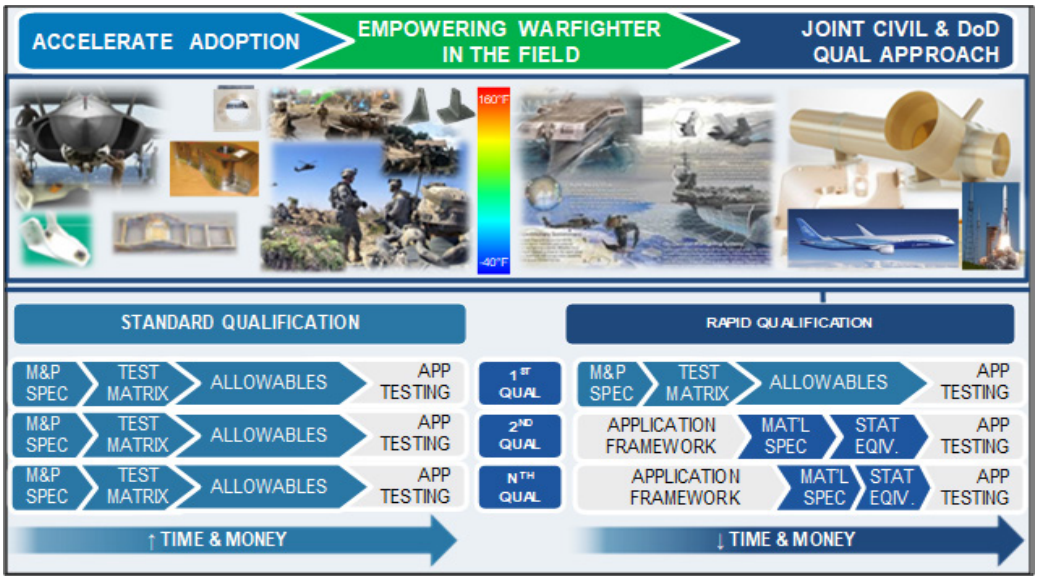
PROJECT SUMMARY 3026.004

ATRQ - Service Life of Additive Manufacturing (SLAM) in Harsh Environments



SLAM takes an application-driven approach, across a wide array of requirements, to understand adoption areas for various material extrusion polymer-AM material systems and reduce material testing.

PROBLEM

Only recently have appropriate process controls been applied to three-dimensional (3D) printers with production floor readiness capabilities in mind. Publicly available data is limited to test results provided by material providers or printer original equipment manufacturers (OEMs), often reporting averages of limited test sampling and ignoring low performing specimens or overall spread of data. The lack of reliable data is a barrier for translation of AM parts into a production setting, leaving production applications vulnerable even when used in a non-load, non-critical application space. Additionally, until recently no standard criteria or specification of printing was available for creating a reliable and understandable data set.

OBJECTIVE

The objective of this project is to deliver an open and comprehensive set of manufacturing tools to improve the rate of qualifying materials and part families. The project seeks to provide scalability from coupon level combined with dataset interoperability to further enable manufacturing technology implementations across relevant DoD services and their strategic / operational / tactical-level sustainment commands.

AMERICA MAKES TECHNOLOGY DEVELOPMENT ROADMAP

This project aligns to:

MATERIAL

ASTM PROCESS CATEGORY:
Material Extrusion

EQUIPMENT:
Fortus 400MC, Fortus 900MC, 3DP 400 Series, Mark Forged Mill

MATERIAL
ULTEM 9085, TBD (PET-G, Nylon 12), ABS, Carbon Fiber-reinforced Nylon

TECHNICAL APPROACH

The technical approach includes two phases. Phase 1 involves creation of a rapid qualification methodology built around a full set of environmental conditioning with extensive dynamic characterizations performed on ULTEM 9085. RP+M's AS9100 certified facility, used to generate the B-Basis Allowables for the previous UTLEM qualification, enables the highest quality specimens and components to be analyzed without concern for unknown processing variables. Testing of the initial ULTEM 9085 specimens is being conducted at National Institute for Aviation Research (NIAR) and Auburn University. EWI's nondestructive evaluation (NDE) techniques capture failure mechanisms and degradation progressions by sampling specimens at different aging stages and cycles. The results of the characterization and NDE methods create a probabilistic framework with the intent to estimate service life reduction and determine the risk in using AM for the proposed environmental conditions.

Phase 2 of the program continues with the selection of a second material from the provided prioritized list based on requirements gathered at the beginning of the program. Optimized ULTEM 9085 specimens and components, and optimized second material specimens and components are sent through an efficiently scoped characterization effort (aging and NDE). The optimize and validate step provides an opportunity to quantify the process optimization efforts captured in the service life guide; validate the predictive service life model; and demonstrate the efficiencies gained by exercising the rapid qualification methodology.

PROJECT START DATE

June 2019

PROJECT END DATE

June 2021

EXPECTED DELIVERABLES

- Completed market requirements document by service branch
- Specifications for each material and process identified
- Process failure modes and effects analysis and probabilistic framework
- NDE methods, fatigue test(s), and wear test(s) validated for austere environments
- Service guide outline with ULTEM 9085 initial service life results
- Supplemental dataset created for ULTEM 9085
- Final report

FUNDING

$1.47M total project budget
($1.056M public funding/$420K private funding)

PROJECT PARTICIPANTS

Project Principal:
National Institute for Aviation Research (NIAR)

Other Project Participants:
Auburn University
EWI
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