

CU 36: Coordinating the AM Process

TOPIC 1: Introduction

Prepared by: David Wimpenny

FOR SAM PILOT ATTENDEES AND TRAINERS ONLY

MM17,21

Contents

- Welcome
- Introduction of the participants
- Outline of the SAM project
- Overview of the course
- What we need from you

Welcome



Trainers

David Wimpenny – Chief Technologist, NCAM-MTC



Aneta Chrostek-Mroz – Research Engineer, NCAM-MTC



Plus short demonstration of scheduling software from
Sven Hinrichs – Head of Technology Consulting AMFG



Prof David Wimpenny
Chief Technologist, NCAM @MTC

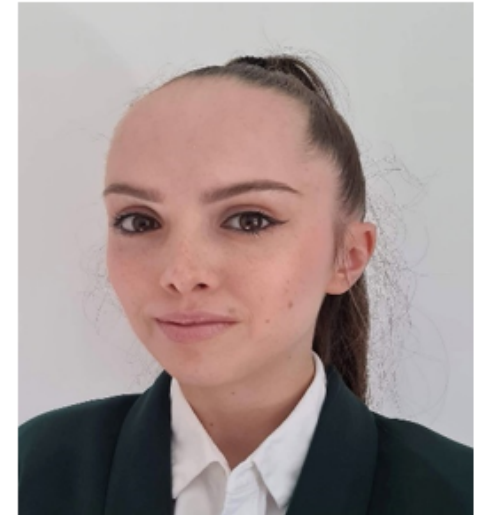
With over 30 years of experience in AM, including establishing research centres at both Warwick and DeMontfort Universities before joining the newly constructed Manufacturing Technology Centre in Coventry in 2011, where he set-up the Net Shape and Additive Manufacturing research theme which has grown to be one of the largest activities in the MTC, driven by demand from some of the world's leading industrial organisations. In 2014 the MTC was awarded the status as the National Centre for Additive Manufacturing (NCAM). David, sits on the UKs AM strategy committee and is the author of over 90 publications in the field of AM.



Ms Aneta Chrostek-Mroz

Research Engineer (Materials Technology) – The Manufacturing Technology Centre

Aneta Chrostek-Mroz has been working as Research Engineer in Materials Technology at the Manufacturing Technology Centre (MTC) since 2016. She obtained her master's degree in Chemical Technology and bachelor's degree in Ceramic Engineering from AGH University of Science and Technology based in Krakow, Poland. She engages in R&D projects related to characterization of powder feedstock used in AM, powder handling and powder processing.



Sven Hinrichs

Head of Technology Consulting AMFG

Technical University of Munich trained engineer, with specialism in Astronautics and Sustainable Energy Systems. Global experience gained at Evonik, ESA, Denso, consulting group Alten before joining AMFG in 2020 as R&D manager before becoming head of Technology Consulting in September 2021.



NATIONAL CENTRE ADDITIVE MANUFACTURING



NCAM Overview

Nov - 2022





NATIONAL CENTRE ADDITIVE MANUFACTURING





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History of AM at the MTC

National Centre for Net Shape & AM opening



ESA AM Benchmarking Centre launch



ASTM International Centre of Excellence launch



28 AM training courses available



Launch of AM Knowledge Hub

ESA Electron Beam & Green Laser Pure Copper project started

2014

2015

2016

2017

2018

2019

2021

2022

First AM training course launch

DRAMA project



Aero pre-production project completion



DRAMA project completion

Joined AM Green Trade Association



ESA Benchmarking of Novel High Strength Aluminium Alloys project started



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NCAM Cross-functional Team

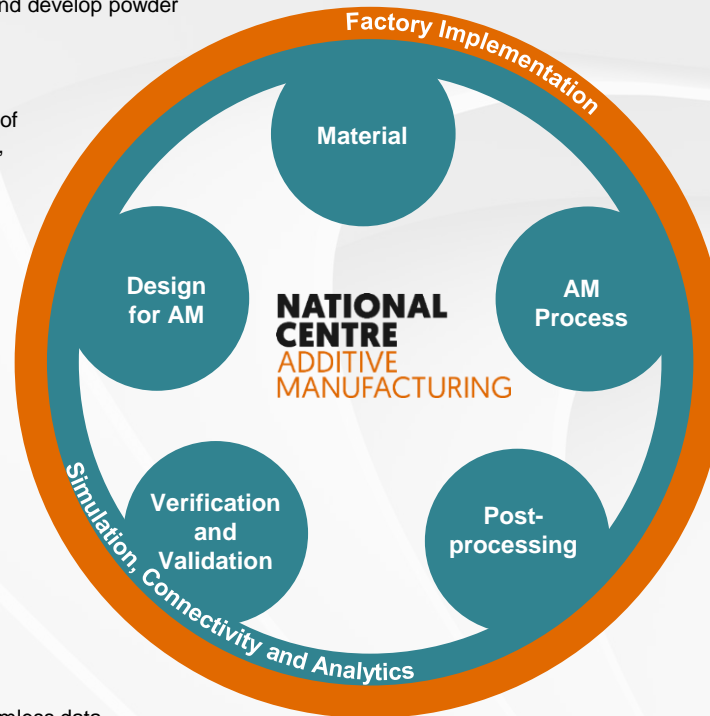
Material: Validate material selection supply and develop powder handling and QA strategies

Design for AM: Support the implementation of knowledge and software to optimise data flows, designs and exploit AM

Verification and Validation: Develop rate capable, cost effective inspection techniques

Simulation: Modelling of the AM process chain to increase right first time manufacture

Connectivity and Analytics: Develop seamless data capture and analysis systems encompassing the whole process chain



Factory Implementation: Develop and validate AM quality processes, H&S procedures and workflows

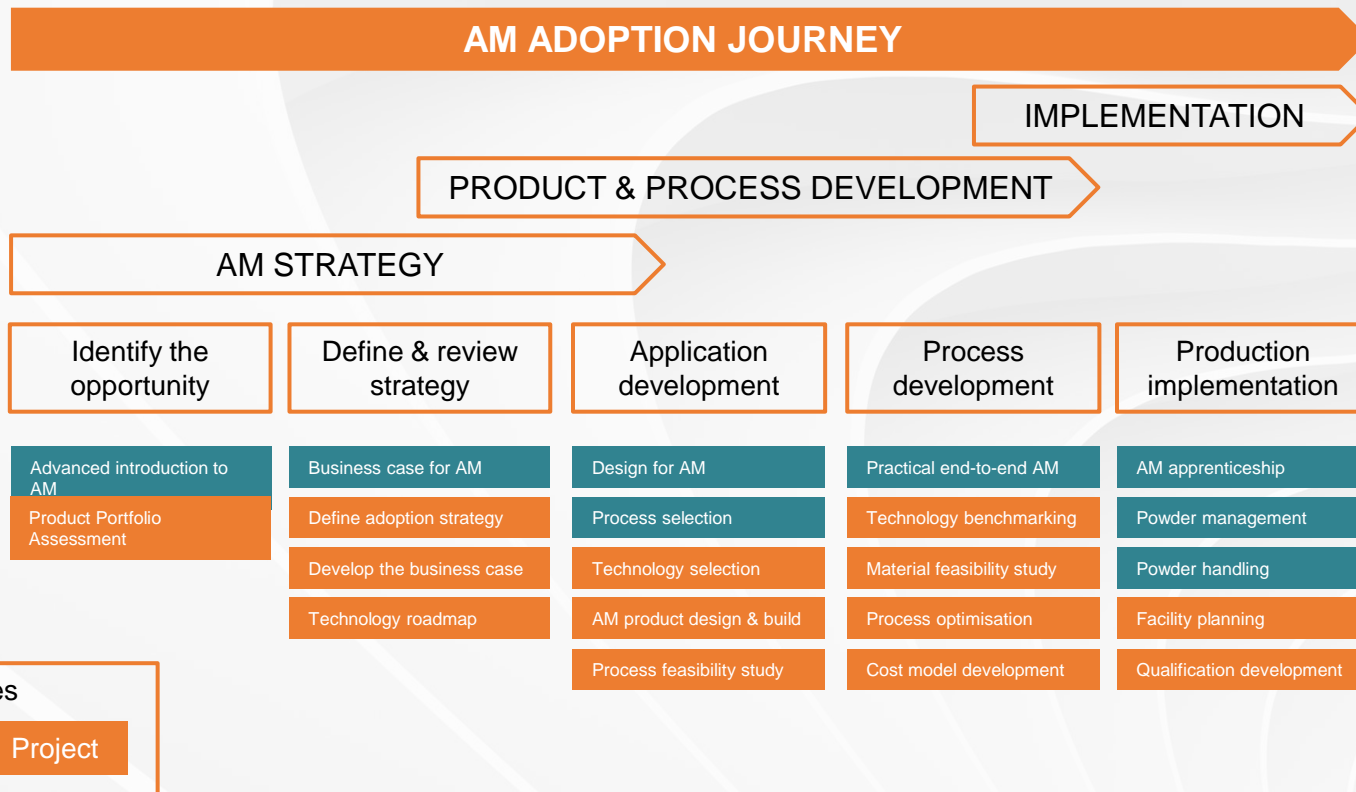
AM Process: Optimise build strategies for process chain efficiency (faster, cheaper, more repeatable)

Post-processing: Develop and validate efficient routes for support removal, surface finishing and heat treatment



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Typical Projects





NATIONAL CENTRE ADDITIVE MANUFACTURING

AM Equipment

- **25+ AM machines based at Ansty Site**
- **Metal PBF**
 - Renishaw RenAM 500Q
 - Trumpf TruPrint 3000
 - EOS M280 & M400-4
 - AddUp FormUp 350
 - Arcam Q10+ & Q20+
- **Polymer**
 - Stratasys Fortus 450mc & Objet 1000 Plus
 - HP Jet Fusion 4200
 - Markforged Mark 2 Enterprise Composite
 - Carbon Digital Light Synthesis M2
- **Ceramic**
 - XJet Carmel 1400
 - Photocentric LC Precision Ceramic
- **Bind & Sinter**
 - AIM3D ExAM 255
 - Digital Metal DMP2500
- **DED**
 - 20kW fibre laser, co-axial & side feed wire, side feed powder
 - 3kW Disc laser, co-axial & side feed wire, side feed powder
 - Plasma Transferred & Gas Tungsten Arc, 3 x 6-axis robots



+ Associated Auxiliary & Post Processing Equipment



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ESA AM BENCHMARKING CENTRE

- NCAM is European Space Agency's AM Benchmarking Centre
- AMBC provides a simple and easy way for ESA projects and hi-tech companies to investigate the potential of AM for their work.
- NCAM can provide the space sector access to state-of-the-art production capabilities and competence to support industrial exploitation, in collaboration with other partners
- Based at MTC, Coventry UK
- Launched May 2017, Renewed in 2020
- Typical projects involve evaluating:
 - AM powders
 - Produced materials
 - Post-processing techniques
 - AM machines



European Space Agency

1

To deliver a series of ESA AM projects through a frame contract allowing ESA projects access to state-of-the-art AM capabilities (metallic and non-metallic)

2

To be a centre for space sector companies to approach to mature their AM products and process understanding

3

To consolidate European leadership on AM for space



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ASTM AM CENTER OF EXCELLENCE

CENTER of EXCELLENCE

RESEARCH TO STANDARDS

Additive Manufacturing



Founding partners



Strategic partners



Center Goals:

1. Accelerate standardisation and close standards gaps in AM
2. House and facilitate R&D in its partners laboratories
3. Create strong global partnerships among AM developers, users and stakeholders
4. Support education, training, proficiency testing, and certification programs
5. Host professional events, workshops, and symposia featuring subject matter experts and practitioners

A synergistic, collaborative, and efficient environment in which R&D advances technical standards, helping all aspects of additive manufacturing flourish.

www.amcoe.org | amcoe@astm.org



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**CENTER of
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RESEARCH TO STANDARDS
Additive Manufacturing

ASTM AM CoE: Projects so far


1



**POWDER FEEDSTOCK
EVALUATION FOR
ADDITIVE
MANUFACTURING**

Output: WK66030 - Standard Guide for Quality Assessment of Metal Powder Feedstock Characterization Data for Additive Manufacturing (AM)

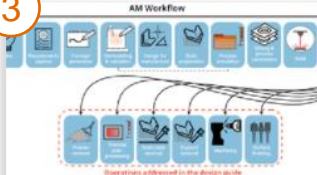
2



**POWDER SPREADABILITY
DEFINITION AND
MEASUREMENT
METHODOLOGIES**

Output: ASTM WK71393 - Additive Manufacturing of Metals - Feedstock materials - Guide for Assessment of Powder Spreadability

3



**DESIGN GUIDE FOR POST-
PROCESSING OF LASER
POWDER BED FUSION AM
COMPONENTS**

Output: ASTM WK78115 (Replaces WK73444) New Guide for Additive Manufacturing Design Post Processing for Metal PBF-LB

4



**METAL POWDER
FEEDSTOCK RECYCLING
AND SAMPLING
STRATEGIES**

Output: ASTM WK75184 Addresses 'Gap PC7: Recycle & Re-use of Materials' and 'Gap PM5: Metal Powder Feedstock Sampling'.

5



**POLYMER POWDER
RECYCLING**

Output: WK75265 Guide for Additive Manufacturing of Polymers—Powder Bed Fusion—Guidelines for Feedstock Recycling and Sampling Strategies Addresses 'Gap PC7: Recycle & Re-use of Materials'

6



**TEST ARTIFACTS —
GEOMETRIC CAPABILITY
ASSESSMENT OF AM
SYSTEMS**

Assessment of proposed revision to ISO/ASTM 52902 by JG52

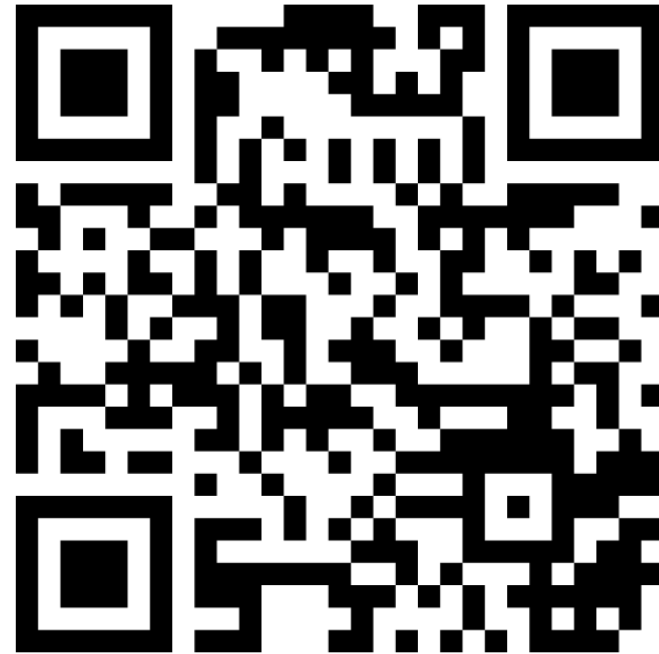
7

**DEVELOPMENT OF
GUIDELINES FOR LB-PBF
PROCESS QUALIFICATION**

Developing specific guidance on process qualification for laser beam powder bed fusion, in collaboration with NASA.

What do you think about the course so far ?

<https://www.menti.com/alaqi3ya6n4o>



- Mentimeter

Competence unit 36 – “Coordination of AM” process

Focuses on **management of end-to-end AM process** to ensure parts produced;

- Meet customer expectations
- Complying with producers quality management system
- Meet prevailing external standards

But also

- we don't make scrap components
- Equipment / people are properly utilised
- We don't waste energy/material
- We make a profit

AM is a great automated manufacturing technology

Why do we need to worry about managing the process ?

Every manufacturing process needs to be managed

AM is complex multistage process involving many manual steps

When does the AM process start ?

<https://www.menti.com/alwofb71as1e>



- Mentimeter

NASA's AM manufacturing standards talk about...



- Manufacturing the feed-stock
- Selecting, approving, installing, maintaining, calibrating the AM equipment
- Ensuring staff are properly qualified.....and more

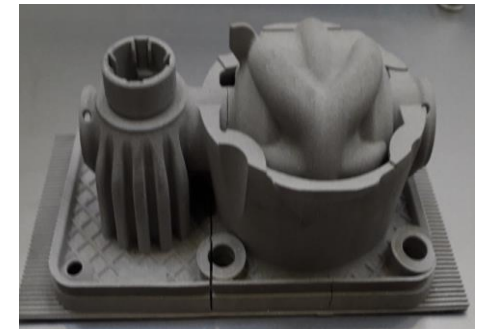
For the sake of time and our sanity when we talk about the end-to-end AM process this includes

- Selecting the right parts for AM
- Choosing the right process
- Design of the part
- Planning the process (either in-house or external sourcing)
- Feed-stock selection and management
- Part set up for the AM process
- AM process monitoring
- Post processing operations
- Inspection

Scrap levels in AM are very high compared to most conventional manufacturing processes....in some cases >30% parts can not be used

Causes ?

- Unreliable AM process equipmentsometimes
- People...usually
 - Bad decisions
 - Poor communication (wrong data, wrong - process sequence...)
 - Lack of care (often parts are scrapped in manual post processing)



Course topics cover.....

- How to ensure clear communication across the process chain.
- Capturing client requests and preparing quotations.
- Design for AM and how to develop a robust design brief.
- Implementing a quality system and quality control documentation.
- Devising a comprehensive Additive Manufacturing Procedure Specification.
- Effective scheduling of AM systems and personnel.
- Traceability and control of documentation.
- Complying with standards.
- Checking part quality before dispatch.
- Dealing with non-conformance issues.

Tuesday - 10th January 2023

START TIME (CET)	CONTENT
9:30	Introduction to the course - <i>David Wimpenny (MTC)</i>
10:00	TOPIC 1: Capturing client requests and preparing quotations - <i>David Wimpenny (MTC)</i>
10:30	TOPIC 3. Design for AM - Setting and meeting the design brief - <i>David Wimpenny (MTC)</i>
11:00	10min break
11:10	TOPIC 4: Controlling design data – <i>David Wimpenny (MTC)</i>
11:40	TOPIC 5: Quality system and quality control documentation - <i>David Wimpenny (MTC)</i>
12:10	TOPIC 6: Additive Manufacturing Procedure Specification - <i>David Wimpenny (MTC)</i>
12:40 – 13:00	Group exercise

Topic 2 has been moved to Thursday

Thursday - 12th January 2023

START TIME (CET)	CONTENT
9:30	TOPIC 2: AM system and Operator scheduling - <i>David Wimpenny (MTC) & Sven Hinrichs (AMFG)</i>
10:00	TOPIC 7: Assessing part quality - <i>David Wimpenny (MTC)</i>
10:30	TOPIC8: Dealing with non-conformance issues – <i>David Wimpenny (MTC)</i>
11:00	10 min break
11:10	TOPIC 9: Traceability and control of documentation – <i>Aneta Chrostek-Mroz (MTC)</i>
11:40	TOPIC 10: Standards - <i>David Wimpenny (MTC)</i>
12:10-12:40	Review of course information – <i>David Wimpenny (MTC)</i>
11:40 – 12:00	Complete course survey

Managing the training sessions

- We need to cover the entire course in 2 x 3.5 hours sessions
- There will be time for questions at the end of each slide for urgent but brief questions, as well as time at the end of each 30min session
- There is a mid morning break for 10min each day but we may take additional breaks as required

What we need from you - PLEASE

- This is 2nd running of this course we need your views on the content/structure and delivery – you will be given time to complete the course questionnaire in the final session of the course on 12th January.
- Unless you complete the questionnaire you will not be allowed to sit the course assessment on the 19th January (1pm GMT/2pmCET)

Please Note

This is not one of MTC standard training courses – the material used has been prepared by the MTC’s research engineers with some material supplied from the Admire project.

More information on Admire go to; <https://admireproject.eu/>



For more information on MTCs portfolio of professional training courses go to; <https://the-amtc.co.uk/training/our-courses/>

Feed back from previous pilot of CU36

- Too many slides
- Too much text on slides
- Too much content to take in
- Not enough interactions/exercises
- Not enough breaks

True....I have tried to address this...

www.skills4am.eu



Thank you & Questions ?

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