Department of the Navy SBIR/STTR Transition Program

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NAVAIR 2018-822

Topic # N15A-T007

Real-Time Additive Manufacturing Process Models Applied to Wire Fed Electron Beam Processed 4340 Steel

Keystone Synergistic Enterprises, Inc.

WHO

SYSCOM: NAVAIR

Sponsoring Program: PEO (A) and NAWCAD

Transition Target: Navy Alloy 54 and 4340 Additive Manufacturing (AM) Applications

TPOC:
(301)342-8003

Other transition opportunities: Alloys which have completed Metallic Materials Properties Development Standardization (MMPDS) and are ready for the Source Approval Request (SAR) process including Ti-6AL-4V and 316L stainless steel

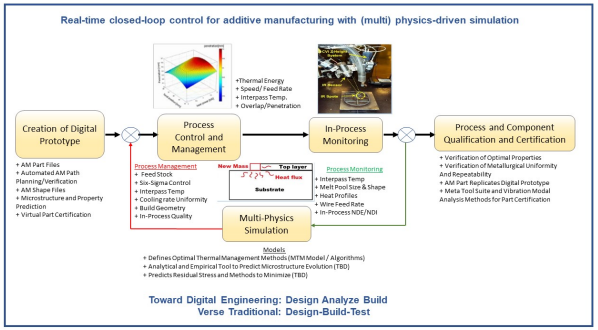

Image courtesy of Keystone, Copyright 2018

Notes: The process chart illustrates the real-time closed-loop control used by Keystone to yield uniformity. Optimization of the metallurgical properties is achieved.

WHAT

Operational Need and Improvement: Time and cost effective replacement or repair of components challenged by diminishing supply and obsolescence

Specifications Required: The Keystone AM process offers cost effective low volume quantities with rapid qualifications and is especially effective for large format components. Typically, the larger and heavier the part, the better the economics for the Navy (and the DoD) to use the Keystone AM process. Ideal target applications are large format components whereby the demand is low, and potentially sporadic, and lead-time for replacement is critical.

Technology Developed: The success is underpinned by: i) the sensor package for the control system repeatability, and ii) integration of metallurgical algorithms to optimize material properties.

- Developed an AM system level qualification capability overcoming the lengthy and costly current approach of empirical part-by-part qualifications
- Achieved system level qualification by developing the AM process to produce uniform material properties independent of part geometry
- Accomplished uniform material properties by developing a highly repeatable manufacturing process using real-time closed-loop process control

Warfighter Value: Lower cost and faster response significantly improves sustainability of aging weapon systems. Alloy system qualification enables the benefits of Additive Manufacturing for rapid adoption. Manufacturing part quantities of one without the tooling and equipment set-up or part number change-over cost of traditional manufacturing enables the Navy to economically procure one part. This drastically reduces issues of diminishing supply and reverses higher cost trends for sustaining aging weapon systems.

WHEN

Contract Number: N68335-17-C-0246

Milestone	Risk Level	Measure of Success	Ending TRL	Date
Demonstrate manufacturing cell maturity levels - current	N/A	Ti-6V-4Al and 316L stainless steel MMPDS	6	April 2018
Qualify M54 alloy - Alloy M54 wire feedstock	N/A	Prove processing viability of M54 wire	7	July 2018
Define and establish process parameters for Alloy M54	Low	Optimum processing window and manufacturing MMPDS test pieces	6	March 2019
Achieve MMPDS including 'B' Basis acceptance	Low	Alloy M54 MMPDS	6	June 2019
Identify parts for SAR approvals and achieve SAR approvals	Med	Complete SAR packages	8	June 2020

HOW

Projected Business Model:

- Provide AM for replacement or additive repair of components to improve cost and time for sustaining systems experiencing obsolescence and/or diminishing sources of supply
- Increase current installed capacity to produce 64,000 pounds per year from two automated robotic manufacturing cells in 2019
- Deliver repaired or replacement parts direct to depots after achieving SAR approvals
- Provide easily transportable AM cells enabling them to be located within or near depots

Company Objectives:

- Become a key manufacturing supplier supporting DoD for repairs and replacement parts
- Identify select part numbers (National Stocking Numbers - NSN's) SAR (as the process can be used on a wide range of part sizes and alloys)
- Create and fill the “pipeline” whereby the alloy system qualification enables cost-effective and rapid qualification of part families
- Expand the use of and resultant benefits of AM, socialize AM into the design stage for new parts

Potential Commercial Applications: Recent success includes Keystone currently using this approach to qualify and manufacture tool surfaces for composite lay-up tools for Boeing and has qualified a sub-scale rocket nozzle for NASA (co-owned patent) with full scale manufacturing planned for late 2018. Qualification and manufacturing of tool surfaces for Boeing's composite lay-up tools started mid-2018. Keystone is currently characterizing 3 alloy systems for Aerojet Rocketdyne for downselect, and then manufacture of production qualification rocket engine components.

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