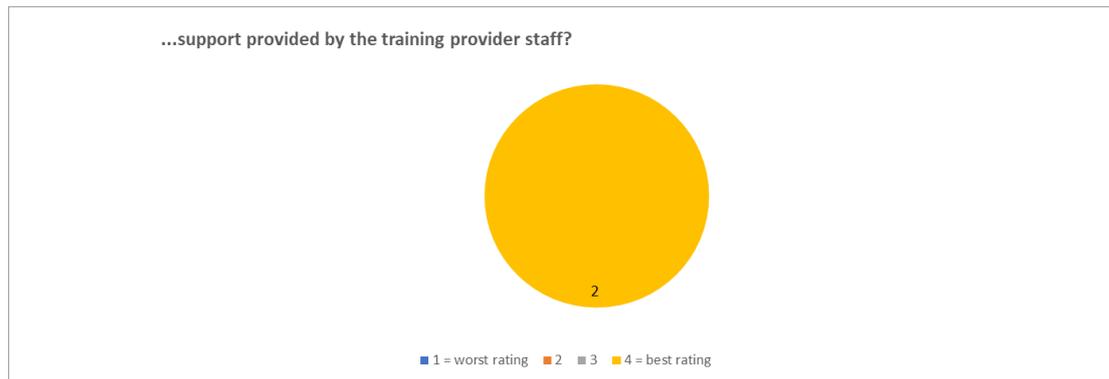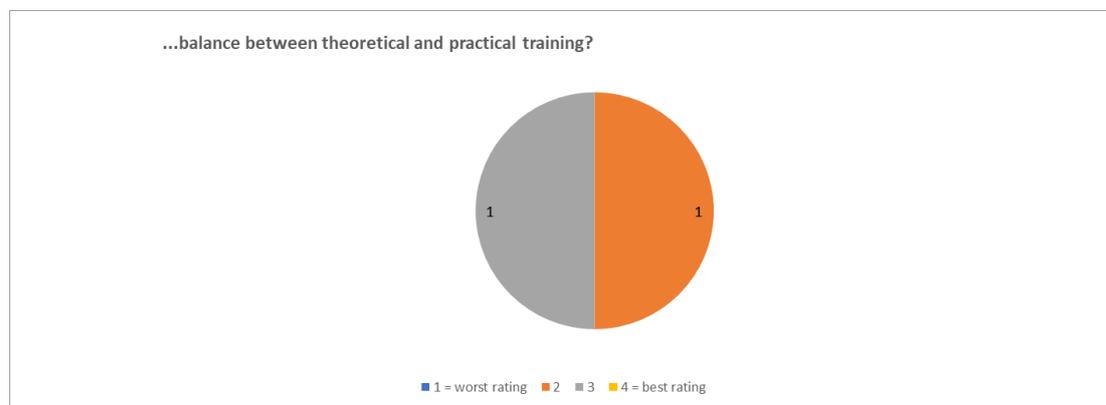
Figure 41: Balance between theoretical and practical training

Not so good results were achieved when looking at the practical vs the theoretical training. Both trainers were not happy with the amount of practical training (see Figure 41).

Positive aspects of the course:

- It covers a lot of aspects of the standardization content
- Different trainers provided an interesting mix of training delivery.
- It was nice using slido to engage the crowd
- use cases in aerospace sector
- Overview of standardization activities ISO/ASTM level
- No delay due to technical difficulties

What could be improved?

- The course structure itself is good – it just needs more clarification what is expected to be talked about in the single sessions as it is difficult to not overlap or understand what is meant to be provided in terms of input or
- Combine virtual classes with practical, on-site programme to gain hands-on experience

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...allocated contact hours for the practical work?

2

■ 1 = worst rating ■ 2 ■ 3 ■ 4 = best rating
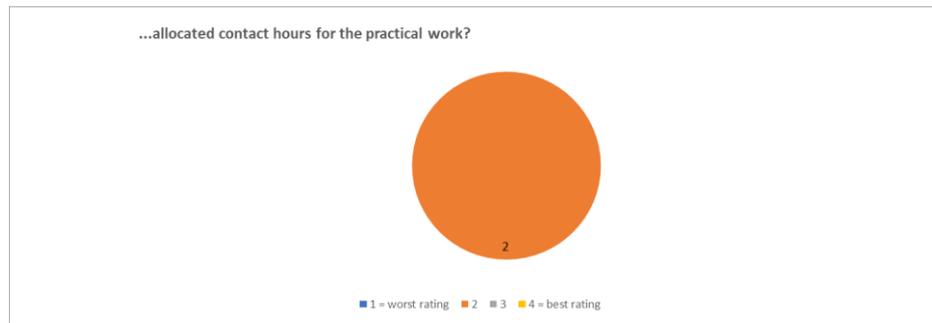
Figure 42: Allocated contact hours for the practical work

Again, as can be seen in Figure 42, the trainers were not happy with the allocated hours for practical work.

Analysis of results:

The trainers were mostly satisfied with all questions and only rarely giving out a 2 in a rating.

The trainers saw a need to adjust the time between practical and theoretical work. This feedback has been also seen by the students. Overall trainers seemed to be happy with an easy integration and good coverage of topics.

6.2.3. Feedback from trainers on CU63: Certification, Qualification and Standardization in Additive Manufacturing piloted by FA

Upon the feedback received from the trainees it is possible to identify very few raised points and based on those the following recommendations for future training activities are:

1 – When possible, develop the training in-person

2 – Provide more in-depth examples of the topics addressed and lectured

4 – More engaging activities when providing the training on-line

5 – Not related to the training itself, but improve the communications off-training

6.2.4. Feedback from trainers on CU64: Business for Additive Manufacturing piloted by EC Nantes

General information:

This pilot study took benefit from six trainers. There were four professors from three universities (1 from EC Nantes, 2 from Politecnico di Milano, and 1 from Université de Technologie de Belfort), and two experts from industry (IRT Jules Verne, BASF). Once the course terminated, they received the feedback survey and eventually five of them sent back their answers.

In overall, the results showed they were satisfied with this course. Table 6 depicts the average score per trainer, where the trainer 5 was fully satisfied with giving the best rating (4 out of 4) while the least satisfied one was trainer 3 whose score was 2.91 out of 4. Considerably, the

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participants expressed their most interest to the module taught by trainer 5 and their least interest to the module taught by trainer 3, respectively.

General aspects of the course:

The result revealed that the trainers were satisfied with the supports, with rating 3.8 out of 4, and infrastructure conditions, with rating 3.67 out of 4, provided by the course organizer.

Table 6: The average score per trainer

Concerns with the training program:

There were five questions to measure this item. In general, the result showed that trainers found no concern regarding the training program; the total average score was 3.52 out of 4. The trainers were most satisfied with the structure of the course, with total average 3.8 out of 4, while the least one was the balance between theoretical and practical training, with total average 3.2 out of 4.

Concern with the training sessions and achieved results:

There were four questions to measure this item. In general, the result showed that trainers found no concern regarding the training program; the total average score was 3.35 out of 4. The trainers were most satisfied with the allocated contact hours for theoretical classes, with total average 3.6 out of 4, conversely the allocated contact hours for the practical work got the lowest score, 2.8 out of 4. This suggested that this virtual training could not provide many facilities for practical training.

Positive aspects and those ones can be improved:

The trainers highlighted a good collaboration between trainers to about the teaching material and contents. In addition, they found this course interesting because of six different trainers from both inside and outside the SAM. To improve the quality of the course, they proposed to reorganize the next on in face-to-face format as soon as the Covid-19 restrictions are lifted.

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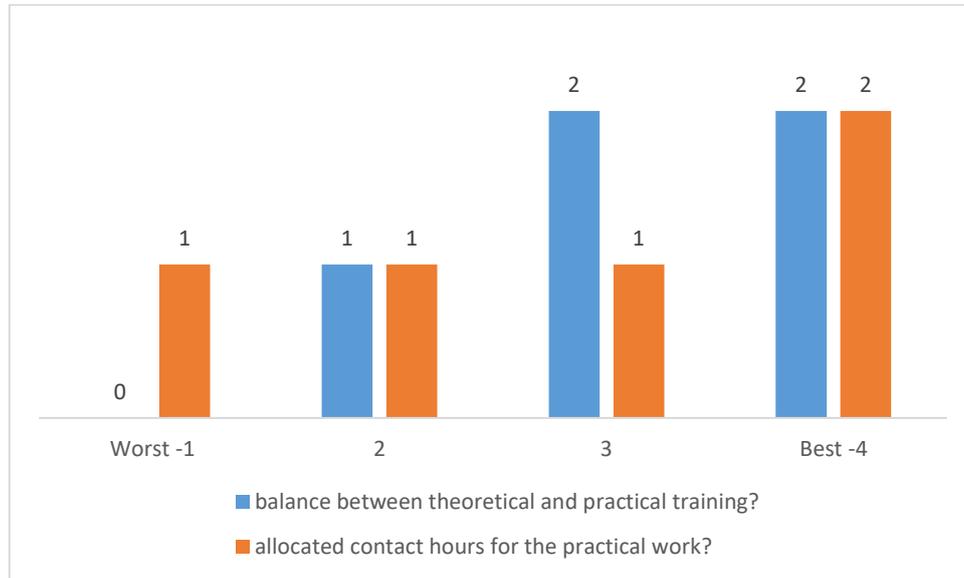
6.2.5. Feedback from trainers on CU65: Overview on polymer materials and properties piloted by URUN

In general, the two trainers from Brunel University London (UBRUN) and ANSYS rated the course excellently well and were satisfied with the content and guideline of the course. Some of the specific positive aspects are shown below:

- Excellent adaptation of the course content for an online delivery
- Useful information about the fundamental concepts of AM Polymer Materials and Properties.
- Good mix of the learning resources from both institutions
- The virtual nature and delivery of the course meant that participants from all over the world could attend the sessions.

On the other hand, the aspect of the course that can be improved is an increase in the total number of contact hours.

The recommendations for improvement of this course entails:

- The allocation of more contact hours
- Provision of practical sessions to supplement the theoretical training
- Accessibility to the Ansys software platform
- Covering more in-depth and comprehensive topics or a follow-up course with more advanced topics.

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6.2.6. Feedback from trainers on CU65: Overview on polymer materials and properties piloted by ISQ

There was only one trainer in this pilot course, so we present the results and analysis of the results at once (no charts needed, in our opinion).

In terms of general aspects of the course (Q3), the trainer rated the support provided by ISQ staff and the infrastructure conditions as the best possible.

Concerning the trainer's satisfaction with the training programme (Q4), the structure of the course and the contents addressed got a score of 3 out of 4. Regarding the established contact hours, the trainer is fully satisfied with the amount established in the CU. However, the balance between theoretical and practical training was given a score of 2 out of 4 – the explanation is found in Q6, where the trainer expresses his opinion that there should be a small practical component included in the CU (*n.b.* this CU is only theoretical, at this point). The relationship between the contents and the learning outcomes was given a score of 3 out of 4.

The three positive aspects of the training course (Q5) pointed out by the trainer were:

- General view of polymers as manufacturing material
- Relationship of structure and properties of polymers
- Use of polymers as raw materials

As to the aspects of the course learning programme that could be improved (Q6), the trainer pointed out:

- Include a specific topic on the recycling of polymers (this point raised a lot of discussion and is, clearly, a hot topic in industry)
- Include a small practical component, maybe 1 to 1,5 hours

Concerning the training sessions and achieved results (Q7), the trainer showed a complete satisfaction with the allocated contact hours for the theoretical classes, gave a 3 out of 4 score to the available equipment and to the evaluation methods used, and scored the allocated contact hours for practical work with 2 out of 4 – reinforcing the idea that he felt it would be better to have some time for practical work (already stated above).

Based on the feedback received and on the experience of implementing the CU65 pilot course, our recommendation would be to consider using a bit more time to make the training more dynamic: show a selection of videos demonstrating some tests related to the materials' properties and ask trainees to present examples of the use of polymers in AM, allowing them the time to present their findings. Also, instead of videos, trainees could also go to a lab and see the materials' tests live, to gain a visual "image" of the materials' properties – this could also be associated with a practical component of the training.

These recommendations are in line with the results of the trainees' feedback survey.

6.2.7. Feedback from trainers on CU66: Designing Polymers AM Parts piloted by MTC

Information provided seemed drip fed and therefore was difficult to fully understand requirements both pre and post training. Maybe some clearer communication directly with the course organiser (Llyr Jones) may have avoided some of the delays/difficulties sometimes. Otherwise it ran smoothly and the participants seemed to find it valuable and enjoyable, which at the end of the day is the most important thing!

6.2.8. Feedback from trainers on CU67: Post Processing for Polymers piloted by LAK

2 trainers conducted the two piloting courses. In total, 4 four feedback questionnaires were collected.

Results:

All four trainers rated the support provided by the training provider staff well. The established contact hours, the relationship between the contents and the learning outcomes and the allocated contact hours for theoretical classes were also rated as good without exception.

The trainers were divided (two to two) on the structure of the course, the hours allocated for practical learning, and evaluation methods.

The provided infrastructure, the balance between theoretical and practical lessons as well as the usable equipment were rated worst, although these points can still be described as mostly good.

Analysis of results:

Overall, the trainers would like to see better infrastructure and equipment provided. They seem to be satisfied with the didactic planning, as the allocated teaching times and the associated learning objectives are appropriate.

6.2.9. Feedback from trainers on CU68: Design for Material Extrusion piloted by LMS

There were three trainers for the CU 68 - Material Extrusion Process, the course was in English language and it was a virtual course (all countries). All of them had participated to the survey and the results are as follows.
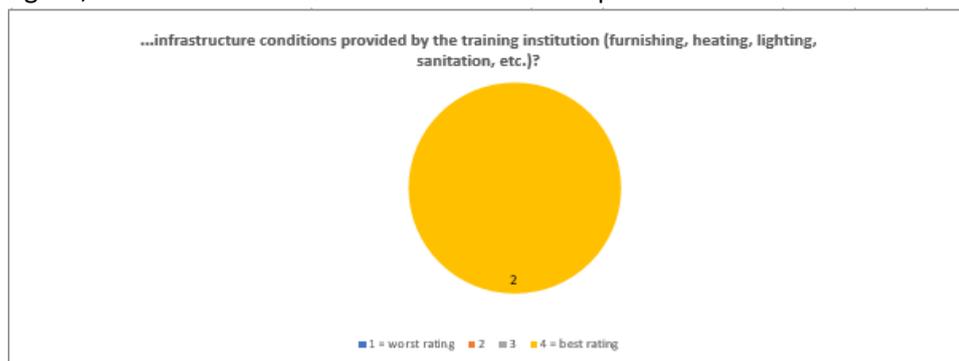
WP5 Pilot Activities Report

Qualification/Professional Profile: Process Engineer PBF-LB | 2 Competence Units: Metal AM Designer

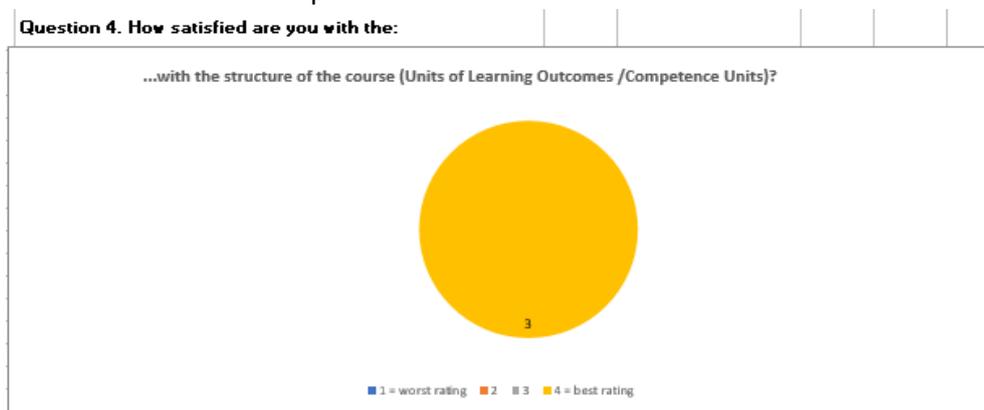*Project No. 601217-EPP-1-2018-1-BE-EPPKA2-SSA-B*

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Question 1. Which pilot course did you implement?

CU 69 - Design for PBF Polymer
CU 68 - Design for MaterialExtrusion
CU 67 - Post Processing for Polymers
CU 66 - Designing Polymers AM Parts
CU 65 - Overview on polymer materials and properties
CU 64 - Business for Additive Manufacturing
CU 63 - Certification, Qualification and Standardisation in Additive Manufacturing
CU00: Additive manufacturing Process Overview

0   0.5   1   1.5   2   2.5   3   3.5

Question 1. In which language did you implement it?

CU 69 - Design for PBF Polymer
CU 68 - Design for Material Extrusion
CU 67 - Post Processing for Polymers
CU 66 - Designing Polymers AM Parts
CU 65 - Overview on polymer materials and properties
CU 64 - Business for Additive Manufacturing
CU 63 - Certification, Qualification and Standardisation in Additive Manufacturing
CU00: Additive manufacturing Process Overview

0   0.5   1   1.5   2   2.5   3   3.5

Question 2. In which country did the pilot course took place?

virtual course (allcontries)
virtual course (one-country)
UK
Sweden
Spain
Slovenia
Slovakia
Romania
Portugal
Poland
Netherlands
Malta
Luxembourg
Lithuania
Latvia
Italy
Ireland
Hungary
Greece
Germany
France
Finland
Estonia
Denmark
Czech Republic
Republic of Cyprus
Croatia
Bulgaria
Belgium
Austria

0   0.5   1   1.5   2   2.5   3   3.5

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SAM
SECTOR SKILLS STRATEGY
IN ADDITIVE MANUFACTURING

- Regarding the first question of how satisfied are you with the support provided by the training provider staff? 1=the worst rating, 4=the best rating). All the trainers have chosen option 4=the best rating. So, we see a total satisfaction of the trainer's part.
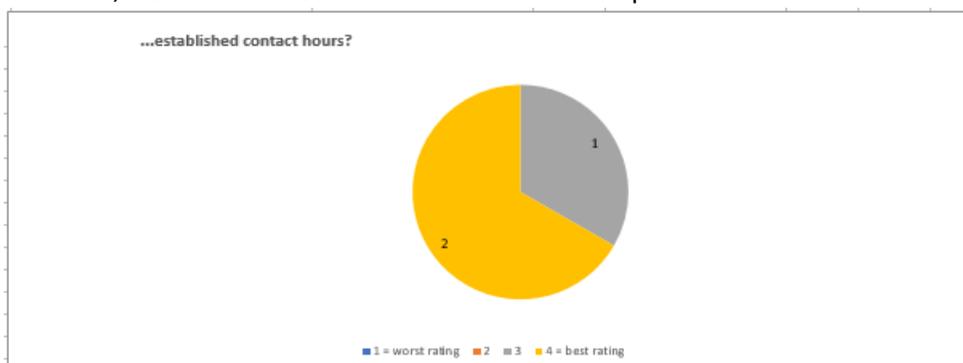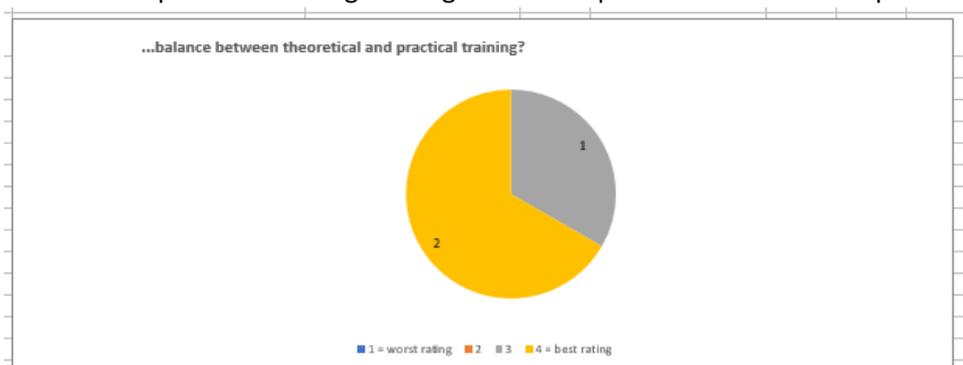
Question 3. How satisfied are you with the:

...support provided by the training provider staff?

■ 1 = worst rating   ■ 2   ■ 3   ■ 4 = best rating

- Regarding the first question of how satisfied are you with the infrastructure conditions provided by the training institution (furnishing, heating, lighting, sanitation, etc., ...)? (1=the worst rating, 4=the best rating) all the trainers had also chosen option 4=the best rating. So, we see a total satisfaction of the trainer's part.

...infrastructure conditions provided by the training institution (furnishing, heating, lighting, sanitation, etc.)?

■ 1 = worst rating   ■ 2   ■ 3   ■ 4 = best rating

- Continuing with the question how satisfied are you with the structure of the course (Units of Learning Outcomes /Competence Units)? (1=the worst rating, 4=the best rating). All the trainers have chosen option 4=the best rating. So, we see a total satisfaction of the trainer's part.

Question 4. How satisfied are you with the:

...with the structure of the course (Units of Learning Outcomes /Competence Units)?

■ 1 = worst rating   ■ 2   ■ 3   ■ 4 = best rating

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- Follows the question how satisfied are you with the contents addressed? (1=the worst rating, 4=the best rating). Again, all the trainers have chosen option 4=the best rating. So, we see again a total satisfaction of the trainer's part.
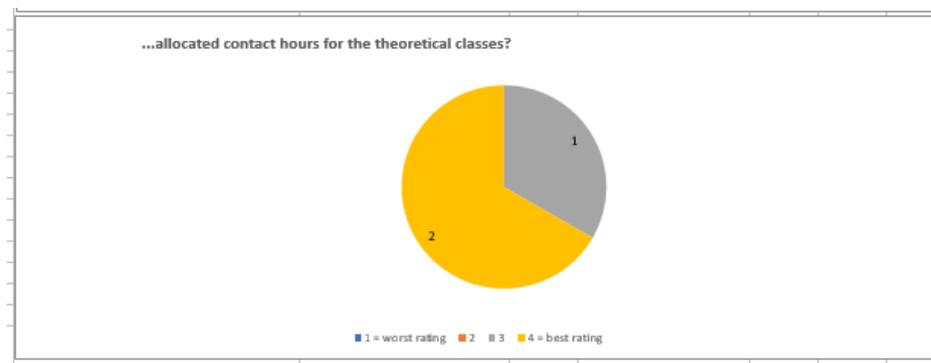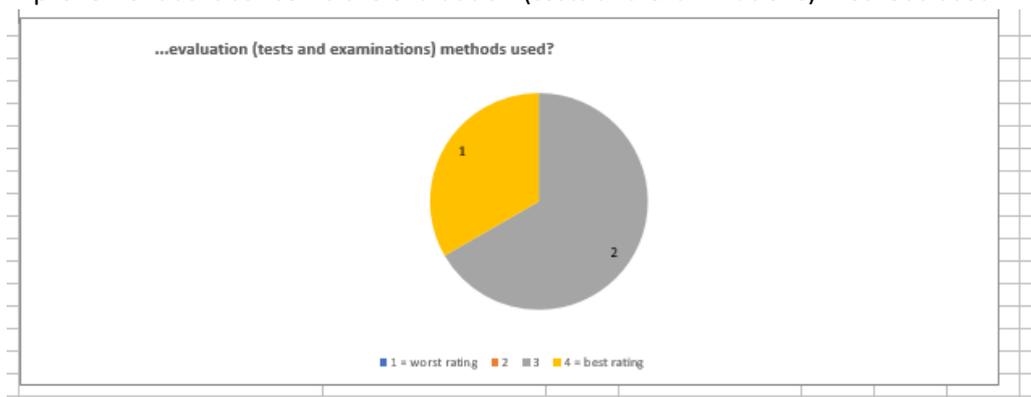

...contents addressed?

- To the question how satisfied are you with the established contact hours? (1=the worst rating, 4=the best rating). We received 2 of the 3 answers choosing option 4 and 1 chose option 3. So, we see that the contact hours could be improved.

...established contact hours?

- To the question how satisfied are you with the balance between theoretical and practical training? (1=the worst rating, 4=the best rating). We received 2 of the 3 answers choosing option 4 and 1 chose option 3. Obviously, there was balance between theoretical and practical training although a small improvement could be implemented.

...balance between theoretical and practical training?

- Following the question how satisfied are you with the allocated contact hours for the practical work? (1=the worst rating, 4=the best rating). Also, we received 2 of the 3 answers choose option 4 and 1 choose option 3. So, we can mention that the duration and the balance between practical and theoretical training could be improved. Although

we have to mention that all trainers are really satisfied as we can conclude by their rating.
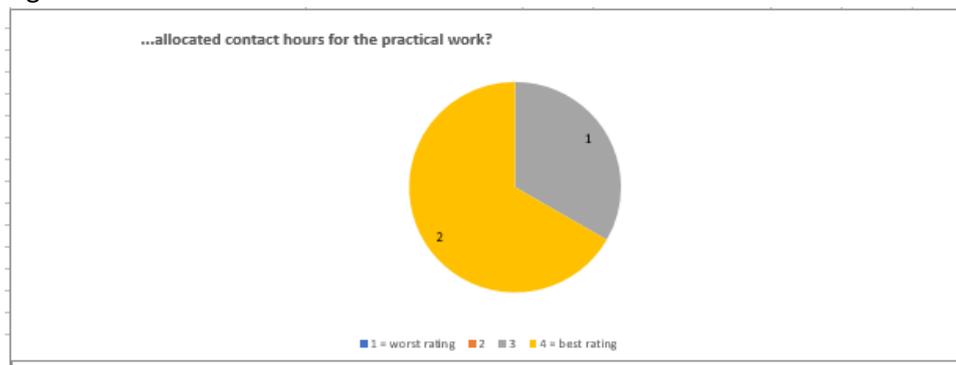
...allocated contact hours for the practical work?

■ 1 = worst rating ■ 2 ■ 3 ■ 4 = best rating

- Then comes the question how satisfied are you with the relationship between the contents and the learning outcomes? (1=the worst rating, 4=the best rating). To this question all the trainers has chosen option 4=the best rating. So, we see again a total satisfaction of the trainer's part.

...relationship between the contents and the learning outcomes?

■ 1 = worst rating ■ 2 ■ 3 ■ 4 = best rating
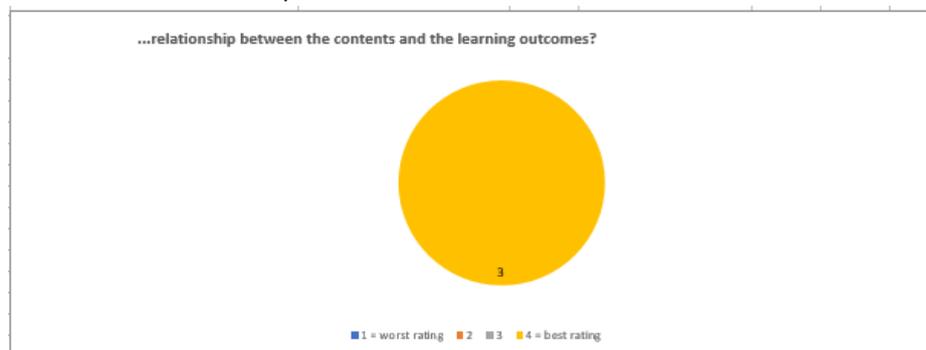
- To the question of remark 3 positive aspects of the training course. We received the following answers:
  - Detailed Analysis
  - Interesting Interaction Activities
  - Interesting Case Study
  - Flowing in terms of content
  - Interesting hands-on aspects
  - Satisfactory participation
  - Structure and contents of the course
- To the question what aspects of the course learning program could be improved? The one trainer answered less duration, the other answered more audience engagement and the other one mentioned more interactive sessions/contact with the students, courses on weekends? So, it's easier for people that are working to be able to join them.
- To the question how satisfied are you with the available equipment? (1=the worst rating, 4=the best rating) all the trainers answered the best rating option 4.

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...available equipment?

3

■ 1 = worst rating   ■ 2   ■ 3   ■ 4 = best rating

- To the question how satisfied are you with the allocated contact hours for the theoretical classes? (1=the worst rating, 4=the best rating) the 2 of 3 trainers answered the best rating option 4 and 1 chose the option 3. So, we see again that the duration remains an issue for the courses and it could be improved by creating courses with less duration.
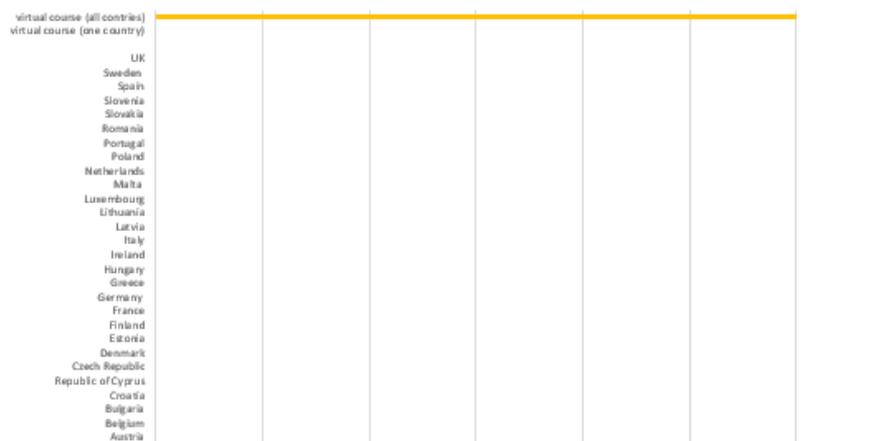

...allocated contact hours for the theoretical classes?

1

2

■ 1 = worst rating   ■ 2   ■ 3   ■ 4 = best rating

- To the question how satisfied are you with the evaluation (tests and examinations) methods used? (1=the worst rating, 4=the best rating) the 1 of 3 trainers answered the best rating option 4 and 2 of 3 trainers chose the option 3. As we can conclude in general trainers are satisfied as we can see from their ratings although there could be an improvement as it concerns the evaluation (tests and examinations) methods used.

...evaluation (tests and examinations) methods used?

1

2

■ 1 = worst rating   ■ 2   ■ 3   ■ 4 = best rating

- None of them has mentioned any other aspect(s).
- And none of them has specify any open aspects.

6.2.10. Feedback from trainers on CU68: Design for Material Extrusion piloted by FAN3D

Only one trainer provided the pilot training for this competence unit and the feedback is presented hereafter:

Results:

1. CU68 – Design for Material Extrusion
2. Portugal and virtual course (one country)
3.
    3.1. 4
    3.2. 4
4.
    4.1. 4
    4.2. 4
    4.3. 2
    4.4. 3
    4.5. 4
5. Easy to have practical and visual examples; Interested and active trainees; Straight forward content
6. Would be beneficial for the trainees to have an experience with the hardware even though not expected in the guideline. Nevertheless, the virtual approach, makes it impossible.
7.
    7.1. 4
    7.2. 2
    7.3. 3
    7.4. 4
8. The duration of the training may need to be assessed to less time

Analysis of results:

Overall, the feedback from the trainer is quite positive with an average mark of 3,45/4,00 taking into consideration the measurable topics. The less positive mark has to do with the expected timeline/duration of the Competence Unit has from the comments it should be reduced. Also, from the comments it is possible to observe that the virtual approach is quite limiting and may need to be reconsidered. Also, despite not being expected in this Competence Unit, and impossible with the virtual approach, some interaction with a Material Extrusion Machine would be extremely positive for the trainees has they would be able to get some hands-on experience.

6.2.11. Feedback from trainers on CU69: Design for PBF Polymer piloted by LMS

There were three trainers for the CU 69 – Design for PBF Polymer, the course was in English language and it was a virtual course (all countries). All of them had participated to the survey and the results are as follows.

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Question 1. Which pilot course did you implement?

CU 69 - Design for PBF Polymer	
CU 68 - Design for Material Extrusion	
CU 67 - Post Processing for Polymers	
CU 66 - Designing Polymers AM Parts	
CU 65 - Overview on polymer materials and properties	
CU 64 - Business for Additive Manufacturing	
CU 63 - Certification, Qualification and Standardisation in Additive Manufacturing	
CU00: Additive manufacturing Process Overview	
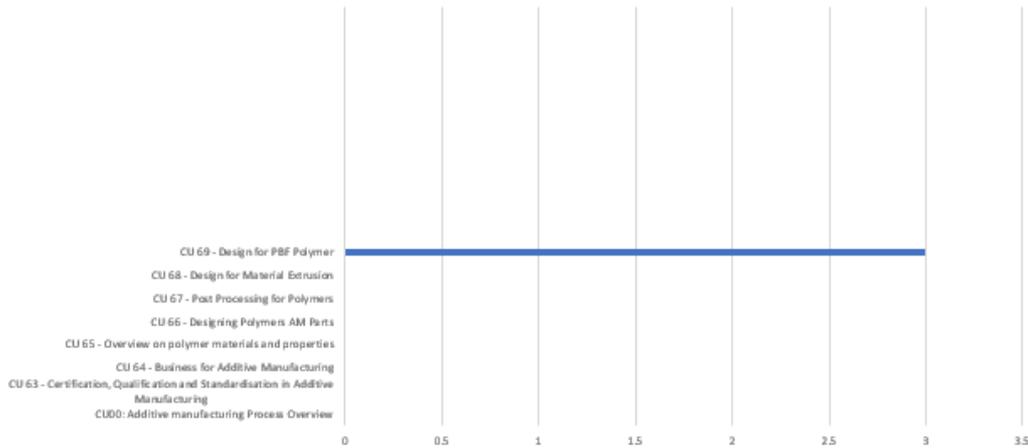
Question 2. In which country did the pilot course took place?

- Regarding the first question of how satisfied are you with the support provided by the training provider staff? 1=the worst rating, 4=the best rating). All the trainers have chosen option 4=the best rating. So, we see a total satisfaction of the trainer's part.

Question 3. How satisfied are you with the:

...support provided by the training provider staff?
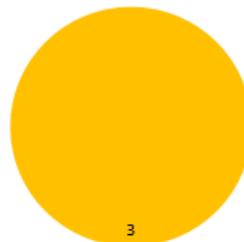
■ 1 = worst rating ■ 2 ▦ 3 ■ 4 = best rating

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- Regarding the first question of how satisfied are you with the infrastructure conditions provided by the training institution (furnishing, heating, lighting, sanitation, etc., ...)? (1=the worst rating, 4=the best rating) all the trainers had also chosen option 4=the best rating. So, we see a total satisfaction of the trainer's part.

...infrastructure conditions provided by the training institution (furnishing, heating, lighting, sanitation, etc.)?

■ 1 = worst rating ■ 2 ■ 3 ■ 4 = best rating

- Continuing with the question how satisfied are you with the structure of the course (Units of Learning Outcomes /Competence Units)? (1=the worst rating, 4=the best rating). The two trainers have chosen option 4=the best rating and the third one chose as rating the 3 option. So, we see a good level of satisfaction from the trainer's part.

Question 4. How satisfied are you with the:						

...with the structure of the course (Units of Learning Outcomes /Competence Units)?

■ 1 = worst rating ■ 2 ■ 3 ■ 4 = best rating

- Follows the question how satisfied are you with the contents addressed? (1=the worst rating, 4=the best rating). Again, all the trainers have chosen option 4=the best rating. The two trainers have chosen option 4=the best rating and the third one chose as rating the 3 option. So, we see a good level of satisfaction from the trainer's part.

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...contents addressed?
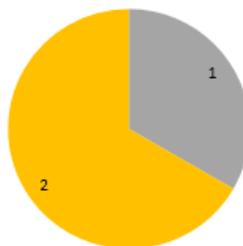
■ 1 = worst rating ■ 2 ■ 3 ■ 4 = best rating

- To the question how satisfied are you with the established contact hours? (1=the worst rating, 4=the best rating), All the trainers chose option 3. So, we see that the contact hours could be improved. It is clear that the duration of the courses is a very important field in order make the course less tiring for both parts, trainers and participants, more attractive and more interactive, this way we could attract also more audience.

...established contact hours?
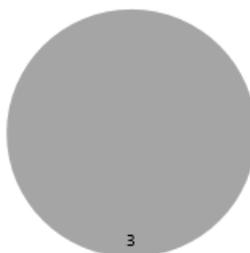
■ 1 = worst rating ■ 2 ■ 3 ■ 4 = best rating

- To the question how satisfied are you with the balance between theoretical and practical training? (1=the worst rating, 4=the best rating). We received 2 of the 3 answers chose option 3 and 1 chose option 4. Obviously, there was balance between theoretical and practical training although a small improvement could be implemented.

...balance between theoretical and practical training?
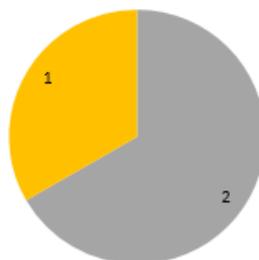
■ 1 = worst rating ■ 2 ■ 3 ■ 4 = best rating

- Following the question how satisfied are you with the allocated contact hours for the practical work? (1=the worst rating, 4=the best rating). Also, we received 2 of the 3 answers chose option 3 and 1 chose option 4. So, we can mention that the duration and

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the balance between practical and theoretical training could be improved. Although we have to mention that all trainers are mainly satisfied as we can conclude by their rating.
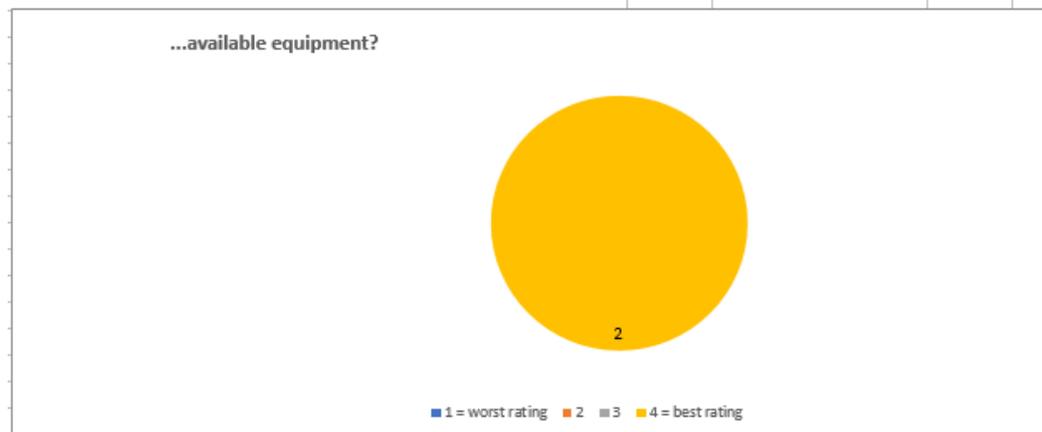
...allocated contact hours for the practical work?
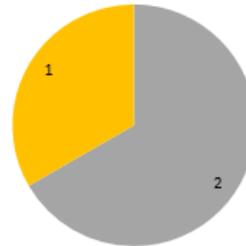
■ 1 = worst rating ■ 2 ■ 3 ■ 4 = best rating

- Then comes the question how satisfied are you with the relationship between the contents and the learning outcomes? (1=the worst rating, 4=the best rating). To this question all the 2 trainers has chosen option 4=the best rating and 1 option 3. So, we see again a satisfaction of the trainer's part but small improvements could be implemented.

...relationship between the contents and the learning outcomes?
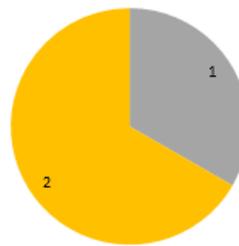
■ 1 = worst rating ■ 2 ■ 3 ■ 4 = best rating

- To the question of remark 3 positive aspects of the training course. We received the following answers:
  o Well-structured contents,
  o Good balance between giving a good overview of the whole process while also providing a lot of in detail technical info in regard to designing for PBF
  o Interesting topic
  o A holistic view on LPBF/Polymer including materials and process setup
  o Decent attendance
  o Specialization
  o Change Ideas
  o Interesting interaction between participants
- To the question what aspects of the course learning program could be improved? The one trainer answered that it is hard to attend the whole course on working days as somebody who has to work, on the other hand trainers don't love working on weekends as well, so need to strike a balance more homework for trainees including designing exercises (and to be also evaluated by those exercises). Also, the other trainer

mentioned that more practical aspects could be included, and finally less duration was mentioned as improvement field.
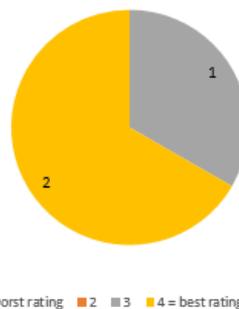
- To the question how satisfied are you with the available equipment? (1=the worst rating, 4=the best rating) all the trainers answered the best rating option 4.

Question 7. How satisfied are you with the:

...available equipment?

■ 1 = worst rating ■ 2 ■ 3 ■ 4 = best rating

- To the question how satisfied are you with the allocated contact hours for the theoretical classes? (1=the worst rating, 4=the best rating) the 2 of 3 trainers answered the best rating option 4 and 1 chose the option 3. So, we see again that the duration remains an issue for the courses and it could be improved by creating courses with less duration.

...allocated contact hours for the theoretical classes?

■ 1 = worst rating ■ 2 ■ 3 ■ 4 = best rating

- To the question how satisfied are you with the evaluation (tests and examinations) methods used? (1=the worst rating, 4=the best rating) the 1 of 3 trainers answered the best rating option 4 and 2 of 3 trainers chose the option 3. As we can conclude in general trainers are satisfied as we can see from their ratings although there could be an improvement as it concerns the evaluation (tests and examinations) methods used.
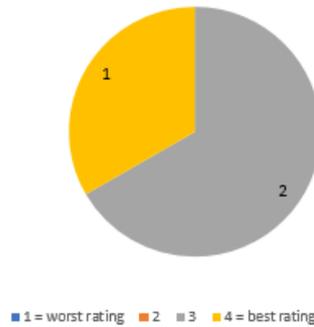
■ 1 = worst rating ■ 2 ■ 3 ■ 4 = best rating

- None of them has mentioned any other aspect(s).
- And none of them has specify any open aspects.

6.2.12. Feedback from trainers on CU70: Design for VAT Photopolymerization piloted by FA

Only one trainer provided the pilot training for this competence unit and the feedback is presented hereafter:

Results:

1. CU70 – Design for VAT-Photopolymerization
2. Portugal and virtual course (one country)
3.
    3.1. 4
    3.2. 4
4.
    4.1. 4
    4.2. 4
    4.3. 3
    4.4. 3
    4.5. 4
5. Interested and active trainees; Practical examples of different applications, Showcase (video) of different printed parts and mechanical behaviour.
6. Include and introduction/listing of the AM processes available in the training programme.
7.
    7.1. 4
    7.2. 3
    7.3. 3
    7.4. 4
8. When possible, to have a dedicated time to hands-on teaching/learning with equipment and material samples.

Analysis of results:

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Overall, the feedback from the trainer is quite positive with an average mark of 3,64/4,00 taking into consideration the measurable topics. From the comments it is possible to observe that the virtual approach is quite limiting and may need to be reconsidered. When possible, hands-on training with equipment and materials samples should be considered, enabling a more positive and didactic learning approach towards the trainees.

Recommendations:

Upon the feedback received from both trainees and trainer it is possible to identify some resembles and alignment on the raised points from both sides. Based on this the following recommendations for future training activities or even updates on the training guideline are:

1 – The introduction of a very brief and short overview of the AM processes, if it is not included in the training of an entire qualification.

2 – To promote a more didactic training activities have at least a few hours with the equipment and a hands-on approach section

3 – Have more engaging activities during the on-line sections promoting even more the engagement of students.

4 – Introduce more in depth the slicer software so that the trainees can simulate the printing process of the equipment and understand how changes to design affect the manufacturing process and enable them to iterate dynamically the part's design.