Additive Manufacturing in the Sustainment Environment:

"Maturation of Advanced Manufacturing for Low-cost Sustainment (MAMLS)"

Phase 3 Announcement

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Objectives & Benefits

- Develop and demonstrate advanced manufacturing technologies related to additive manufacturing that improve rapid part replacement/maintenance for legacy aircraft.
- Enable on-demand replacement of critically damaged or obsolete components that do not meet economic requirements of conventional supply chains.
- Develop and demonstrate rapid fabrication of shop tools such as assembly aids, jigs, and fixtures for sustainment center utilization.
- Identify technology gaps and workforce issues that need to be solved prior to effective implementation.
- Reduction of the cost and lead time to fabricate replacement components for legacy aircraft as well as for rapid tooling, masks, fixtures, etc.
- Technology demonstrations and learning for future implementations both in industry and AF organic sustainment operations.

MAMLS Phase 3

Phase 3 of the "Maturation of Advanced Manufacturing for Low-Cost Sustainment (MAMLS)" program is intended to address key challenges to insertion of AM technology for maintenance, sustainment, and logistics operations within the DoD that have been identified throughout Phases 1 and 2. Currently, these material, process, and post-process barriers are preventing greater penetration of AM technology for more challenging, safety critical applications or for the breadth of parts demand sought by the AF sustainment community.

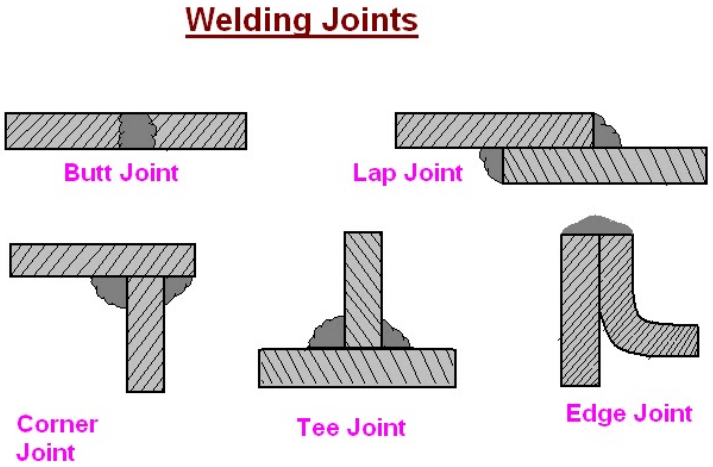
- 2-stage competitive proposal process: white paper followed by a down select to full proposals
- 3 Topic Areas:
  - Feature Based Qual for DED, up to1 Award, up to $2.5M in Federal funding
  - Effects of Defects, up to 2 awards, up to $1M in Federal funding
  - Emerging Processes, up to 2 awards, up to $600K in Federal funding
- 50% cost share minimum

NCDMM Will Define the Channels for Communication and Questions

Feature Based Qualification using Directed Energy Deposition

Feature based qualification (FBQ) approaches seek to identify and create a catalog of all relevant unique combinations of process parameters with simplified specimen geometries. This catalog of qualified features is subjected to extensive material and process qualification testing. Parts are qualified by decomposing the parts into the relevant constituent features and producing each feature in a manner compliant with the catalog specification. FBQ is seen as a potentially viable strategy for avoiding non-statistical based approaches and inefficient point design practices.

(1) Demonstrate the extent of utility of the FBQ approach
(2) Identify associated implementation challenges and risk reduction or alternative qualification strategies



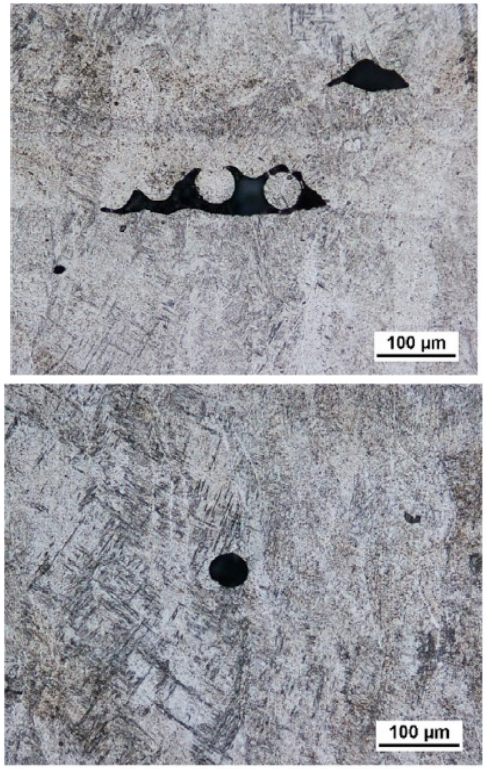
Analogy to Welding Procedure Specification

Think about actionable transition artifacts, not demonstrations

Understanding Manufacturing Realities of AM: Effects of Defects

There are many factors that lead to scrapped material from the additive manufacturing process. Possible root causes include powder contamination, process interruptions, unremoved powder, rough finish on downward facing surfaces, and unintended volumetric flaws such as lack of fusion voids or distributed porosity. Characterization of such flaws, their influence on mechanical performance and the ability to conduct post-processing to repair such flaws is desired

- Evaluation of material properties that are sensitive to statistical extremes is of particular interest, as well as the evaluation of real flaws rather than having to make assumptions about the relevance of intentionally-induced flaws such as CAD-embedded voids.
- Characterizing the extent to which specific post-processing approaches, such as Hot Isostatic Pressing, improve mechanical performance is also relevant to this topic area.



Lack of Fusion Defect

Gorelik M. Additive manufacturing in the context of structural integrity. Int J Fatigue (2016), http://dx.doi.org/10.1016/j.ijfatigue.2016.07.005

Deep dive on material/defect/process, not cover the waterfront

Emerging Process Technology for Low Criticality Part Families

The goal for this program area is to evaluate the ability of ***emerging*** processing and technologies to supply low criticality components that satisfactorily fulfill the required part function. Additionally, AFRL seeks to assess the degree to which the demonstrated solutions extend to part families of similar size, shape, criticality and function

Some examples include, but are not limited to, unique electrical connectors, ducting, manifolds, instrumentation knobs, wiring harnesses, small brackets, and other non-critical end use items. Such parts may have identical function, but slightly different geometries or features that result in many variants of very similar parts.

The following processes as defined by ASTM F2792 will be considered for funding under this program area:

- Highly loaded material extrusion – e.g. fiber, metal, ceramic
- Vat photopolymerization
- Powder bed fusion with non-laser and non-electron beam energy sources
- Sheet Lamination

How does this process integrate into the Depot environment/workflow?