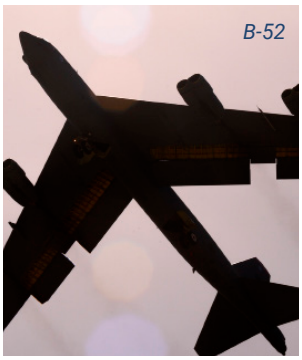
SUCCESS STORY 3000

Program enhances and improves U.S. Air Force Sustainment Operations

Rapid response solutions support AM technologies for low-cost sustainment



A wide range of USAF systems saw sustainment benefits in the MAMLS program.

PROBLEM

Legacy aircraft used by the U.S. Air Force (AF) require parts that may be difficult to procure due to situations such as manufacturing obsolescence, costs to create, low-quantity requirements, poor documentation, or other availability-related challenges. Additive Manufacturing (AM) along with other advanced manufacturing technologies, such as reverse engineering, offers the potential to increase part availability at the supply chain level, depot level, flight line, and in theater, alleviating high part and tooling costs and long lead time issues, thereby enabling mission readiness. The MAMLS three-phase program was created to incorporate these advanced manufacturing technologies to provide rapid, low-cost sustainment solutions.

OBJECTIVE

The program enhanced and improved AF sustainment operations by:

- Developing and demonstrating advanced manufacturing technologies related to AM that improve rapid part replacement and maintenance for legacy aircraft
- Enabling on-demand replacement of critically damaged or obsolete components that would not meet economic requirements of conventional supply chains
- Developing and demonstrating rapid fabrication of shop tools for sustainment center utilization
- Identifying technology gaps and workforce issues that need to be solved prior to effective implementation

TECHNICAL APPROACH

The program team included advanced manufacturing leaders from industry, academia, and government agencies working together to provide solutions to the DoD world.

A range of technologies was investigated in Phase 1:

- Reverse Engineering and Model Generation
- Assembly and Manufacturing Aids
- Metal Forming and Composite Autoclave Tooling
- Directed Energy Deposition for Metal Part Repair
- Metal Casting Tooling
- Direct Digital Part Production

Each approach provided value in the sustainment of aircraft and peripheral equipment. MAMLS was intended to prove that AM had the materials and processes in place to create nominal structural and functional performance properties for four different, complex, direct part demonstrations – a bell crank, a fuel-oil cooler, composite sandwich panels, and structural repair panels – with the breadth covering a family of each type of part, which lead to a path for qualification.

AMERICA MAKES TECHNOLOGY DEVELOPMENT ROADMAP

This project aligns to: VALUE CHAIN

ASTM PROCESS CATEGORY: Powder Bed Fusion, Binder Jetting, Directed Energy Deposition, Material Extrusion

EQUIPMENT: 3DS ProX DMS 320, ExOne S-Max Sand Printer, *LENS®, various FDM machines

MATERIAL: Multiple types, including metals and polymers

ACCOMPLISHMENTS

The 3-phase applications program ultimately provided rapid response solutions to ongoing projects and initiated new projects to support emerging AM technologies in relation to the sustainment environment.

Technology Transitions

- The casting supply chain team worked with the 910th Airlift Wing to adopt reverse engineering and AM for tooling and part replacement options such as the creation of custom 3D printed sand molds to cast an aluminum T-Pipe header for its aerial spray systems on C-130 aircraft.
- At Hill AFB, a damaged vertical tail assembly for an F-16 was 3D laser scanned to determine final fixture requirements for alignment and compatibility with an existing fuselage — revitalizing the damaged tail that would otherwise be scrapped.
- Other team members worked with the ALC's at Tinker AFB and Warner Robins AFB to transition advanced manufacturing techniques to affect lead time reduction, cost reduction, and flight readiness improvements, while developing organic and supply chain options for sustainment.

Workforce and Education Outreach

- The team not only demonstrated the advanced manufacturing technologies for sustainment operations but also provided focused workforce training to enable transition at an organic level at the ALC's and flight lines. Additionally, training and workforce education curriculum was developed to support the Air Force Research Laboratory (AFRL) and Air Force Life Cycle Management Center (AFLCMC) at enterprise levels.

Research Application Areas

- A-10: Heads-Up Display (HUD) bracket
- B-1B: Ram air inlet scoop, refueling tee, ejection handle, bell crank qualification readiness evaluation
- B-2: Auxiliary Power Unit (APU) rear bearing housing replacement
- B-52: Hybrid fairing qualification readiness evaluation
- C-5: Composite panels
- C-17: Avionics cooling duct, cargo floor tie-down pan
- C-130: Modular aerial spray system castings, yoke cover, instrumentation mounts
- E-3: Door handle, Wing tip light, elevator tab, fuel tank adapter
- F-15 and F/A-18: Missile launcher cylinder piston
- F-22: Structural repair parts qualification readiness evaluation
- F-16: Vertical stabilizer repair fixture, door drill fixture
- F-110: Engine gearbox housing masking

PROJECT END DATE

April 2018

FUNDING

$27M total project budget
(Across 3 Phases)

PROJECT PARTICIPANTS

Project Principal:
University of Dayton Research Institute

Other Project Participants:
NCDMM/America Makes
Youngstown State University
Youngstown Business Incubator
Case Western Reserve University
University of Northern Iowa
Pennsylvania State University - ARL
GE Aviation
Boeing
Raytheon
Honeywell Aerospace
Lockheed Martin
3D Systems
Optomec
BasTech
Deloitte
American Foundry Society
M-7 Technologies
National Center for Manufacturing Sciences
Humtown Products
SLICE Manufacturing
DRT Manufacturing Company

Public Participants:
U.S. Department of Defense