



WP6 Real Case Scenarios- Revised Professional Profiles /Qualifications and Units of Learning Outcomes
Review of CU65



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WP6 Report on Real Case Scenarios- Revised Professional Profiles /Qualifications and Units of Learning Outcomes

| Working Session Summary | |
|---|-----------------------|
| Date and Venue | (13/06/2022) (Online) |
| Participants | 13 |
| Working Group: | Polymers |
| Leading Expert | Paula Queipo |
| Chairman (if applicable) | NA |
| Members of the WG | NA |
| Other participants (if applicable) | NA |

| Session topics | |
|----------------|--|
| Agenda | Revise CU65 Overview on polymer materials and properties |

| Templates | |
|--------------------------------|--|
| D3.2 (Kit of Templates) | Link (A new and simplified version will be available in July) Select the template to use based on the working session aim |

| Results and Recommendations | |
|--|--|
| <p>Amendments to Learning Outcomes to add reference to recyclability and multilaterals (1) introduce new KNOWLEDGE - Concepts of mono-material, multi-material and composite polymers. (2) introduce new SKILLS - Determine the implications of using different materials in recyclability and characteristics of the final piece, when selecting materials.</p> | |

| Annexes | |
|------------------------------------|-------------------------------|
| Best Practice document | Link |
| Kit D2.8 (working sessions) | link (page 9) |

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1. Introduction

The Competence Unit (CU)65 “Overview on polymer materials and properties” was originally developed by SAM consortium and polymers Work Group (WG) in the context of D5.4 “2nd Stage of Real Case Scenarios” where the Polymers AM designer Qualification was developed. Below is the original CU65 structure - recommended contact hours (Table 1), learning outcomes (Table 2). During the 2nd Stage piloting events, UBRUN, ANSYS and ISQ piloted CU65, and feedback was collected. The goal of this exercise was to take students and trainers feedbacks as recommendations so as to embed this into future Real-Case Scenarios for IAMQS (International Additive Manufacturing Qualification System). A description of all meetings and agreed actions on the revised CU65 is presented in this document. The original piloting was initiated in WP-5 by UBRUN and ISQ with a focus on polymer materials and their properties. UBRUN course was delivered virtually in English language which garnered 95 attendees around the world. Over 94% of participants were fully satisfied with the course. ISQ implemented the course in two sessions. Most were fully appreciated of the course although some younger members felt that they needed bit of extra support to build suitable background on fundamentals. The feedback was to include recycling related topics and inclusion of practical aspects in teaching and delivery. This document is the output of deliverable D6.2 “Meeting for Real Case Scenarios Revised Professional Profiles-Qualifications and Competence Unit-Training Modules”.

Table 1: Original CU65 - Recommended contact hours

| 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 |

Table 2: Original CU65 – Learning Outcomes

| LEARNING OUTCOMES Overview on polymer materials and properties | |
|--|---|
| COMPETENCE UNIT/ULO | Overview on polymer materials and properties |
| KNOWLEDGE | Factual and broad knowledge of theory, principles and applicability of: <ul style="list-style-type: none"> - Type of Polymer Materials - Polymer materials properties - Materials applications |
| SKILLS | Identify types of polymer materials commonly used in AM Interpret polymer materials properties according to design and industrial requirements. |

Importantly, we made references to the [D4.5 report](#) (3rd Report on the Analysis and Validation of Needs) that highlighted the fact that 93.06% of Industries are using AM, regarding the materials Metals and Plastics are the most wanted from Industries in accordance with the training centers specification. This was also supported by the fact that when research organisations were asked about upcoming trends on AM Materials, “Multi-materials and functionally graded materials” are mentioned also linked with the emergence of “AM machines for Multimaterials (45%) “ as the top three main process trends. To ensure that we are better prepared for the growth of more novel materials and with greater awareness of plastics sustainability, the D4.5 finds gave a strong rationale to update and revise CU65 which is about an “Overview on polymer materials and properties”. In addition to D4.5 findings, a validation workshop was conducted with the IAMIC on 29th April 2022 that further reinforced the need to update CU65. Members of IAMIC agreed on the scope of D6.1 and gave support that CU65 should be updated, recommending that a follow up meeting should be set up which is described in the next section regarding working sessions with Experts.

2. Working Sessions with Experts

The 1st working session were held during the 8th Technical Meeting on 23rd to 26th of May 2022 in Gijon, Spain. In this context A thorough discussions on Real case scenarios and their revision was held. UBRUN initiated a brain storming session on the revision of CU65, Figure 1 shows UBRUN presentation at TM8. The power point presentation is available on SharePoint at web link: [TM8 WP6.pptx \(sharepoint.com\)](#). Overall, there was a consensus among SAM members that largely the quality and participants feedback from the pilot was satisfactory. Based on the feedback from both course attendees and trainers, a broad conclusion was drawn to overload the **content with multi-materials** and examine the allocated time where appropriate. Based on feedback, the SAM members and WG decided to review the structure and content, together with the contact hours to better represent by aligning multi-materials landscape with CU65.

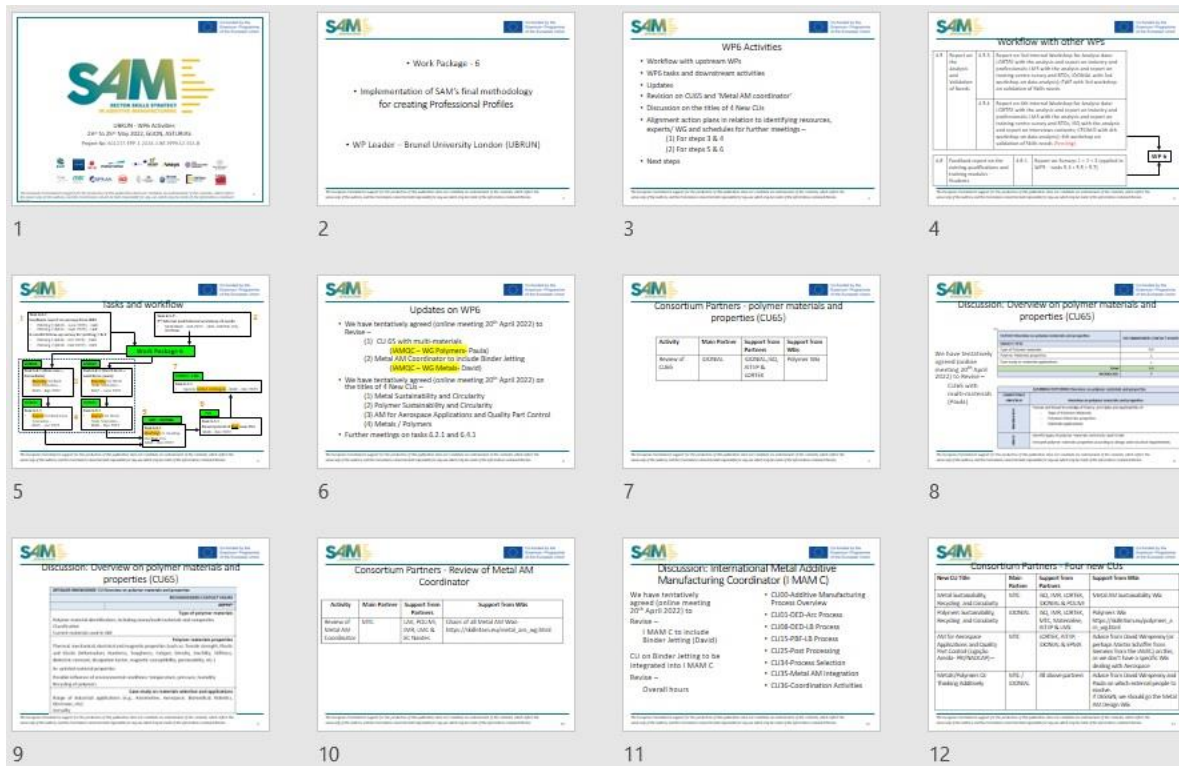


Figure 1: TM8 meeting - UBRUN presentation on WP6 and revision of CU-65

All SAM and WG members who were originally involved in CU65 creation and piloting agreed to get involved in the revision of CU65. The TM8 meeting follow up actions on CU65:

Ms Raquel Almeida (ISQ) suggested to (1) revise the Overview on polymer materials and properties. (2) include multi-materials topic (3) potentially revise the Polymers Designer qualification (4) Carefully look into number of hours to be allocated, and this be kept at a level in harmony with rest of CUs.

David Wimpenny (MTC) suggested to look into critical issues and risk assessment with regard to revision of CU65. Specifically, the timeline with WP6 as there are new CUs that are also needed to be developed.

2.2 First working session – overview

The first working session to review the CU was held on 13th June 2022 which was organised by Ms Raquel Almeida (ISQ), supported by Ms Adelaide Almeida (EWF) and Ms Paula Queipo (IDONIAL). This was a complete virtual meeting session held using the platform MS-TEAMS. The meeting Recordings was provided on ISQ SharePoint.



Figure 2: virtual working session on revision of CU-65 with SAM members and experts

2.3 First working session - participants

A total of 12 members participated in the group meeting whose affiliations are provided in the Table 3.

Table 3: Participating experts in the revision of CU-65 group meeting

| | Name of Expert | Organisation |
|----|------------------------|--------------|
| 1 | Paula Queipo | IDONIAL |
| 2 | Mario Lopez | IDONIAL |
| 3 | José António Dieste | AITIIP |
| 4 | Sathish Nammi | UBRUN |
| 5 | Eujin Pei | UBRUN |
| 6 | Borzoï Pourabdollahian | EC NANTES |
| 7 | Colin Meade | IMR |
| 8 | Harry Bikas | LMS |
| 9 | Guillermo Vicente | AITIIP |
| 10 | Adelaide Almeida | EFW |
| 11 | Eva Sanchis | AITIIP |
| 12 | Raquel Maria Almeida | ISQ |
| 13 | Claes Fredriksson | GRANTA |

2.4 First working session – content and discussion

Ms Raquel Maria Almeida (ISQ), opened the session with a reminder of TM8 agreed framework, the information on the current hours. The main objective was to **introduce multi-materials into existing CU65 which was on Polymers in AM**. The methodology developed in WP3 regarding the [Revision of Professional Profiles](#) and/Or Competence Units was used as a reference for the working session aiming to

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update CU 65 content. In this case for CU65 which is already an existing Competence Units/Units of Learning Outcomes that requires an update and what needs to be changed, the templates below were used:

➤ **Stage 0 – PreSkill gap origin**

Key question:

- What is the origin of the skill gap?

| Skill Gap Origin | | | | |
|---|--------------------------------------|---|----------------------|---------------------|
| Reference: SG | | Instance Ref: | | |
| Creator: | | AM Observatory Management Team | Creation date: | 13.06.2022 |
| Validator: | | Polymers WG | Validation date: | TBD |
| New Professional Profile | | Professional Profile designation | | AM Polymer Designer |
| Review of existing Professional Profile | | CU65 | | |
| Technological process | | Material | | Qualification |
| New technological process | Advancement in technological process | New material | Being updated in use | Systematic review |
| | | | | |

Stage 1 – Professional profile

Systematic review of Qualification/Professional profile

Key questions:

- What job functions/activities are reviewed to update the qualification/professional profile?

| Systematic review of Qualification/Professional Profile | | | | | |
|--|--------------|--|------------------|------------|---|
| Reference: | | | Instance Ref: | | |
| Creator: | | AM Observatory Management Team | Creation date: | 13.06.2022 | |
| Validator: | | Polymers WG | Validation date: | TBD | |
| Supporting documents: | | D4.5 3 rd Report on Skills Needs D4.6 2 nd Report on students feedbacks | | | |
| Professional Profile/qualification/Unit of Learning Outcomes | | AM Polymers Designer/ CU65 Overview on polymer materials and properties | | | |
| Topic | Section | Update required | Yes | No | x |
| Professional profile description | Introduction | | | | |
| | | | | | |

| Systematic review of Qualification/Professional Profile | | | | | | | |
|---|-----------------|------------------|-----------------------|--|-----|----|---|
| Topic | | Section | Update required | | Yes | No | x |
| Access conditions | | 2 | | | | | |
| Topic | | Section | Update required | | Yes | No | x |
| Qualification descriptors | | I.1 | | | | | |
| Topic | | Section | | | | | |
| Job Functions/Activities | | I.2 | Update required | | Yes | No | x |
| CU Nr | Job Function | Job Activities | Job Function | Job Activities | | | |
| | JF _i | JA _{i1} | JF ₁ " ... | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| Update required in Competence Unit/Units of Learning Outcomes | | | | Yes | | No | |
| List of impacted CU/ULO | | | | AM Polymer Designer /CU65 Overview on polymer materials and properties | | | |

Stage 2 – Units of learning outcomes

Updates in Competence Units/Units of Learning Outcomes

Key questions:

- Which Competence Units/Units of Learning Outcomes need to be updated?

| Systematic review of Competence Units/Units of Learning Outcomes | | | | | | |
|--|----------------------------------|--|-----------------|------------------|------------|----|
| Reference: | | | Instance Ref: | | | |
| Creator: | | AM Observatory Management Team | | Creation date: | 13.06.22 | |
| Validator: | | Polymers WG | | Validation date: | | |
| Supporting documents: | | D4.5 3 rd Report on Skills Needs D4.6 2 nd Report on students' feedback | | | | |
| Competence Unit/Unit of Learning Outcomes | | CU65 Overview on polymer materials and properties | | | | |
| Topic | | Section | | | | |
| Competence Units | | I.2 | Update required | | Yes | No |
| CU Nr | Learning Outcomes | | Workload | Resources | Assessment | |
| | Knowledge/ Detailed Knowledge | Skills | | | | |

| Systematic review of Competence Units/Units of Learning Outcomes | | | | | |
|--|--|--|------------|--|--|
| 65 | - Add “Concepts of mono-material, multi-material and composite polymers” | Add “Determine implications of using different materials in recyclability and characteristics of the final piece, when selecting materials” | N.A | N.A | Add a Multiple choice question to assess the new knowledge and skills |
| Update required in Qualification Guideline | | | Yes | x | No |
| List of impacted qualification guidelines | | | | AM Polymer Designer /CU65 Overview on polymer materials and properties | |

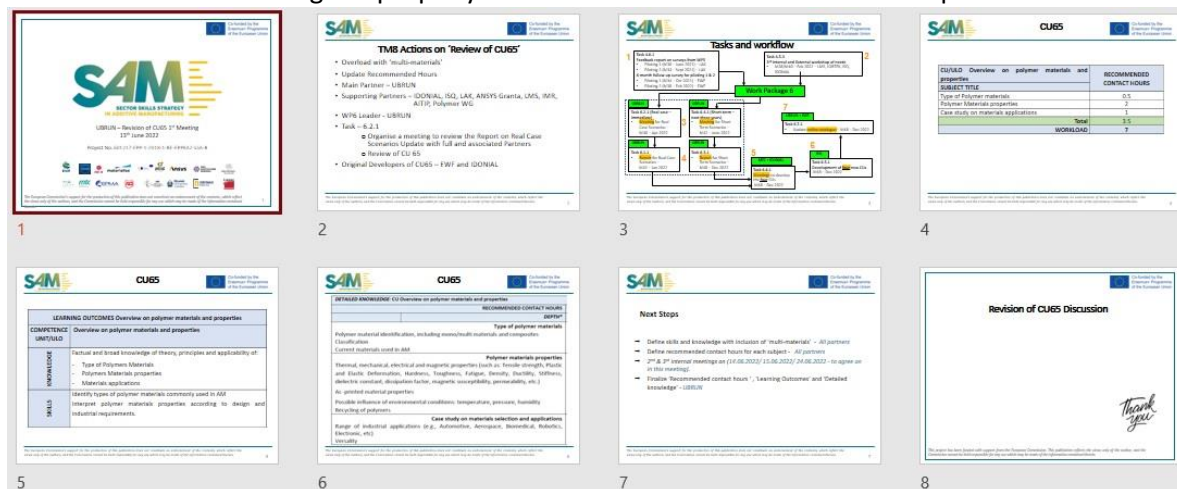
This was followed by Mr Sathish Nammi (UBRUN) who made a presentation (see

Figure 3) giving an overview of present state of CU65. Ms Raquel conveyed to all participants that CU65 was a short, but very thorough CU. UBRUN’s pilot course gave greater emphasis on ANSYS software whereas ISQ’s focus was more on testing of materials. At ISQ there was discussion on recyclability of polymers. Given the rule of IAMQS which sets an upper ceiling of 3.5 hours for each CU, by increasing it to 7 hours will have a big impact on the overall Polymers AM Qualification. Also, the hours are recommended, which gives the possibility of the trainer/training centre to implement in more session in alignment with the audience needs. Ms Raquel emphasized to include a light version on recyclability as this area has significant importance as people always come up with recyclability issue.

Figure 3: First working session - UBRUN presentation

2.5 First working session - results

There was consensus on the revision structure and it was decided that no further sessions were necessary. The feedback given by the experts were noted and Ms Raquel Almeida revised the SKILLS and KNOWLEDGE sections of the learning outcomes. The recorded session can be checked for more details on individual experts' feedback and discussion. During the review of CU65, it was acknowledged that 3.5 hours would not be enough to properly deliver the CU. This was the feedback provided when the CU was



1

2

3

4

5

6

7

8

tested. However, changing it to 7.0 hours could be excessive to meet the intended learning outcomes and at the same time could be much workload for trainees. In terms of contact hours. At present, the market prefers courses that are “as short as possible”. In this sense, it was decided to keep the number of contact hours that were allocated before the revision, despite the fact that additional topics and learning outcomes were included in the CU. In fact, the estimation of 5 hours as the appropriate contact hours to deliver this CU with good quality standards was pointed out. Although the IAMQS framework only uses multiples of 3.5 hours to deliver the CU, it should be noted that the hours shown for CU65 are

recommended for the implementation and can be changed when delivering the course. It was therefore decided that the final number of contact hours would remain the same as before the revision. The agreed recommendations are below:

- The focus should be on multi-materials in AM
- To consider the implications of using different materials in recyclability and characteristics of the final piece, when selecting materials
- To introduce knowledge of mono-material, multi-materials, and composite polymers
- To increase hands on practical content.

3. Revised Competence Unit CU 65

SAM members set the recommended contact hours to be used as a guide and discretion be given to trainers and trainees for increasing it. Emphasis be put on hands on practical aspects to consolidate knowledge. In this regard, the skills and knowledge were overloaded with multi-materials. No changes were recommended for detailed knowledge and its content.

3.1 Competence Unit – Recommended Contact Hours

The subject titles of revised CU65 structure are shown below. The contact Hours are the minimum recommended teaching hours for the standard routes. It is recommended to contain at least 3.5 hours of direct teaching time. The workload is calculated in hours, corresponds to an estimation of the time students typically need to complete all learning activities required to achieve the defined learning outcomes in formal learning environments plus the necessary time for individual study.

Table 4: Revised CU65 - Recommended contact hours

| 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 |

3.2 Competence Unit – Learning Outcomes

The learning outcomes structure – Knowledge and Skills are listed below.

Table 5: Revised CU65 – Learning Outcomes

| LEARNING OUTCOMES Overview on polymer materials and properties | |
|--|---|
| COMPETENCE UNIT/ULO | Overview on polymer materials and properties |
| KNOWLEDGE | Factual and broad knowledge of theory, principles and applicability of: <ul style="list-style-type: none"> - Type of Polymer Materials - Concepts of mono-material, multi-material and composite polymers - Polymer materials properties - Materials applications |
| SKILLS | Identify types of polymer materials commonly used in AM Interpret polymer materials properties according to design and industrial requirements. Determine the implications of using different materials in recyclability and characteristics of the final piece, when selecting materials. |

3.3 Competence unit – Detailed Knowledge

The Detailed Knowledge structure, covering (1) types of polymer materials (2) Polymer material properties and (3) case study on materials selection applications is available only under request.

Table 6: Revised CU65 – Detailed Knowledge

4. Conclusions

The CU65 was developed and piloted by UBRUN, ANSYS and ISQ with the support of polymer workgroup. The inputs for the change was linked to information coming from D4.5; validation and the piloting. All these insights from participants were considered in the scope of TM8, where it was agreed by all partners to revise this CU. Specifically, the inclusion of multi-materials and amendments to contact hours were the areas set for review. A review session was conducted on 13th June 2022. Overall, all areas were examined. It was decided to maintain the CU contact hours at 3.5 hours in harmony with other CUs that are already integrated with IAMQS. At the same time “multi-materials” relevant to polymer materials were overloaded into skills and knowledge. However, it is imperative. These amendments were implemented into the revised CU. UBRUN, promptly circulated the revised CU to all partners for feedback.

5. References

- [1]. 2nd Stage Real Case Scenarios – New Professional Profiles/Qualifications and Competence Units/ Training Modules. SAM-Deliverable-D5.4.
- [2]. Kit of templates – Revision and Creation of Professional Profiles. SAM-Deliverable-D3.2.
- [3]. TM8 - Minutes, SAM Project.