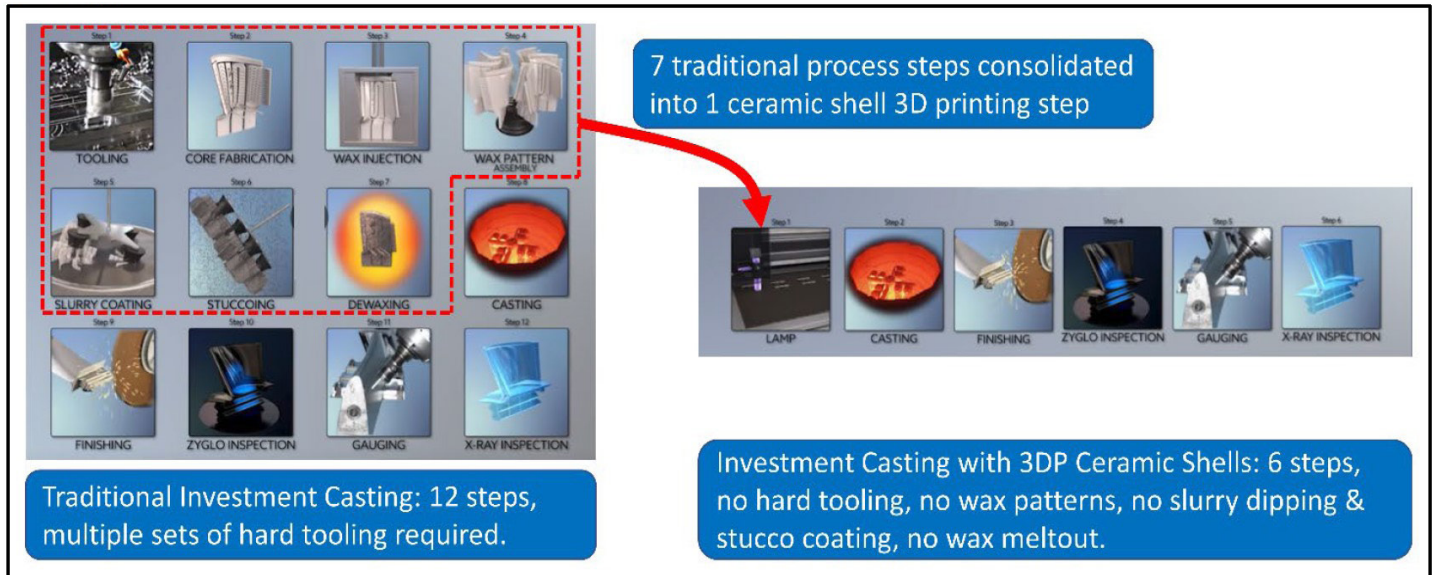


Maturation of Ceramic 3D Printed Shell-based Investment Casting Foundry Capabilities of the 76th CMXG at Tinker AFB



DDM Systems' Large Area Maskless Photopolymerization (LAMP) ceramic 3D printing technology reduces investment casting lead times.

PROBLEM

The 76th CMXG at Tinker Air Force Base (AFB) needs replacement parts for the B-2 Spirit Bomber, C-5 Galaxy, and A-10 Thunderbolt II aircrafts since commercial suppliers currently do not exist. Producers of traditional investment castings typically perform approximately 12 major process steps to complete a production part. Each step of production creates the potential for defects, rework, and scrap contributing to longer lead times, higher part costs, and additional energy usage. Legacy methods for creating tools from wax and ceramic are complex, labor-intensive, and susceptible to dimensional distortion. The material variability of wax, the reliance on complex injection molding processes, and the manual assembly techniques to create castable shells contribute to casting lead times of 12 months or more. Ceramic 3D printing has the potential to decrease investment casting lead times through the reduction of up-front traditional processing steps from seven steps to one.

OBJECTIVE

The objective of this project is to mature the ceramic 3D printing capabilities of the 76th CMXG at Tinker AFB from a Technology Readiness Level (TRL) and Manufacturing Readiness Level (MRL) of seven to nine. The increased readiness level enables onsite casting, provides sustaining engineering opportunities, and maximizes the probability of producing high-quality castings that conform to AMS-2175 Class I Grade A requirements.



AMERICA MAKES
TECHNOLOGY
DEVELOPMENT
ROADMAP

This project aligns to:



PROCESS

ASTM PROCESS
CATEGORY

Vat
Photopolymerization

EQUIPMENT

DDM Systems'
CPT6060 Ceramic
3D Printer

MATERIAL
Ceramics



TECHNICAL APPROACH

DDM Systems, Inc., (DDM) will partner with the 76th CMXG casting foundry at Tinker AFB to develop a comprehensive program to mature and transition Large Area Maskless Photopolymerization (LAMP) ceramic 3D printing technology for the rapid, low-volume production of investment castings. Leveraging DDM's ceramic 3D printing capabilities for investment casting shells with the latest casting modeling tools, the project will accelerate the path to obtain critical parts necessary for sustaining aircraft readiness. The project team and industry professionals will collaborate to develop a rigorous development plan that guides this project through detailing shell design, shell optimization, and ceramic 3D printing innovations to significantly reduce casting lead times. Simplification of front-end casting processes using LAMP ceramic 3D printing eliminates many of the traditional processing steps needed to build cores and shells. One component will be selected from each aircraft program (B-2 Spirit Bomber, C-5 Galaxy, and A-10 Thunderbolt II) to undergo demonstration of on-demand investment casting using LAMP ceramic 3D printing technology and inspection results will be evaluated for acceptability.

PROJECT START DATE

October 2023

EXPECTED END DATE

January 2026

EXPECTED DELIVERABLES

- Ceramic shell design files
- Ceramic shell slice image stacks
- Presentations shared at MMX and TRX events
- Final report

FUNDING

\$1,868,331 total project budget
(\$1,245,554 public funding/\$622,777 private funding)

PROJECT PARTICIPANTS

Project Principal:

DDM Systems, Inc.

Other Project Participants:

NCDMM/America Makes
76th CMXG at Tinker Air Force Base
Air Force Sustainment Center
Mueller Additive Manufacturing Solutions

Public Participants:

U.S. Department of Defense