



### Document Details

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## 1. Executive summary

This document provides a description of the methodology applied to the review process, including details of the information and training provided as well as the procedure used and the outcomes from the review session of the Metal AM Engineer Profile for Powder Bed- Fusion Laser Beam (PBF - LB) to achieve the 1<sup>st</sup> stage of Real Case Scenarios Revision.

A carefully considered and executed approach was adopted for conducting the review of the qualification guidelines and key Competence Units (CU) or Units of Learning Outcomes (ULO). The members of all of the metal AM workgroups (WGs) were invited to attend a briefing session to provide background information on the SAM project, the international AM qualification system (IAMQS), as well as best practice for the review of qualifications / professional profiles and CU or ULO. A hands-on session was held with the metal WG chairs to dry run the review process and templates were simplified based on feed-back from this session. In addition, the Chair of the PBF-LB WG was given a separate briefing prior to the review session. The members of the PBF-LB WG were supplied with documents prior to the review to enable them to read them and prepare.

The working session linked to the 1<sup>st</sup> stage of Real Case Scenarios was held on the 30<sup>th</sup> October with 11 experts from the PBF-LB WG, supported by additional representatives from the SAM project. The session was well received, with positive comments regarding the planning and support given, however it was recommended that some improvements should be made to help with time management.

Within the remit of the review, several minor changes were requested to the wording in the qualification guidelines and CU/ULO 43: Production of PBF-LB parts, primarily to improve clarity. A general conclusion was that for the systematic review of qualifications and units of learning outcomes shall be conducted with a periodicity of two years (short term), as the pilot implementation reveal that no significant changes results from the implementation of training every 6 months.

A number of additional recommendations were also made which should be carefully considered in the future. A particular concern was raised regarding the qualification guidelines in respect of the appropriateness of the composition of the CU/ULOs and duration of the training.

## 2. Introduction

This document provides a description on the major changes carried out on Metal AM Engineer Profile for Powder Bed- Fusion Laser Beam (PBF - LB) achieved during the 1<sup>st</sup> stage of Real Case Scenarios Revision. It also provides a description of the methodology applied to the review process, including details of the information and training provided as well as the procedure.

## 3. Methodology

The methodology used is given below, it consists of 5 main steps;

1. Briefing sessions for all attendees.
2. Hands-on session for metal WG chairs.
3. Detailed alignment session for PBF-LB WG chair.
4. Working session for the Review
5. Post review assessment and recommendations for the 1st stage of Real Case Scenarios Revision.

### 3.1. Briefing sessions;

All of the metal WG members (across the 5 technology areas; PBF-LB, PBF-EB, DED-ARC,DED-LB, binder jetting) were invited to attend one of the 1 hour briefing session prior to the review to provide the background, aims and objectives of the SAM project.

These briefing sessions were held;

- 16<sup>th</sup> September 10-11am (CET)
- 8<sup>th</sup> October 10-11am (CET)
- 30<sup>th</sup> October 10-11am (CET)

The agenda for the sessions was;

- Introduction to the SAM project.
- International AM qualification system.
- Introduction to the international AM guidelines & best practice for the review of qualifications / professional profiles and competence units.
- Next steps.

The key presentations used at this meeting are given in the Annexes section

### 3.2 Training session for metal WG chairs;

A training session was held with all of the WG Chairs on the 16<sup>th</sup> September, after the general briefing session, where the review process was discussed in detail, together with the associated templates, developed in WP3. The attendees were given the opportunity to complete the templates and provide feed-back on the process. Based on the feed-back at the meeting it was decided to simplify the process and adopt a single consolidated template for the subsequent review.

The agenda, list of attendees and minutes are shown in the Annex **8.2 “Hand-on” session for metal WG chairs -16<sup>th</sup> September.**

### 3.3 Detailed Alignment Session for the PBF-LB Chair

This detailed alignment session took place on 15<sup>th</sup> October and involved Adelaide Almeida (EWF), Johannes Henrich Schleifenbaum (FhG ILT) and Gustavo Menezes de Souza Melo (RWTH Aachen University).

The objectives of the meeting was to discuss and agree the final arrangement for the 1st review session on 30th October for the AM Process Engineer PBF –LB.

Topics covered included;

- Discussion about the changes into the Qualification; Professional Profiles, Descriptors of the Qualification ; Job Functions; Job Activities and Units of Learning Outcomes and Reporting
- Template to be used.

The presentation used at this meeting is shown in the Annex 8.3 Detailed PBF-LB WG Chair briefing – 15<sup>th</sup> October.

**3.4 Working Session for Review** The session was held on the 30<sup>th</sup> October, led by Johannes Henrich Schleifenbaum (Chair of the PBF-LB working group) with support from his colleague Gustavo Melo. The overall procedure is shown in Figure 1 (“Best practice for the review of qualifications / professional profiles and competence units” <sup>1)</sup>) and the agenda for the review session is shown in Figure 2



Figure 1 - Diagram of the review process

11:00 (CET)*	Welcome	Meeting link
11:00-12:20	<p><b>Working session for the review of AM Process Engineer PBF -LB</b></p> <p><b>Introduction by Metal AM Leading Experts</b> <i>David Wimpenny</i> <i>MTC (UK) / Leading Expert of the Metal AM Working Group</i></p> <p><b>Collection of review results, decision on changes into the Qualification and reporting</b> <i>Johannes Schleifenbaum</i> <i>Fraunhofer-Institut für Lasertechnik ILT (DE) / PBF -LB Chairman (EAMQC)</i> <i>Gustavo Menezes de Souza Melo</i> <i>RWTH Aachen University (DE) / Operationally supporting the Chairman</i></p> <p><b>Validation of working Group procedures and review methodology</b> <i>Adelaide Almeida</i> <i>EFW (PT)</i></p>	<p><a href="#">Join Microsoft Teams Meeting</a></p>
12:30	Farewell	

Figure 2 - Agenda for first review session

The meeting was attended by representatives from the SAM project as well as eleven experts from the WG, with knowledge covering; process, materials, regulations/standards, as well as training. The attendees are shown in Table 1 - PBF-LB WG members who attended the 1st Review Table 1 and Table 2.

PBF-LB Working Group				
Name	Organisation	Type	Expertise	Gender
Johannes Henrich Schleifenbaum	FhG ILT	RTO	Chair of WG PBF-LB process	Male
Gustavo Menezes de Souza Melo	RWTH Aachen University	Uni	PBF-LB process	Male
Klas Boivie	SINTEF	RTO	PBF-LB process Standards	Male
Sean McConnell	IMR	RTO	PBF-LB process	Male
Nick Cruchley	MTC	RTO	PBF-LB process Materials	Male
Maximilian Kunkel	Siemens	Ind	PBF-LB process	Male
Simona Masurtschak	Lortek	RTO	PBF-LB process	Female
Bianca Maria Colosimo	POLIMI	Uni	PBF-LB process Materials	Female
Mustafa Megahed	ESI	Ind	PBF-LB process Simulation	Male
Julien Bajolet	AFPMA	Ind	PBF-LB process	Male
Luis Ignacio Suarez Rios	Iodinial	RTO	PBF-LB process	Male

Table 1 - PBF-LB WG members who attended the 1st Review

Addition attendees				
Name	Organisation	Type	Expertise	Gender
David Wimpenny	MTC	RTO	Metal WG coordinator	Male
Adelaide Almeida	EFW	RTO	WP4 lead	Female
Sandra Kramprich	LZH Laser Akademie (LAK)	Uni	Training	Female
Borzoou Pourabdollahian Tehran	University of Nantes	Uni	WP3 lead	Male
Yvonne Wessarges	LZH Laser Akademie (LAK)	RTO		Female
Ana Beatriz Lopez	EFW	RTO		Female
Francisco Barros	EFW	RTO		Male

Table 2 - Additional attendees to the 1st Review

Prior to the meeting all attendees were provided with three documents;

1. European/International Metal Additive Manufacturing Process Engineer Powder Bed Fusion - Laser Beam qualification guidelines including minimum requirements for qualification and examination (EFW-AM-QUAL-006-19)<sup>2</sup>
2. Analysis and validation of needs – Executive summary Report<sup>3</sup>
3. SAM – Report on AM Courses Implementation<sup>4</sup>

The review commenced with David Wimpenny (Coordinator for the Metal AM WGs) giving a brief introduction which included a brief presentation on the result of the SAM Report on courses implementation based the feed-back from attendees to the Metals MSc course run under the ADMIRE project (<https://admireproject.eu/>)

The modules on this course have been used as a blueprint for some of the CU in the SAM project. The summary of the feedback is shown in Figure 3.

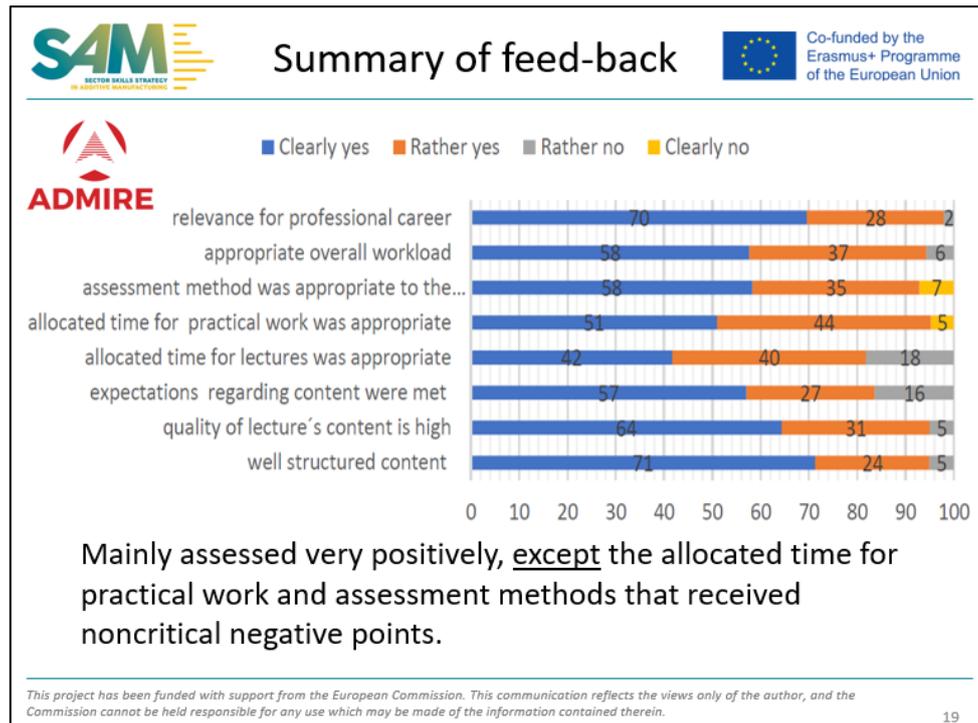


Figure 3 - Summary of feedback from the attendees to the metal AM MSc course run under the Admire project (SAM – Report on AM Courses Implementation 4

After the attendees had introduced themselves, the review process commenced under the direction of the WG Chair (Johannes Henrich Schleifenbaum). In addition to the Qualification guideline, three key competence units, selected by the Chair prior to the meeting, were also reviewed;

- CU/ULO 43: Production of PBF-LB parts
- CU/ULO 44: Conformity of PBF-LB parts
- CU/LUO 45: Conformity of facilities featuring PBF-LB

A systematic approach was adopted for the review based on methodology to design and review professional profiles/qualifications and/or Units of Learning Outcomes (D3.1) as well as the templates (D3.2), developed under Work package 3, which are aligned with the recommended approach from “Best practice for the review of qualifications / professional profiles and competence units”<sup>1</sup>, as shown in Figure 4.

1. Qualification Guidelines
2. Professional profile
3. Qualification descriptions
4. Competence units
5. Units of learning
6. Learning outcomes
7. Workload
8. Resources

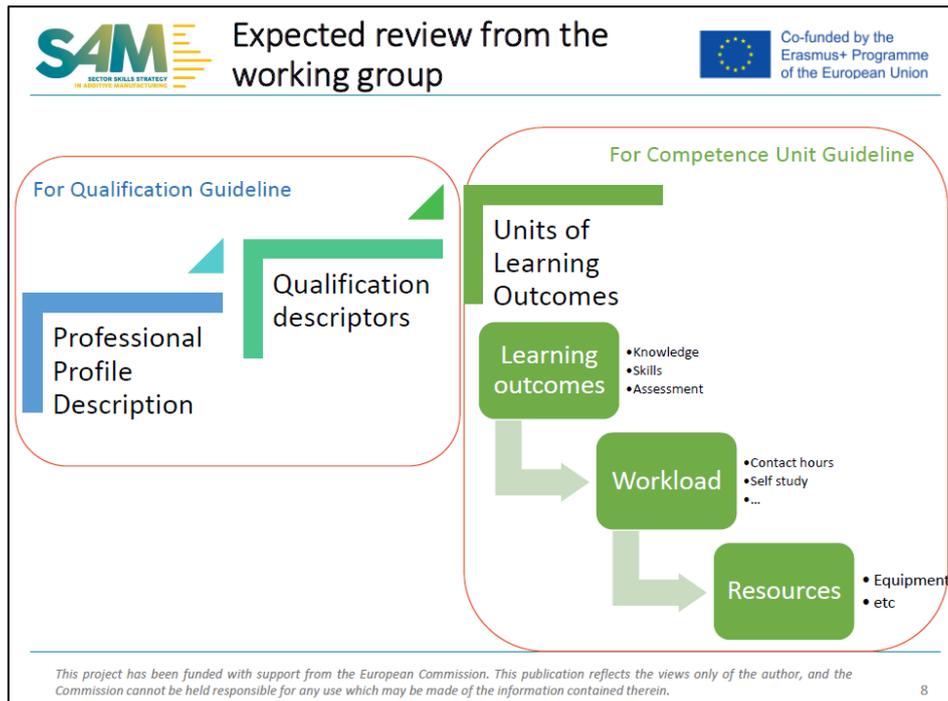


Figure 4 - Expected systematic approach from the “Best practice for the review of qualifications / professional profiles and competence units” 1.

Johannes Henrich Schleifenbaum led the discussion but every attendee was asked to provide comment which were entered directly into the review template (as shown in Section 4).

#### 4. Documental Review of the European Metal AM Eng. PBF-LB Qualification Guideline

##### 4.1 Changes into the Guideline

The completed template addressing the Qualification Systemic Review is shown in the Annex 8.4 **Working Session for Review**, together with contemporaneous notes.

Summary of requested changes included in the template are shown below;

##### Qualification/Professional Profile

###### **Professional profile;**

- suitability for customers’ requests become suitability for customer’s requests

###### **Access conditions;**

- “The defined access conditions” updated to “The recommended access conditions”
- “Aeronautic, Materials or similar.” updated to “Aeronautic, Materials, Industrial or equivalent.”

##### CU43 “Production of PBF-LB parts”

- Run basic simulations” updated to “Using simulations as process prediction”

- “Interpreting simulation results and design” updated “Interpreting simulation results and design, being aware of where the risks are”

#### 4.2 General Recommendations (Action plan)

The following points were recorded in the general notes taken during the review session;

- Concern expressed about the overall duration of the course and the length of the CUs/ULO
- The structure of the course and Qualifications suits a one year full-time Masters course but may be unsuitable for retraining of staff wishing to undertake short courses on a part-time basis.
- The compulsory technical CUs seem to be bias towards DED CUs – is this appropriate given this is PBF-LB qualification?
- Is there the potential to offer reduced hours CUs/ ULO for different roles ?
- Add more clarity on the fact that “contacts hours are recommended” and “Workload is estimated”, the solution can be to add this reference in the tables/template of the Guideline
- Include “recommended” to “access conditions” section
- Requested that the order of development of the qualification for the different technology strands be reviewed – there was some concern the PBF-EB and binder jetting may have higher priority than the development of DED qualifications.
- Need to clarify the difference between initial and advanced level for the CUs/ ULO in the preview briefing.
- Need to include machine part planning in the DED and PBF training.
- Engineers should have a holistic view of AM process to support customer discussions.
- Important that engineers understand where AM is competitive.
- Is it important to include knowledge of statistical process control ?
- To consider the amount of practical work and assessment tools related to the learning outcomes covering the AM design ad finite elements analysis (CU/ULO43)

A particular concern was raised regarding the qualification guidelines in respect of the appropriateness of the composition of the qualification, specifically the CUs/ULO and duration of the training.

#### 5. Feedback on the review process

In addition to reviewing the qualification and CUs and important aspect of the 1st review session was for the participants to provide feed-back on the review process so that, where needed, improvements could be implemented in subsequent reviews.

Feed-back was captured using a slido survey based on three questions – the data captured is given in the Annex 8.4 **Working Session for Review** and the main points are shown below for each question;

##### **Q1.What went well?;**

- Introduction of participants.
- Structure of the meeting.
- Discussion.

##### **Q2. What do we need to improve /avoid in future sessions?**

- Time management.
- Avoid deviating from the topic being discussed.
- Ensuring topics are brought to a proper close.

- Too much content for the time allowed.
- Clearer etiquette for discussion (raising hands).
- Clearer / rigid structure for session.

### **Q3. Suggest 2 activities that could contribute to improve the working group sessions**

- More background information on how the qualifications and CUs/ULO were devised.
- Preliminary discussion.
- Potential to introduce voting.
- Ensure that everyone's views are captured
- Potential to split into several groups to capture more input.
- Understand participant's expertise.
- Structured agenda.
- Introduction to the topics to be discussed.

Generally speaking the participants felt that the review session went well but for future reviews some improve the time management, pre-analysis of selected CUs/ULO and more background information needs to be supplied (particularly how the qualification guidelines and competence units were conceived).

In a nutshell the recommended actions to the future working session are:

- To conduct good debrief sessions, namely to consider the presentation of specific guidelines in the debrief session)
- To have clear focus on the objective of the session, thus following the template along the review
- To have a specific slot in the agenda to address general recommendations (which are not foreseen in the scope of the templates);
- To keep the presentation of the conclusions of the supporting document conclusions during the working sessions
- To enhance the preparation of the working session, namely by having all experts selecting the CUS/ULO they aim to analyze beforehand
- To address minor editorial changes outside the working sessions, meaning that it is possible to perform them without conducting a session.
- To use a common SharePoint repository for the working documents -
- To use digital forms and tools to facilitate the capture of information

## **6. Conclusions**

The changes requested to the qualifications and CUs/ULO are minor and should be implemented without further review.

Additional recommendations should be carefully reviewed and where appropriate changes implemented immediately or at a future review.

Also to consider that for systematic review of qualifications and units of learning outcomes, the periodicity of two years (short term) to conduct the working session is appropriate, as the pilot implementation reveal that no significant changes results from the implementation of training every 6 months.

In terms of the review process it seemed to work well, however based on the feedback from attendees improvements should be made including; providing more background information, improved structure and control of the meeting to ensure better time management.

## 7. References

1. Best Practices for review of Qualifications /Professional Profiles and Competences Units.
2. European/International Metal Additive Manufacturing Process Engineer Powder Bed Fusion - Laser Beam Qualification guidelines, including minimum requirements for qualification and examination (EWF-AM-QUAL-006-19).
3. Analysis and validation of needs – Executive summary Report.
- 4.SAM – Report on AM Courses Implementation.

## 8. Annexes

### 8.1 Briefing session for metal WG members -16<sup>th</sup> September

Presentation on introduction to the International AM guidelines and best practice for the review of qualification/professional profiles and competence units.

Debrief session with Additive Manufacturing Experts - 30th October 2020  
Adelaide Almeida, Project Manager

**SAM**  
SECTOR SKILLS STRATEGY  
IN ADDITIVE MANUFACTURING

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

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Introduction to the International AM Guidelines

Best Practices for the review of Qualifications / Professional Profiles and Competences Units

Summary

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

AM Observatory - Qualification Council Working Groups

Active role in the development and/or update of the Unique International Qualification System for AM;

IAMQS - Stucture

Guidelines

Context of review

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

IAMQS

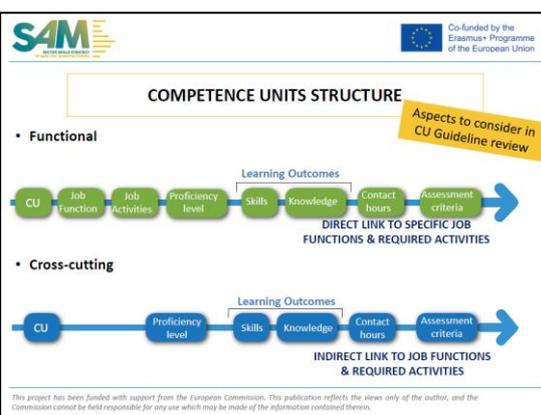
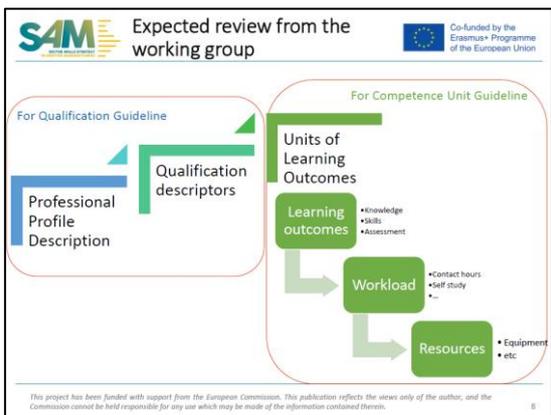
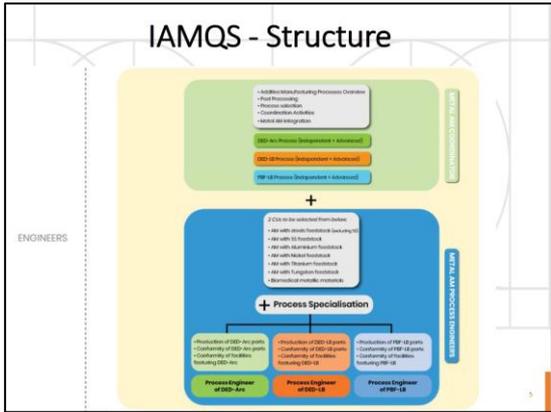
Cumulative System & Common CUs

AM MODULAR SYSTEM

MOBILIZED AUTONOMOUSLY OR FEED ONE /SEVERAL QUALIFICATIONS

CUMULATIVE FROM LOWER TO HIGHER LEVELS

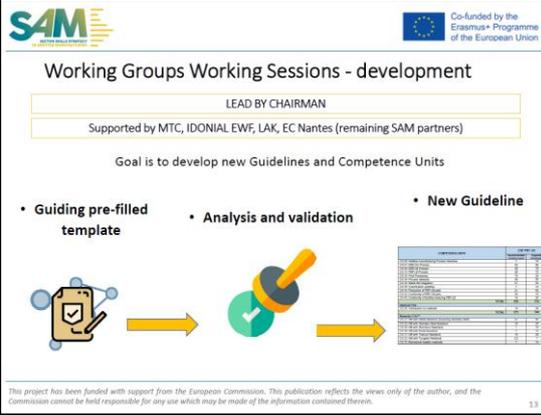
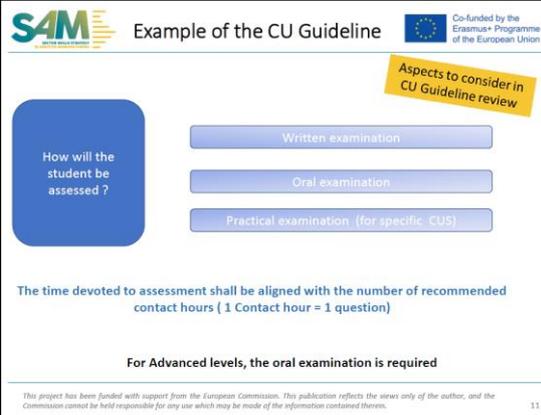
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### Example of the CU Guideline

Overview of the Scope of a specific Competence Unit

CU 01 DED-Arc Process	LEVEL	RECOMMENDED CONTACT HOURS	
		INDEPENDENT (I) (applied to Operators and Engineers)	ADVANCED (A) (applied only for Engineers)
DED-Arc System (Hardware & Software)		5	0
DED-Arc Physical Principles, Processes and Parameters		5	0
DED-Arc Build platform, feedstock and other consumables		3	0
First processing operations		1	0
DED-Arc Processes		0	14
DED-Arc Build platform, feedstock and other consumables		0	5
DED-Arc Equipment and accessories		0	3
DED-Arc Manufacturing strategy		0	6
<b>Subtotal Per Level</b>		<b>14</b>	<b>28</b>
<b>Cumulated Subtotal</b>		<b>14</b>	<b>42</b>
			<b>WORKLOAD</b>
	<b>PER LEVEL</b>	28	56
	<b>CUMULATED</b>	28	84



**Working Groups Working Sessions - review**

LEAD BY CHAIRMAN

Supported by MTC, EWF, LAK, EC Nantes (remaining SAM partners)

Goal is to decide and recommend changes into the Guidelines & Report these changes

- Guiding questions following template
- Report
- Revised Guidelines

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**Review Qualifications**

- Metal AM Engineer PBF-LB
- AM Design

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**Working Groups Working Sessions**

**METAL AM WORKING GROUP for PBF-LB**

Reviewing process of the AM Eng. PBF- LB Qualification & CUs

Example of the procedure

15 days before session → 1 week after

Before - Reception of Documents: Analysis of Documents for the revision of Qualification and CUs and Professional Profiles

1<sup>st</sup> Review Online Session: Review of Guidelines

After - Reporting: Reporting about the documental review undertaken

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**Future Qualifications**

**Future Short Term Skills (until mid 2021):**

- Certification and Standards
- Numerical Modelling
- Materials (Eng level)
- Polymers (Designer)
- Entrepreneurship
- Digital and Green skills

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## 8.2 “Hand-on” session for metal WG chairs -16<sup>th</sup> September

- Agenda
- Attendee list
- Minutes

10.45	<p><b>CHAIRMANS SESSION</b></p> <p><b>Transfer of the Methodological approach for developing and Reviewing AM Qualifications and Units of Learning Outcomes</b></p> <p><b>Practical case applied to an AM Technological Innovation</b></p> <p><i>(Speaker: Borzoo from EC Nantes /Leader of SAM WP3 – Methodology to develop and review Qualifications)</i></p>
12.45 – 13.00	<p><b>Closure and Next Steps</b></p>

Figure 5: Agenda for the WG Chairs training session

	Organisation	Participant name
1	AIMEN	Ambroise Vandewynckele
2	Cranfield University	Stewart Williams
3	EWF	Adelaide Almeida

4		<i>Cristina Almeida</i>
5		<i>Francisco Barros</i>
6		<i>Ana Beatriz Lopez</i>
7	<i>EC Nantes</i>	<i>Alain Bernard</i>
8		<i>Borzoo Pourabdollahian</i>
9	<i>Friedrich-Alexander-Universität</i>	<i>Carolin Körner</i>
10	<i>IDONIAL</i>	<i>Paula Queipo Rodríguez</i>
11		<i>David González</i>
12	<i>LAK</i>	<i>Ilka Zajons</i>
13		<i>Sandra Kramprich</i>
14		<i>Yvonne Wessarges</i>
15	<i>Lortek</i>	<i>Juan Carlos Pereira</i>
16	<i>IS</i>	<i>Philippe Lebeau</i>
17	<i>MTC</i>	<i>David Wimpenny</i>
18	<i>POLIMI</i>	<i>Bianca Maria Colosimo</i>
19	<i>RWTH Aachen University</i>	<i>Gustavo Menezes de Souza Melo*</i>
20	<i>IIS</i>	<i>Stefano Morra</i>

Table 6: List of attendees for the WG chairs training session

### Minutes of the meeting

(SAM TM4 Minutes – Online Meeting Project No. 601217-EPP-1-2018-1-BE-EPPKA2-SSA-B)

## Chairman’s Session – Minutes

16 September 2020, 10:45-13:00 CET

Host: Online meeting with Microsoft Teams (EWF, EC Nantes – Minutes by LAK)

	Organisation	Participant name	Abbreviation
1	<i>AIMEN</i>	<i>Ambroise Vandewynckele</i>	<i>AV</i>
2	<i>Cranfield University</i>	<i>Stewart Williams</i>	<i>SW</i>
3	<i>EWF</i>	<i>Adelaide Almeida</i>	<i>AA</i>
4		<i>Cristina Almeida</i>	<i>CA</i>
5		<i>Francisco Barros</i>	<i>FB</i>
6		<i>Ana Beatriz Lopez</i>	<i>AL</i>
7	<i>EC Nantes</i>	<i>Alain Bernard</i>	<i>AB</i>
8		<i>Borzoo Pourabdollahian</i>	<i>BP</i>
9	<i>Friedrich-Alexander-Universität</i>	<i>Carolin Körner</i>	<i>CK</i>
10	<i>IDONIAL</i>	<i>Paula Queipo Rodríguez</i>	<i>PQ</i>
11		<i>David González</i>	<i>DG</i>
12	<i>LAK</i>	<i>Ilka Zajons</i>	<i>IZ</i>
13		<i>Sandra Kramprich</i>	<i>SK</i>
14		<i>Yvonne Wessarges</i>	<i>YW</i>
15	<i>Lortek</i>	<i>Juan Carlos Pereira</i>	<i>JP</i>
16	<i>IS</i>	<i>Philippe Lebeau</i>	<i>PL</i>
17	<i>MTC</i>	<i>David Wimpenny</i>	<i>DW</i>
18	<i>POLIMI</i>	<i>Bianca Maria Colosimo</i>	<i>BC</i>

19	<i>RWTH Aachen University</i>	<i>Gustavo Menezes de Souza Melo*</i>	<i>GM</i>
20	<i>IIS</i>	<i>Stefano Morra</i>	<i>SM</i>

\* Is responsible for providing prof. Johannes Henrich Schleifenbaum, operational support in his duties as Chairman

## 1. Welcome & Overview

BP opened the Chairman's Session with a short overview on the agenda for the next two meeting hours. He pointed out that the following presentation of the SAM Methodology for developing and Reviewing AM Qualifications and Units of Learning Outcomes consists of two parts: Introduction to the methodology and the templates and hands-on workshop to explain how the methodology works on the basis of an example distributed before. The aim of the interactive session was: Transfer of the Methodological approach for developing and Reviewing AM Qualifications and Units of Learning Outcomes and agreement on the process.

He asked the participants to take notes or use the templates previously sent by email. In case of questions or doubts, interrogation is possible at any time.

Mainly at the end of the meeting there was an opportunity for the participants to ask their questions. Some issues were also discussed in between.

For the sake of simplicity, all questions that have also been asked in between and the corresponding answers are summarized in point 4. Finally, next actions are collected.

## 2. Part 1: Description of SAM Methodology for Revision and Definition of Professional Profiles

BP introduced the methodology for Reviewing AM Qualifications and Units of Learning Outcomes. He explained different types of skill gaps and their classification. The logic of the methodology is regardless of the origin of the skill gap, but depending on the origin of the gap, it may be possible that some steps are different.

BP showed a flowchart of the methodology with review phases that can be identified by different colors. He explained that the methodology is triggered by the identification of the skill gaps. In this context he underlined that as a main principle the review process is based on the similarity analysis.

BP explained the stages for Revision and Creation of the Professional Profile based on the definition of Job Functions and Job Activities. On slide 6 he showed that for each stage there are different steps to fulfil and pointed out that the first step of this stage consists of a similarity analysis.

On slide 6, BP showed the process to define Job Functions/Activities. He pointed out that the IDEFO Model (a function *modeling* methodology for describing manufacturing functions) is important for fulfilling the steps of stage 1 regarding the definition of the type of Job Activities (new, independent, dependent).

Next (slide 7), BP introduced Stage 2: *Design and Review of Units and Learning Outcomes* and emphasized the importance of the similarity analysis for this stage in order to extract necessary

knowledge and skills. The IDEFO Model is also important for this stage to define knowledge and skills.

On slide 8, he pointed out that for every stage we need to make different steps one by one. He explained that the Revision process of professional profiles and the related Learning Outcomes based on the Analysis, Validation and Definition of Job Functions/Activities.

In the following slide, 9 BP introduced an overview of the reference templates for the Revision and Creation of Professional Profile. He pointed out that for every stage explained before it needs a template to collect and gather the necessary data and the templates build on each other. He underlined that there are many similarities between the Revision and Creation phases and that there are just four more templates for the Creation phases. He gave the participants the prospect that the forms will become clearer in Part 2 of the presentation.

On slide 10, he showed the diagram of the Revision process with assigning the associated templates to the different steps.

→ Please see part 1 of the presentation: Webinar on SAM methodology.

### **3. Part 2: Testing SAM Methodology for revision PBF- LB Process Engineer Professional Profile**

BP explained that the 2<sup>nd</sup> part of his presentation would focus on the testing of the SAM methodology for revision of the PBF-LB Process Engineer Professional Profile. Therefore, a Competence Unit of this Professional Profile was chosen and a hypothetical example prepared. BP underlined that the audience would see which are the related Job Activities/Functions.

BP explained that in the following example we would go through the whole process and the related templates and tables. These templates are blank and BP asked the Chairmen to fill in their input in this tables. After the blank ones an already filled out, the example was presented. BP underlined that suggestions for modification would be welcome and he described the hypothetical example of technological update.

On slide 13, BP introduced to the selected Competence Unit 43: production of PBF-LB parts and asked the audience to keep the Job Functions/Activities in mind. In order to understand how this updated technology impact the activities and functions to revise the professional profile.

In the following BP, went through the individual templates to test the SAM Methodology and gave the participants a few minutes to fill in the templates. Moreover, he showed examples and clarified what would had to be observed when filling in the templates. He emphasized that the templates also include parts to be filled out within the verification process that would be done at another stage (grey fields). So, the participants should focus on fields with white background. Where the documents were not directly available for participants, direct input was given via the chat function.

It is important to note that the templates were not filled in during the review sessions, but before. They are the basis for discussion in the Working Groups.

At the end of part 2, BP invited participants to express their ideas and suggestions and to ask questions.

→ Please see part 2 of the presentation: Webinar on SAM methodology.

**Files:**

- [Presentation: Webinar on SAM methodology](#)
- [Hypothetical Example](#)
- [Templates for Webinar](#)

#### 4. Questions & Answers

In this part of the meeting, questions could be asked. They are summarized in the following section. DW underlined that any further questions that may occur after this meeting are always welcome by email to AA.

**Question 1:**

**DW asked if he understands correctly that the background of the Similarity Analysis is to avoid duplication by checking if we can use existing material where appropriate**

BP confirmed that it is a good point to avoid duplication and to extract what is needed from something already existing. If there is something missing the next action would be to develop something from scratch. This avoids wasting of time and efforts.

**Question 2:**

**SW asked when a technological advancement will be defined as being significant to go through this process?**

BP answered that this process only starts whenever we are sure that the technological advancement definitely affects the Professional Profiles. The definition is made before the methodology starts. Namely in the phase of the identification of the skill gap. The methodology is set in motion, if the influence of the technological update on the Professional Profile is considered to be given at this stage.

CA answered that this is hopefully an output from the specific working groups. Because the experts of these groups know what are the technological updates that have an impact on how these technologies being applied and implications on how the process is being undertaken. These experts have the knowledge to propose and indicate the need to go through the revision process. Since the experts are also aware of industrial requirements, innovations and advancements that will actually impact how things will be done in the future. The aim is to include this in the guidelines to make sure that we are providing the right training to tackle the industry needs.

**Question 3:**

**SW remarked that this is obviously an ongoing process over several years. He would like to know, if the working groups are expected to continue reviewing the technology and making this decision about what needs to be included and what not for the future beyond the SAM project? In order to keep the qualifications up-to-date.**

AA explained that it is indeed expected that the working groups keep their activity according to the needs of the market/industry. When there is a new significant change within the technology and therefrom the implementation of training, the Qualification or the Competence Unit's needs to be revised then the group should be active in order to do that assessment to see, if rather or not there is some work to be done. Some stability in the working groups in terms of composition would be beneficial. It is foreseen to work with the group of experts for the next two years, but this will be a dynamic process and it is also possible to have new Chairmen or new experts joining the groups. The WG activity will be kept after the project end and on a voluntary basis, always oriented at what are the needs in the additive manufacturing sector.

#### **Question 4:**

**CK noted that she now better understands the concept. But what is the role of the experts? Do they have to fill in the templates or who does it? Do the Working Groups receive the templates filled in and revises these documents?**

AA answered that during the review sessions there will be the support from the SAM partners/analysts in order to be able to complete fill in these templates. What will happen is that actually there will be some preparatory work before the review session itself. The Working Group members will receive some background information that will enable them to decide whatever needs to be changed within the Professional Profile, the Job Activity or the Competence Units. As a preparation for the working sessions, the experts will be asked to have a look into the documents and discuss this in the session, if everyone agrees with the proposed changes. The methodology templates pre-filled in and used for the discussion during the session. In the session there will be filled in another template (about the summary changes) shown by CA before, in which the work groups document and report the agreement what needs to be changed.

#### **Question 5:**

**SW asked: Does the Chairman suggest what needs to be filled in before the meeting? Will the template deciding what needs to be changed be filled in by the Working Group or by the Chairman? What documents shall the experts look inside before the meeting. Do the experts as a review looking at the process (if it is suitable) or will they carry out the process? He remarks that nobody has the time to fill in all these templates.**

AA referred to the SAM auscultation of the market and the results from prior implementation of training (when available), will be the basis to decide if there is a need to change the composition of Qualification or Competence Unit. Within the working session, the Working Group members will discuss the process and the template to be filled in is the outcome of the discussion in terms of implications for the reviewing process and with indication what needs to be changed. The chairman prepares the report about the necessary changes validated by the group.

#### Question 6:

**SW asked if he understood correct, that the Experts shall develop a list of topics that needs to be changed.**

AA replied that they will receive the information on what needs to be changed in the different guidelines.

CA added that this is the 1<sup>st</sup> version of the methodology of the whole process for the design and review that has been developed within SAM project. Actually, this is not the final version of the working documents to work with in the future. It is a starting point to the beginning of the working group activities.

In the presentation the validation steps were not shown. This means that the Working Groups will receive some of the fields of the templates already filled by the analysts. The analysts will do a prior identification of possible changes to be done in the Qualifications. Actually, the Working Group analyses this and come to the conclude to do a change or not in the Guidelines. A lot of this information will be sent to the Working Group already fulfilled.

The experts will receive a list of suggested things to evaluate whether there are changes needed or not. Based on this decision and in case of a need of change it will be afterwards reflected in the guideline.

AA added that the experts are not working directly in the guidelines, but indicating where changed are needed.

In this context DW suggests a written response to the Chairmen regarding the process and what needs to be done by them. To avoid any misinterpretation. Moreover, CA and DW confirm that the experts can of course suggest topics for review as well.

#### Not answered question:

**SW asked: When do we judge that this is something an AM Engineer would need to consider in terms of his technology readiness level? What is the criteria to be applied (e.g. when it is commercially available)? Is there a methodology for when the methodology needs to be applied?**

### 5. Conclusion

AA closed the meeting, thanked all chairs for accepting the invitation, for their participation in this meeting and that they accepted to lead the Working Group. She thanked the presenters and DW for his support on this process as well.

DW finally underlined that this is a process we are testing out and it needs improvements. For this the feedback of the Chairs is needed. DW announced that AA and DW will organize a session to address the questions raised and provide answers to them to go forward.

Another, conclusion is that the methodology requires a simplification in terms of templates to be analyses and fill in, so that the experts can implemented it in an effective way during the review process.

### ACTIONS

- Written response to the Chairmen regarding the process and what needs to be done (linked also with the simplification of the methodology)
- Necessary documents will be provided, also from this session – so that the experts are prepared for the sessions
- Follow-up session to address questions raised
- Working session for the PBF-LB Group: 8 October

### 8.3 Detailed PBF-LB WG Chair briefing – 15<sup>th</sup> October

# Preparation meeting

1<sup>st</sup> review session – 30<sup>th</sup> October

**AM Process Engineer PBF -LB**

## Agenda

**AGENDA**

11:00 (CET)*	Welcome	Meeting link
	<p><i>Working session for the review of AM Process Engineer PBF -LB</i></p> <p><b>Introduction by Metal AM Leading Experts</b>  <i>David Wimpenny</i>                      MTC (UK) / Leading Expert of the Metal AM Working Group</p> <p><b>Collection of review results, decision on changes into the Qualification and reporting</b>  <i>Johannes Schleifenbaum</i>                      Fraunhofer-Institut für Lasertechnik ILT (DE) / PBF-LB Chairman (EAMQC)  <i>Gustavo Menezes de Souza Melo</i>                      RWTH Aachen University (DE) / Operationally supporting the Chairman</p> <p><b>Validation of working Group procedures and review methodology</b>  <i>Adelaide Almeida</i>                      EWF (PT)</p>	<p><a href="#">Join Microsoft Teams Meeting</a></p>
11:00-12:20		
12:30	Farewell	

**How many time for each slot ?**

- MTC is introducing the experts + Summary of support documents (**10 minutes**)
- PBF-LB chairman will leading the discussion + report the conclusion (**1h**)
- LAK is taking the minutes
- EWF is conduction the validation about the operational procedures /methodologies of the WGs. (**10 min**)

## Participants

- Invitation have been send to all Experts
- Next Action – follow to confirm who is available ?

Simona Masurtschak	<a href="mailto:smasurtschak@iortek.es">smasurtschak@iortek.es</a>
David Hardacre	<a href="mailto:david.hardacre@lr.org">david.hardacre@lr.org</a>
Maximilian Kunkel	<a href="mailto:maximilian.kunkel@siemens.com">maximilian.kunkel@siemens.com</a>
Bianca Maria Colosimo	<a href="mailto:biancamaria.colosimo@polimi.it">biancamaria.colosimo@polimi.it</a>
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Sean Mc Connell	<a href="mailto:sean.mcconnell@imrie">sean.mcconnell@imrie</a>
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Luis Ignacio Suarez	<a href="mailto:luisignacio.suarez@idonial.com">luisignacio.suarez@idonial.com</a>



## Chairman- inputs PBF LB

In general lines, Prof. Schleifenbaum and I found the guideline Metal Additive Manufacturing Process Engineer Powder Bed Fusion - Laser Beam (E/I MAM PE PBF-LB) really well described and comprehensive. Great job to all involved!

- Based on the supporting documents, we decided that the review should be focused on the **following functional CUs**:
  - **CU 43: Production of PBF-LB parts**
  - **CU 44: Conformity of PBF-LB parts**
  - **CU 45: Conformity of facilities featuring PBF-LB**
- If we have enough time after that, we let the experts suggest other areas of common interest for reviewing.

SAM		Simplified Template		Co-funded by the Erasmus+ Programme of the European Union	
Systematic review of Qualification/Professional Profile					
Reference: SRQ/PP	AM Observatory Management Team			Instance Ref: SRQ-xxxx-xxxx	Creation date: 30/09/2020
Validator:	QC PBF-LB Working Group			Validation date:	08/10/2020
Supporting documents:	E/I MAM PE PBF-LB Guideline; Report on training implementation; Latest report on AM skills gaps E/I MAM PE PBF-LB				
Professional Profile/qualification/Unit of Learning Outcomes	Topic Section		Update required	Yes	No
Professional profile description Introduction	Full description in page 6 of guideline		"Item" updated to...		
Access conditions 2	Topic Section		Update required	Yes	No
Access conditions in page 6 of guideline	Topic Section		"Item" updated to...		
Qualification descriptors I.1	Topic Section		Update required	Yes	No
Qualification descriptors in page 6 of guideline	Topic Section		"Item" updated to...		
CU Job Function Job Activities	Job Functions/Activities I.2		Update required	Yes	No
Nr	CU	Job Function	Job Activities	IF: "item" updated to...	JA: "item" updated to...
33					
35					
41					
Update required in Competence Unit/Units of Learning Outcomes				Yes	No
List of impacted CU/ULO				33	

SAM		Simplified Template		Co-funded by the Erasmus+ Programme of the European Union	
Systematic review of Competence Units/Units of Learning Outcomes					
Reference: SRQU/ULO	AM Observatory Management Team			Instance Ref: SRQU/ULO-xxxx-xxxx	Creation date: 30/09/2020
Validator:	QC PBF-LB Working Group			Validation date:	08/10/2020
Supporting documents:	E/I MAM PE PBF-LB Competence Units Guideline; Report on training implementation; Latest report on AM skills gaps				
Competence Unit/Unit of Learning Outcomes	Topic Section		Update required Yes No		
Competence Units	Learning Outcomes I.2		Workload Resources Assessment		
CU Nr	CU	Learning Outcomes	Workload	Resources	Assessment
		Knowledge/ Detailed Knowledge			
-					
-					
Update required in Qualification Guideline				Yes	No
List of Impacted qualification guidelines				DED Designer: PBF Designer	
<p><small>This project has been funded with support from the European Commission. This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.</small></p>					

## Validation of working Group and review methodology

- **What went well, and shall be kept for the next sessions?**
- **What do we need to improve / avoid in future sessions?**
- **Suggest 2 activities that could contribute to improve the working group sessions.**
- In your opinion what is the periodicity in which a Qualification shall be revised ?
- Which frequency to meet.
- [www.slido.com](http://www.slido.com)
- #T823

### 8.4 Working Session for Review

- Information supplied to the prior to the review
- Completed review template
- Notes from meeting
- Feed-back on the review process

Figure 6: Information supplied to the prior to the review

<p>Qualification guidelines: European/International Metal AM Process Engineer: Powder Bed Fusion - Laser Beam</p>	<p>Report on AM Course Implementation</p>	<p>Report on the Analysis and Validation of Needs</p>

Table 5: Completed review template

Systematic review of Qualification/Professional Profile						
Reference: SRQ/PP				Instance Ref: SRQ -xxx-xxxx		
Creator:		AM Observatory Management Team		Creation date:	30/09/2020	
Validator:		QC PBF-LB Working Group		Validation date:	30/10/2020	
Supporting documents:		E/I MAM PE PBF-LB Guideline; Report on training implementation; Latest report on AM skills gaps				
Professional Profile/qualification/Unit of Learning Outcomes		E/I MAM PE PBF-LB				
Topic		Section		Update required	Yes	No
Professional profile description		Introduction		"suitability for customers' requests" updated to "suitability for customer's requests"		
Full description in page 6 of guideline						
Topic		Section		Update required	Yes	No
Access conditions		2		"The defined access conditions" updated to "The recommended access conditions"		
Full description in page 8 of guideline		"Aeronautic, Materials or similar." updated to "Aeronautic, Materials, Industrial or equivalent."				
Topic		Section		Update required	Yes	No
Qualification descriptors		I.1		-		
Full description in page 9 of guideline						
Topic		Section		Update required	Yes	No
Job Functions/Activities		I.2		Update required	Yes	No
CU/ULO Nr	Job Function	Job Activities	Job Function	Job Activities		
43 "Production of PBF-LB parts"	"Specify the process chain for the PBF-LB parts"	"Interpreting simulation results and design"	-	-		
		"Run basic simulations"		"Run basic simulations" updated to "Using simulations as process prediction"		
		"Establishing manufacturing plan (e.g. build file, parts nesting, supports, post processing operations, Laser parameters, feedstock, gas, building plate, standards)"		-		
		"Defining the production of PBF-LB parts together with other staff (e.g. including providing inputs to designers to optimize the shape of AM products)"		-		
		"Providing technical counselling to the decision of the acquisition of AM equipment"		-		
		"Preparing instructions for PBF-LB operators"		-		
		"Defining AM staff's tasks distribution according to the workplan"		-		

Systematic review of Qualification/Professional Profile				
		“Interpreting simulation results and design “		“Interpreting simulation results and design” updated “Interpreting simulation results and design, being aware of where the risks are”
44 “Conformity of PBF-LB parts“	“Ensure the conformity of the AM process and AM parts“	Preparing QA/QC procedures (e.g. reception, handling and storage of feedstock, manufacturing process monitoring) “Supporting the development of testing and inspection plan (including acceptance criteria for NDT and DT)”		-
		“Troubleshooting for causes of non-conformity in the production of AM parts”		-
		“Determining corrective actions for eliminating defects (e.g. metallurgical, deformation, warping) based on technical reports (e.g. DT, NDT)”		-
		“Ensuring the compliance of the AM production process and the AM parts with the relevant documents (e.g. standards, product specifications, legislation)”	-	-
		“Identifying requirements in terms of AM training”		-
		“Implementing AM process and AM parts certification procedures”		-
		“Developing procedures to repair parts (e.g. parts damaged in service; together with the client)”		-
		“Ensuring production chain qualification (i.e. equipment, operations, staff)”		-
45 “Conformity of facilities featuring PBF-LB”	Support the implementation of facility conformity procedures featuring PBF-LB	“Supporting the design of HSE procedures featuring PBF-LB (e.g. Control of Substances Hazardous to Health (COSHH), risk analysis, mitigation plans)”		-
		“Providing safety requirements to be implemented to ensure people’ safety on the shop floor”	-	-
		“Providing inputs for waste management”		-
		“Preparing incident reports”		-

Systematic review of Qualification/Professional Profile				
Update required in Competence Unit/Units of Learning Outcomes	Yes	x	No	
List of impacted CU/ULO	CU43			

## Chair notes - General

- Julien Bajolet
  - CU 1, 8 and 14
    - he is concerned about difference between initial and advanced level, what and who is that concerned -> covered in Appendix I (page 29)
- Mustafa Megahed
  - Concern 1:
    - Review are negative for finite analysis -> to be discussed in CU 43, 44
  - Concern 2:
    - Path planning:
      - DED have are more aware of it but PBF-LB are not so, but one also need to understand path planning and G code -> to be discussed in CU 43, 44

## Professional Profile

- Klas Boivie
  - Concerned about what kind of machine to expect from engineers
    - David Wimpenny
      - Correct customers' to customer's
      - Need to get have a holistic understanding and be able to communicate with client
        - Johannes Henrich Schleifenbaum
          - Able to understand the root causes
- Sean McConnell
  - Profile shall be analogue to process engineer in industry: root causes, keeping the process working
- Simona Masurtschak (topic out of Professional Profile) -> regarding CU 00
  - She is missing the binder jetting
    - Suggestion of reducing hours from DED and adding to BJ. Although the CU 00 covers BJ and EBM, it has too few hours
      - Klas Boivie
        - BJ and PBF-EB (EBM) are covered in the overview
          - David Wimpenny
            - He will discuss with EWF the distribution of hours from DED to other technologies (BJ and PBF-EB)
  - Bianca Maria Colosimo, Julien Bajolet
    - Agreed EBM and BJ to be better covered
  - Nick Cruchley
    - Important to understand if and where AM is competitive
- Maximilian Kunkel (topic out of Professional Profile) -> regarding General Contact Hours (CH)
  - Concerned about total workload of the qualification to be too high = 7 months duration. Where should it be applied? Bachelor? Or Professional Profile in industry?

- Klas Boivie
  - Course requested by labour chamber in US to ISO/ASTM is similar what EWF is defining; something intermediated between academia and professional, it gives the needed understanding for someone outside the area of AM
- 3 days courses = 30h contact time from machine manufacturing
  - Adelaide Almeida
    - CH are recommended, training centre are flexible (20% variation). It is still in implementation (first in Cranfield)
    - It considers time inside and outside classroom

## Access Conditions

- Bianca Maria Colosimo
  - Add “Industrial engineering degree”
- David Wimpenny
  - Personal with 2 years degree (not engineer) with years of experience in shop floor should be able to progress by passing through the processes of recognition of prior learning
    - Klas Boivie
      - The path from operator to engineer should be possible
      - Change “similar” to “equivalent”
    - Maximilian Kunkel
      - It should not be so restrictive, but more a recommendation
        - Change “defined” to “recommended”

## Qualification Outcome Descriptors

- No changes, no big discussions

## CU 43 Production of PBF-LB parts

- Mustafa
  - Finite Analysis was bad reviewed
    - David Wimpenny
      - He will check the review offline (out of topic)
  - Basic simulation means distortion, right? It should be more specified
  - Material simulation should be considered
    - David Wimpenny
      - It should be better described
    - Johannes Henrich Schleifenbaum
      - It is more processability, aiming a part to meet the client requirements
        - Mustafa
          - Yes, not all kind of defect but focus in distortion, avoiding high stresses and failure of support systems
    - David Wimpenny
      - Maybe reformulate “run basic simulations” to “use simulations as process prediction” – simulations to be considered are distortion simulations which needs an understanding (basic, not expert) of material models
        - Be able to use simulation as a tool, not just run a simulation
    - Nick

- Complex simulations now will become basic simulations in the future, so important to know how to apply, not just run
- David Wimpenny, Klas Boivie
  - The focus is not create a material or simulation specialist. Lifelong learning plays a key role to keep professionals up-to-date with new developments
    - Mustafa
      - One must interpret and understand the combination of simulation and material models, we should **address and raise the awareness of where the risks are** (e.g. dealing with specific materials: 316 is easy vs 347 is risky)

#### CU 44 Conformity of PBF-LB parts

- Maximilian Kunkel
  - I should **add as knowledge “statistical and process control and underlying statistics”**
    - Klas Boivie
      - It is definitely relevant
- David Wimpenny, Simona Masurtschak, Klas Boivie
  - Standards are important to be mentioned
    - David Wimpenny
      - They are indeed mentioned, maybe to emphasize
- Maximilian Kunkel (for all CUs)
  - **Change in the table “contact hours” to “recommended contact hours”**
    - David Wimpenny, Klas Boivie
      - This applies to whole qualification package (even for welding)
- Julien Bajolet
  - In France funding is required for training and it will be never be set with this amount of contact hours (too high)
  - He thinks there is not enough people to deliver this profound qualification. It can take 10 years similarly to welding in order to be stabilised

#### CU 45 Conformity of facilities featuring PBF-LB

- Klas Boivie
  - HSE can be known as EHS in many English speaking countries
- Julien Bajolet
  - We should mention post-processing (depowdering, support structure removal)
    - Klas Boivie, David Wimpenny
      - The whole HSE (EHS) should be considered in whole process chain, not only the machine bed and lasers
        - Klas Boivie
          - But we should not expect that a PBF-LB engineer will be expert in heat treatment and its HSE (EHS)
            - Mustafa Megahed
              - PBF-LB engineer should **be aware of where the risks are**
              - David Wimpenny, Klas Boivie
                - **This “understanding should be across the entire AM process chain”**

**SLIDO POLL - Providing feed-back on the review process from the attendees (5 slides)**



**Working session WG PBF-LB**  
**30.10.2020**

30 Oct - 01 Nov 2020

Poll results



**Table of contents**

- What went well, and shall be kept for the next sessions?
- What do we need to improve / avoid in future sessions?
- Suggest 2 activities that could contribute to improve the working group sessions.

## What went well, and shall be kept for the next sessions?

015

Very well driven, valuable points were made  
discussion within participants  
Structure good discussion pre selection of CU  
too much content for 1.5h introduction Guides on limits of scope

# introduction of participants

Discussion Everything !

taking it one CU at time fruitful discussion nothing specific to say  
Valuable discussion send documents before the session Open discussions  
mute when not talking, fast presentation  
The document on the left capturing inputs.

## Wordcloud poll



## What do we need to improve / avoid in future sessions?

010

Clear plan for call, allows for focused prep  
create separated session for general topics  
increase visibility during guideline work  
jumping from topic to topic without closure  
Clearer focus pre-selection of units to be looked at

# time management

content reduction structure for document drafting Focus on topic  
more structure to stick to the timetable  
focus on content OR structure  
Clearer engagement rules (raising hands etc)

Wordcloud poll



**Suggest 2 activities that could contribute to  
improve the working group sessions.**

0 1 2

Capture of participant expertise      Define next steps / closure  
ensure everyones views are captured      Pre work, ratify in call  
Voting capability      selection from before based on them  
feedback from experts before      structure agenda in several small topics      Election process

**more background  
information**

previous analysis      split into 2 small groups      One CU in a meeting  
preliminary discusssion      polls to vote easily  
Split into smaller groups for more input  
Introduce the topic to be discussed