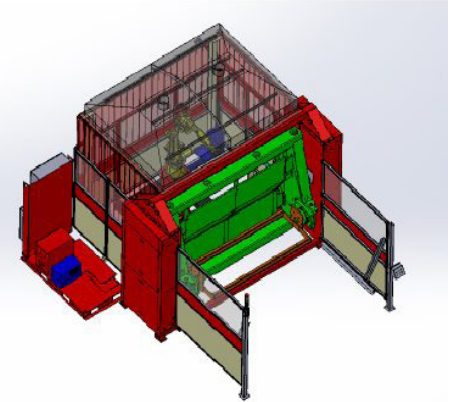
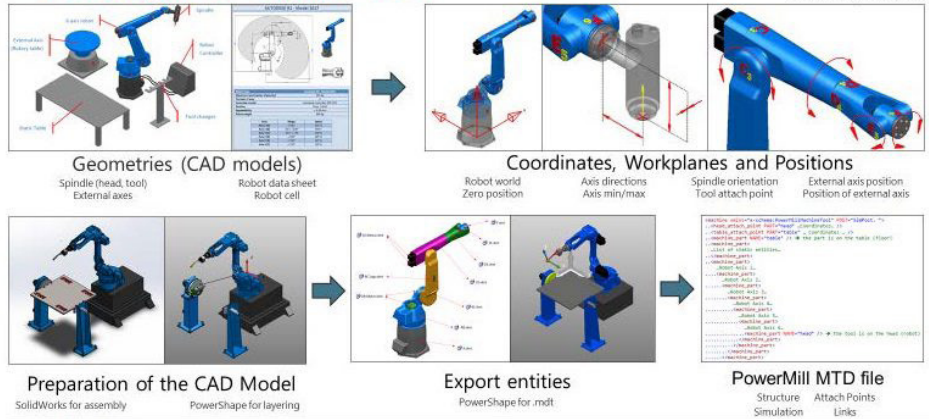


# RIA Robotic DED System - Digital Twin Setup and Capability Demonstration

## Building The Digital Twin



Workflow required for digital twin model and post-processor development along with Genesis System DED digital twin model.

### PROBLEM

Robotic welding systems represent a cost-effective piece of equipment that can enable DED AM for a range of end parts. These systems are not always production ready off the shelf. Numerous manufacturing process constraints may arise due to limitations introduced by AM equipment motion and feed rates, manufacturing cell design, material and process compatibility and processing window requirements, tooling and fixturing designs, and component manufacturing access (interference conditions). While robotic welding equipment presents potential to address manufacturing of a range of complex component geometries, integration of necessary control software and critical spatial reference information allows for the use of these systems as DED AM equipment which can readily serve a range of applications. Integration of CAM software and a digital representation of the manufacturing environment should consider a range of product geometric forms, materials systems, AM process heat sources (arc, laser, electron beam), and feedstock forms (powder or wire). These novel digital methods require training for RIA and GVSC personnel to readily address future application and manufacturing needs as well as methods for flexible fixturing techniques.

### OBJECTIVE

The objective of this project is to develop and demonstrate affordable pre-engineered robotic welding system conversion into a robotic DED AM technology capable of addressing a wide range of GVSC applications. In phase one, robotic AM processing capability is verified and demonstrated via the production of standard qualification builds using multiple feedstocks on-site at Rock Island Arsenal – Joint Manufacturing and Technology Center (RIA – JTMC). Phase two of the effort will address expansion of the product range which may be served by this AM capability by addressing flexible fixturing needs for various DED and welding applications. In addition, GVSC and RIA personnel are trained in executing and developing digital workflows to adapt and address future robotic DED AM applications and manufacturing needs.



**AMERICA MAKES  
TECHNOLOGY  
DEVELOPMENT  
ROADMAP**

This project aligns to:



PROCESS

**ASTM PROCESS  
CATEGORY**  
Directed Energy  
Deposition

**EQUIPMENT**  
Fanuc 9-axis  
Welding Robot  
System

**MATERIAL**  
MIL-100S-1 and  
MIL-120S-1

## TECHNICAL APPROACH

Phase one of the project approach includes equipment setup, calibration, validation, and demonstration. EWI is working on-site at JMTC to calibrate the Genesis Fanuc DED system digital twin. A series of tests are being performed to calibrate the digital twin to the physical system. EWI is converting the Genesis robotic welding system onsite at RIA – JMTC into a DED AM system using PowerMill CAM software. The CAD models for all robot cell components are being developed to design and program a functional digital twin of the physical robot cell in PowerMill's simulation tools. EWI is working with Genesis Systems to establish critical coordinates, work planes, and component positions of the digital twin system for the JMTC. The team is developing and transitioning gas metal arc pulse DED wall and block procedures for two commonly used arc welding electrodes: MIL-100S-1 and MIL-120S-1. Demonstration of the DED procedure standard qualified build (SQB) using MIL-100S-1 electrode is planned with the full-scale single-sided non-integrated build platform design and specimen matrix.

Phase two of the project expands upon the robotic DED AM technology to develop flexible fixturing for a range of DED and joining applications. In addition, the team will train GVSC and RIA personnel on the digital tools and DED data workflows and controls necessary to address future GVSC needs. The training will conclude with the production of a demonstration part.

## PROJECT START DATE

September 2021

## EXPECTED END DATE

May 2023

## EXPECTED DELIVERABLES

- Genesis System digital twin in PowerMill software
- Genesis System post-processor in PowerMill software
- One GMA-P DED procedure for steel using MIL-100S-1 electrode
- One GMA-P DED procedure for steel using MIL-120S-1 electrode
- One GMA-P DED standard qualification procedure and build for property testing at JMTC
- Final report

## FUNDING

**\$261,000 total project budget**  
(\$261,000 public funding)

## PROJECT PARTICIPANTS

### Project Principal:

EWI

### Other Project Participants:

America Makes

### Public Participants:

U.S. Department of Defense