I/UCRC Executive Summary - Project Synopsis	Date: October 2021
Center/Site: CANFSA/Colorado School of Mines	
Tracking No.:52-L Data Driven Qualification (DDQ) Framework for Metals Additive Manufacturing	**E-mail :** csmith@mines.edu **Phone :** (678) 327-7874
Center/Site Director: CANFSA/M. Kaufman/P. Collins/A. Clarke	**Type: (Continuing)**
Project Leader: Charles Smith	**Proposed Budget**: Federally funded and administered through ADAPT

Project Description: This project aims to solve an inherent problem with additive manufacturing systems. The range of equipment suppliers that use their proprietary feedstock and process parameters makes each AM system and qualification protocol unique. This creates a lengthy qualification process for any new part or material used in manufacturing.

Experimental plan: This project uses a data-driven qualification approach from relationships across platforms and alloy systems using intelligent machine learning algorithms and physics-based modeling. This project aims to create relationships between solidification velocity, thermal gradients, and microstructure development to help accelerate the qualification and adoption of additive manufactured parts into defense applications. These relationships will help accelerate the qualification and adoption of additive manufactured parts into defense applications.

Related work elsewhere: Other attempts to generalize the microstructure development in AM across equipment manufacturers and AM processes is not know.

How this project is different: Few studies have examined the relationships between solidification velocity, thermal gradients, and microstructure developments across different additive manufacturing processes. This gap in understanding is key in predicting the microstructure of as-built material and material properties after post-process treatments.

Milestones for the current proposed year: Development of microstructure prediction models that can predict microstructure in the as-build condition based on solidification conditions such as temperature gradient and solidification velocity. Develop a heat transfer model to simulate the solidification conditions observed in laser powder bed fusion (LPBF) as a function of build parameters.

Deliverables for the current proposed year: Development of predictive models to guide process development and validation of additive manufactured parts.

How the project may be transformative and/or benefit society: An adaptive microstructure prediction model will provide insight into the microstructure of as-built materials and material properties after post-process treatments. This model will allow quicker development of additive manufacturing processes to produce desired material properties.

Research areas of expertise needed for project success: Understanding heat transfer models to simulate the solidification conditions observed in LPBF as a function of build parameters. Access to SEM, EBSD, and EDS analysis in determining microstructural differences related to solidification rate and thermal gradients.

Potential Member Company Benefits: Better understanding of laser powder bed fusion would lead to the development of materials that display desired material properties. Predictive material properties after post-process treatment.

Progress to Date: Heat transfer models to predict melt pool geometry are in progress. LPBF builds of 316 stainless steel in the process of analysis to determine microstructure development. Process parameters of LPBF for 316 stainless steel are in the process of analysis to determine optimal parameters.

Estimated Start Date: Fall 2017	**Estimated Knowledge Transfer Date**: December 2021

The Executive Summary is used by corporate stakeholders in evaluating the value of their leveraged investment in the center and its projects. It also enables stakeholders to discuss and decide on the projects that provide value to their respective organizations. **Ideally, the tool is completed and shared in advance of IAB meetings to help enable rational decision making.**