Figure 1: Comparison of SEM micrographs (200x magnification) for three powder batches procured from three separator powder suppliers. All powder batches have a chemical composition consistent with Grade 5 Titanium and nominal size distribution 15-45 microns.

Figure 2: Quantitative particle morphology assessment of powder batches from three suppliers; Black – Supplier (a), Red – Supplier (b), and Blue – Supplier (c).

Figure 3: Bulk powder properties (powder flow and packing density) as a function of particle morphology.
Figure 4 Geometric plot of in-situ shelled canister. Courtesy of the University of Birmingham

Figure 5 Laser + powder DED. Courtesy of Fraunhofer ILT.
Figure 6  Microstructure of hull and core build strategy in laser melting powder bed fusion. Courtesy of Fraunhofer ILT.

Figure 7  Adaptive Fixture by the MTC, Thales Alenia sun sensor bracket.
Figure 8 BCT System concept – adaptive machining
Figure 9  Fraunhofer ILT laser polishing of IN718 compared to Am as built part.

Figure 10 Integration of different in-situ monitoring systems into the WAAM machine head.

Figure 11 Image from blown powder thermal camera.
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Figure 13 Integration of thermal camera in the IREPA blown powder system
Figure 14 Powder bed supply interacting with coaxial laser in powder bed processes.

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Figure 16 Component scale models resolve the large-scale processes providing insight on manufacturability and whether the final product will be conformal to the original design.
Figure 17 Four AM factory locations.

Figure 18 Norsk Titanium AM Machine Rapid plasma deposition

Figure 19 AMAZE APOD 12 ESA Cylinder Laser Blow Powder by Irepa Laser
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Figure 22 Non-destructive testing by neutron diffraction (ILL)

Non-destructive test by neutron diffraction (ILL)

Figure 23 Tungsten deposit
Figure 24 In-process cold-worked titanium

Figure 25 Nanoindentation maps of AlSi10Mg and Al-Si-Ni cross-sections.
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Figure 27 Process window of the AlSi10Mg powder, chosen based on optical microscopy on-top images.
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Figure 31 Alloying aluminium and silicon elemental powders by selective laser melting.

Figure 32 Process optimisation for the production of fully dense AlSi6 by selective laser melting.
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Figure 36 SEM micrograph showing defect formation in SLM fabricated Mo.
Figure 37 Micrograph showing HIP diffusion bond between Mo and W.