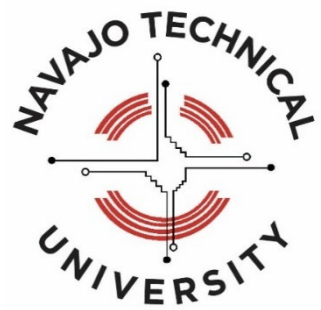


Center for
Advanced
Manufacturing



Center for Advanced Manufacturing Sustainability

H. Scott Halliday

Center for Advanced Manufacturing Coordinator

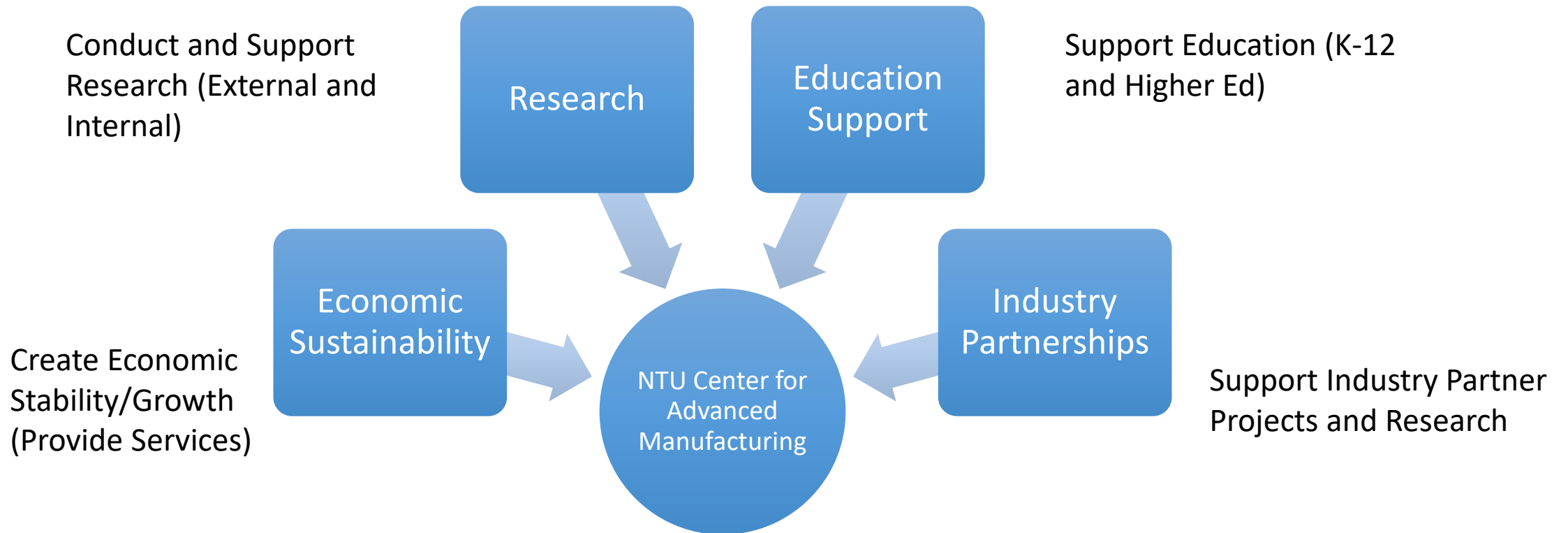
Navajo Technical University

Vision & Mission

The vision of the of the NTU Center for Advanced Manufacturing is to develop a Center of Excellence in advanced manufacturing technology and to provide the Navajo Nation and New Mexico the tools to be a leader in the Advanced Manufacturing industry in education, research, industry partners and economic sustainability.

The mission of the NTU Center for Advanced Manufacturing is to develop a Navajo workforce and to serve the needs of advanced manufacturing on the Navajo Nation and at NTU. The Center will provide sustainable educational programs, research and technology transfer opportunities. Navajo students, both K-12 and college, can benefit from experiential learning, in order to begin their own work experience both at NTU and with industry partners.

What Does NTU CAM do?



Manufacturing Sustainability

Educating students in sustainable manufacturing processes

- **Additive manufacturing**
 - **Low production**
 - **High customization**
 - **Material usage**
 - **Simulation usage**

Manufacturing Sustainability

Sustainability of the Navajo Nation

- **Decrease the “brain drain”**
- **Improve conditions on the Navajo Nation**
- **Increase sustainable manufacturing on the Navajo Nation**

NTU CAM Workforce

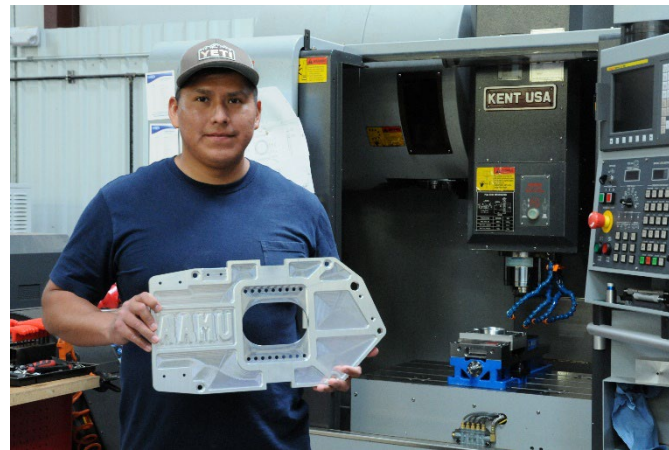
Apprenticeship-style programming in AM is a proven fast track to employment. Demand for manufactured parts is exceeding our current workforce capacity.



Joshua Toddy



Eric Bailey



Shane Tsosie

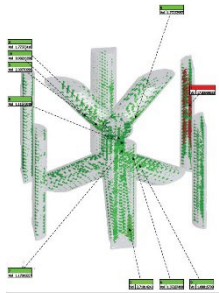


Gregory Dodge

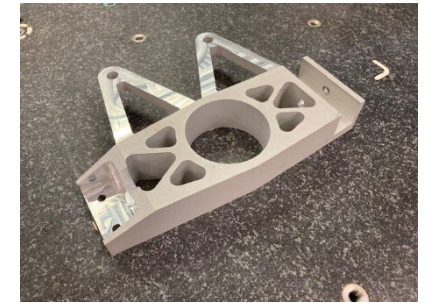
Metal AM Manufacturing

- Pre-Processing
 - CAD Skills – Design for AM (DfAM)
 - File Formats – Quality .stl files
 - Pre-Processing – Magics Software
 - Design for Inspection
 - Design for Simulation and Structural Simulation
 - Build and Parameter Simulation
- Processing
 - Powder Characterization
 - Metal Powder Safety
 - Parameters/build preparation
 - Process monitoring
 - Removing parts
 - Machine cleaning
 - Machine maintenance
- Post-Processing
 - Support Removal
 - Machining
 - Surface Treatment
 - Heat Treatment
- Validation
 - Material Testing
 - Material Characterization
 - Metrology
 - Porosity/Internal Defects

Economic Development



- ***Advanced Manufacturing Company/Industry***
 - New Business Growth within Navajo Nation
 - Expanding Job Opportunities



Engineering/Design

Metal AM Technician

Machinists (Lathe, Mill, EDM)

Metrology/Inspection (programmers and operators)

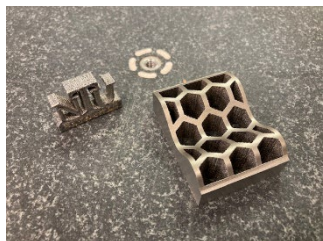
Material Testing

3D Modeling/Simulation

Research & Development

CT Scanning/X-Ray Technicians

- For each Technical Job created, 3 Non Technical Jobs Created Locally



Jobs in Demand within Advanced Manufacturing



Engineering/Design
Metal AM Technician
Machinists (Lathe, Mill, EDM)
Metrology/Inspection (programmers and operators)

Material Testing
3D Modeling/Simulation
Research & Development
CT Scanning/X-Ray Technicians

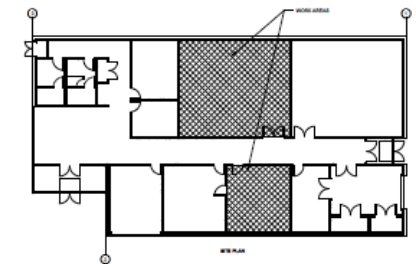
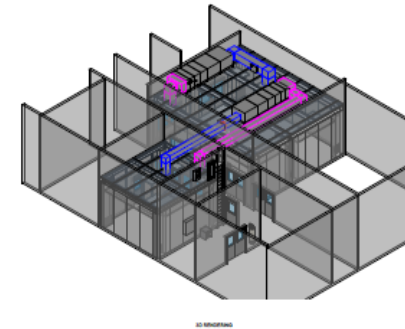
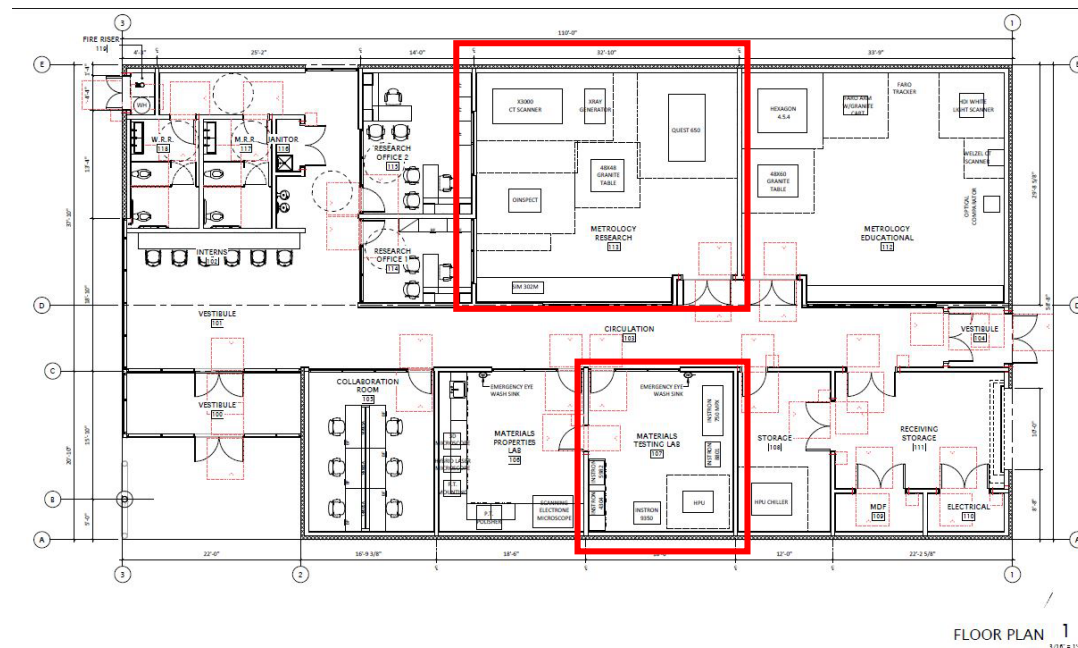


- Manufacturing Technicians in America average **\$64,330 per year** or **\$31 per hour**.
- The top 10% earn over **\$95,000 per year**, while the bottom 10% earn **\$43,000 per year**.



Metrology & Materials Testing Building

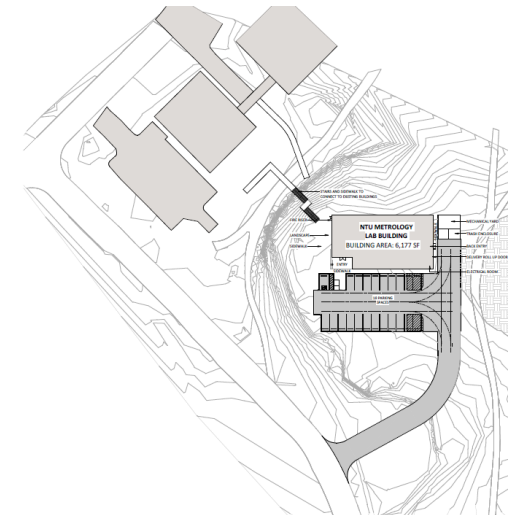
- New Building
- ISO 17025 Certification
- Nadcap Certification
- Metrology lab for research and services
- Metrology lab for education
- Materials testing lab



Building Update



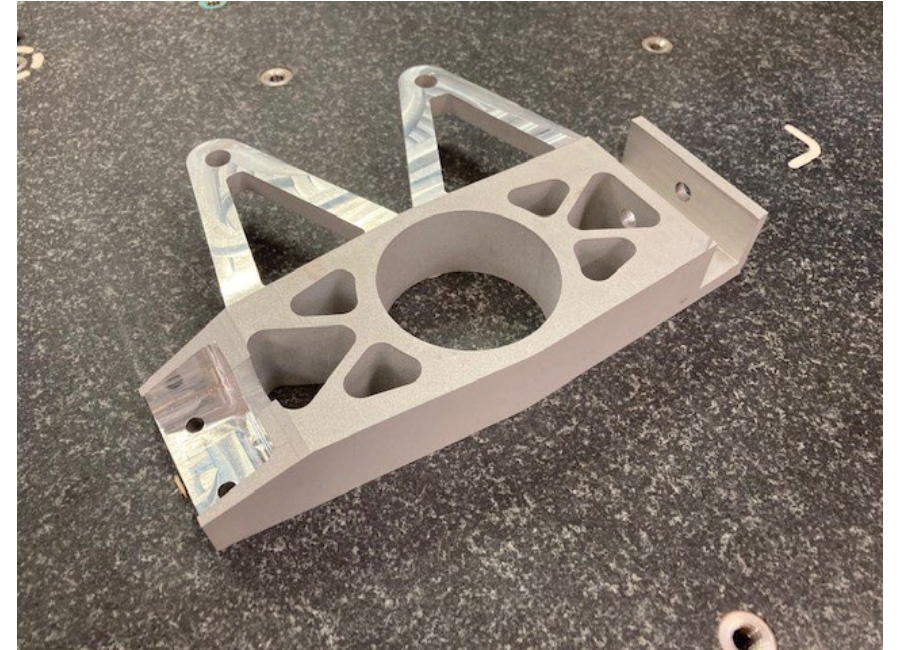
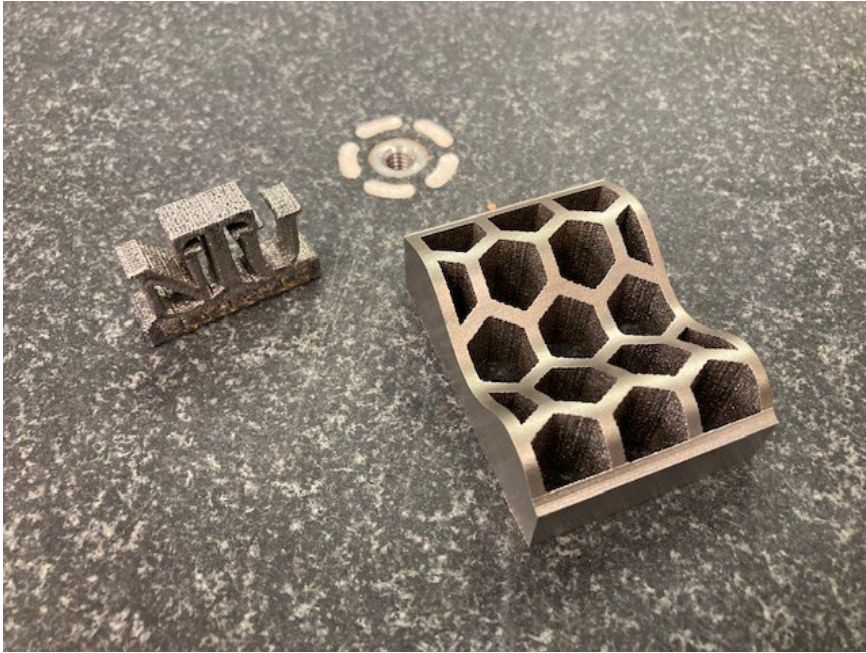
- Navajo Nation Economic Development - \$1.5 million
- Dept of Commerce Economic Development - \$3.3 million
- Needed for conducting services in
 - Metrology/inspection
 - Material Testing
 - Must have ISO 17025 and Nadcap
 - Cannot manufacture without inspection

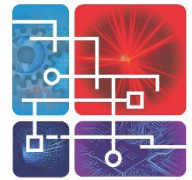


NTU Center for Advanced Manufacturing

- Fabrication Lab (Over \$10 million invested since 2010)
 - Additive Manufacturing (metal and polymer)
 - CNC/Machining & Post Processing
- Metrology and Materials Testing Lab
 - Construction Spring-Spring 2023
 - Metrology Services
 - Materials Testing and Characterization

NTU CAM Products

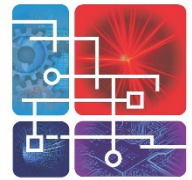




Metal Additive Manufacturing

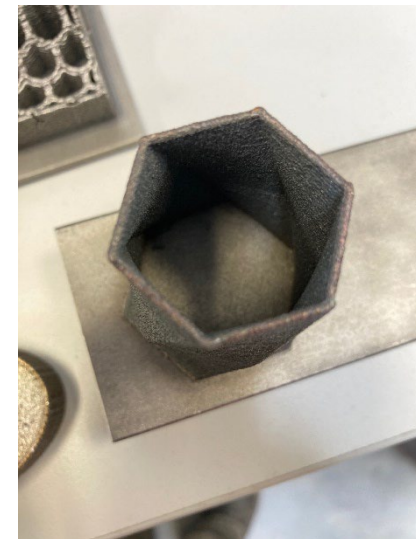
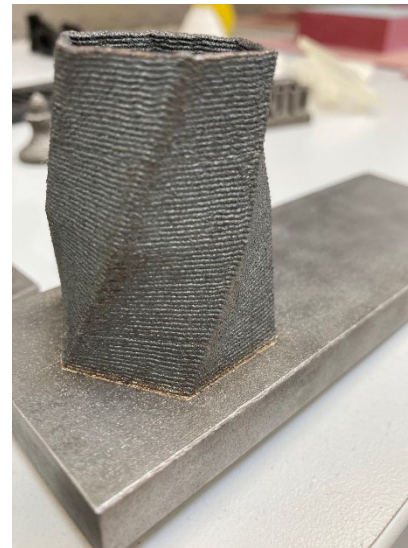
- Optomec MTS 500
 - Direct Energy Deposition (DED)
 - Hybrid – Additive and Subtractive
 - Post Process in situ
 - 350mmx325mmx500mm
 - Closed Atmosphere – reactive metals
 - Infrared Laser – Reflective metals

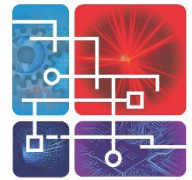




Metal Additive Manufacturing

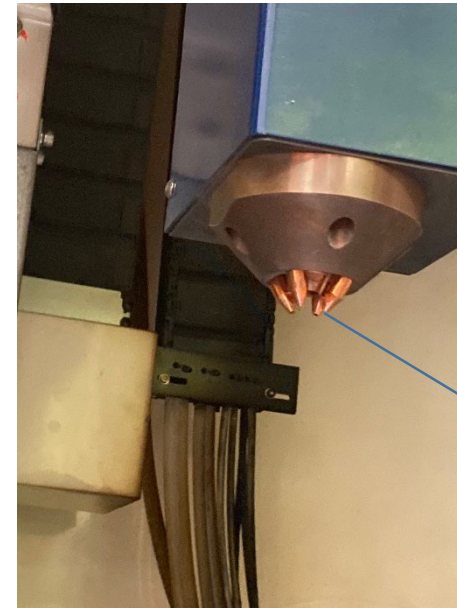
- Optomec MTS 500
 - Fast Deposition rates 0.5 kg/hr
 - Resolution .2 mm (Z)
 - Minimum Wall Thickness 300um
 - Surface Roughness 12-25 um Ra





Metal Additive Manufacturing

- Optomec MTS 500
 - Multi-materials
 - Graded Materials
 - Wear Coatings
 - Printing on Existing Parts
 - Repairs (gears, turbines, etc)

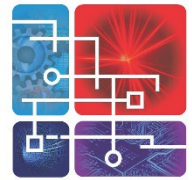


Four nozzles blow metal powder. Laser melts powder at substrate

Mikino U6 EDM

- Electrical Discharge Machining
- High Precision Machining
- Complex Shapes
- 1000mm x 800mm x 420mm
- 3,300 lbs Capacity

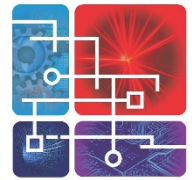




HAAS Mill & Lathe

- CNC Machining
- 16"x12"x10"
- CNC Turning
- 16"x30"

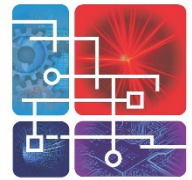




Horizontal Band Saw

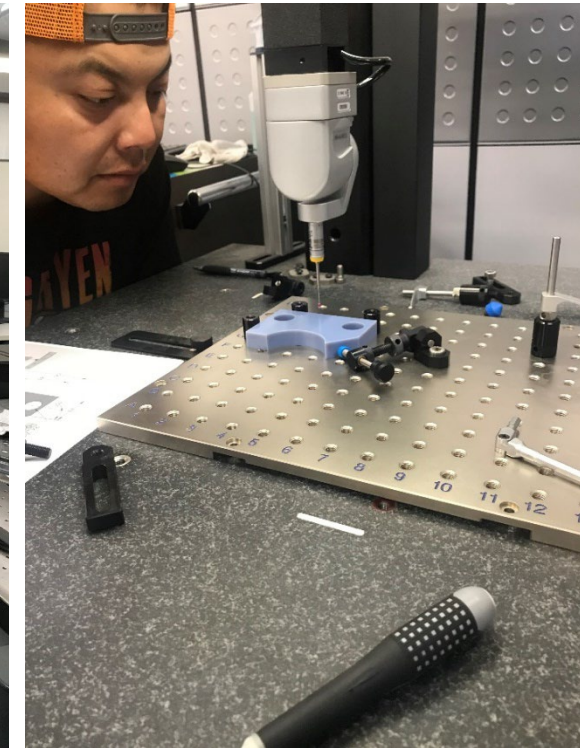
- CNC
- 12"x10.25"x10.25"



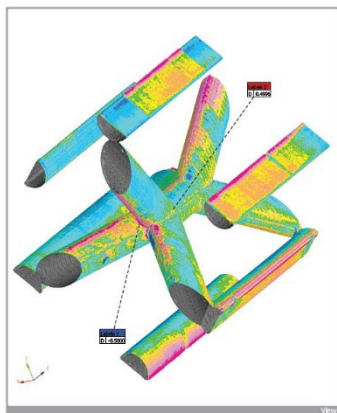
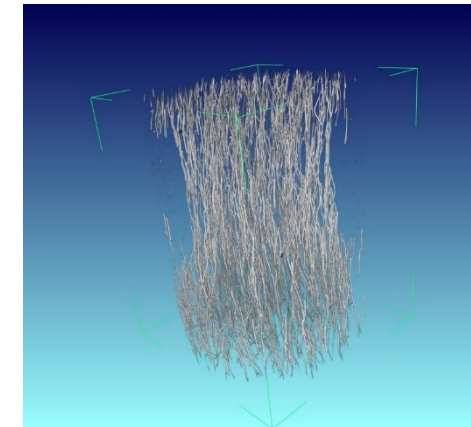
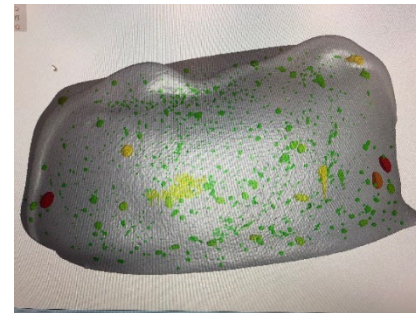


Metrology

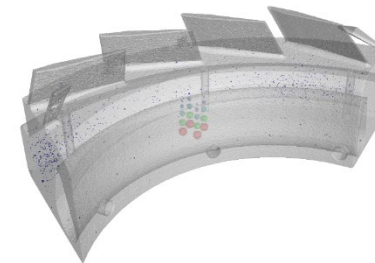
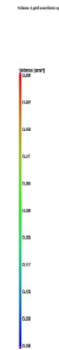
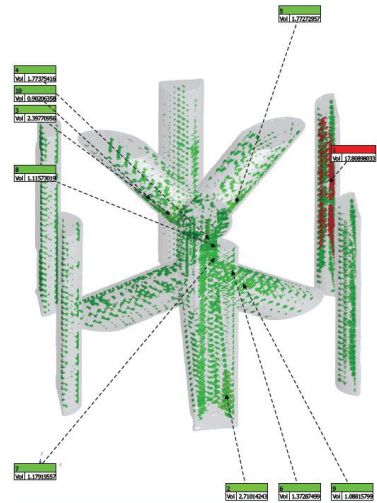
- Metrology
 - Hexagon 4.5.4 CMM
 - Zeiss O-Inspect CMM
 - FaroArm/Scanning
 - Faro Tracker
 - NSI X3000CT Scanner
 - Keyence 3D Microscope



CT Scanning

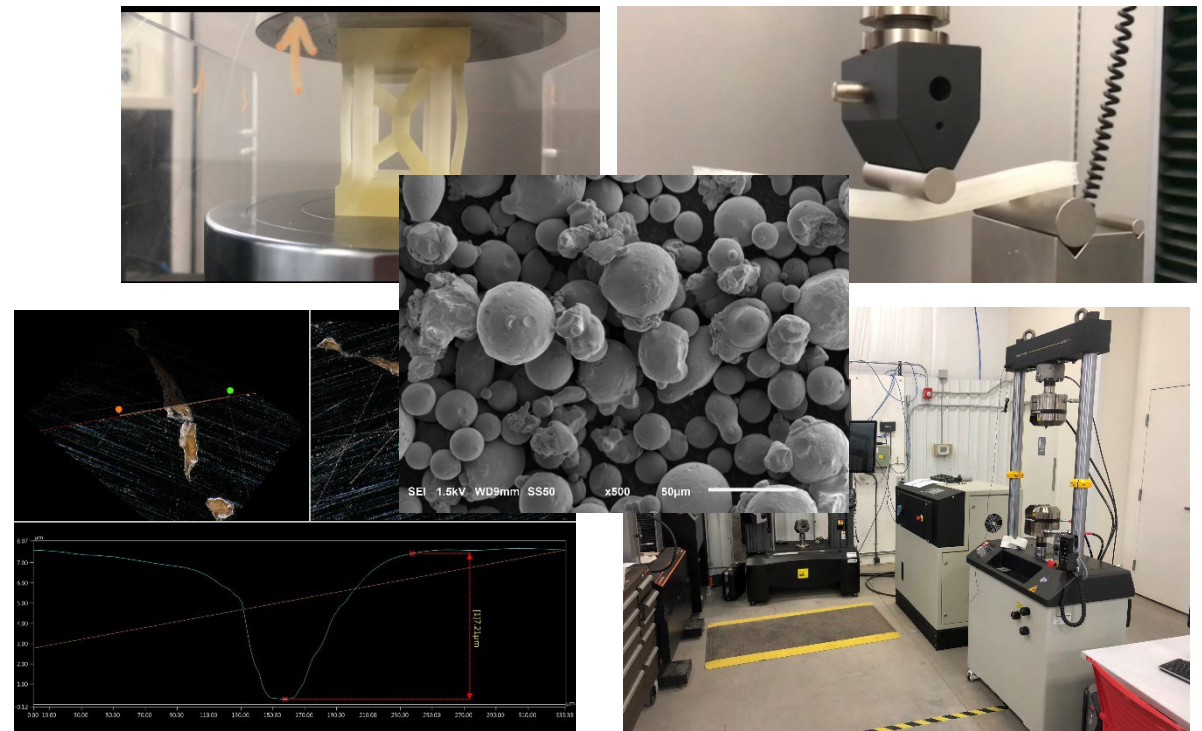


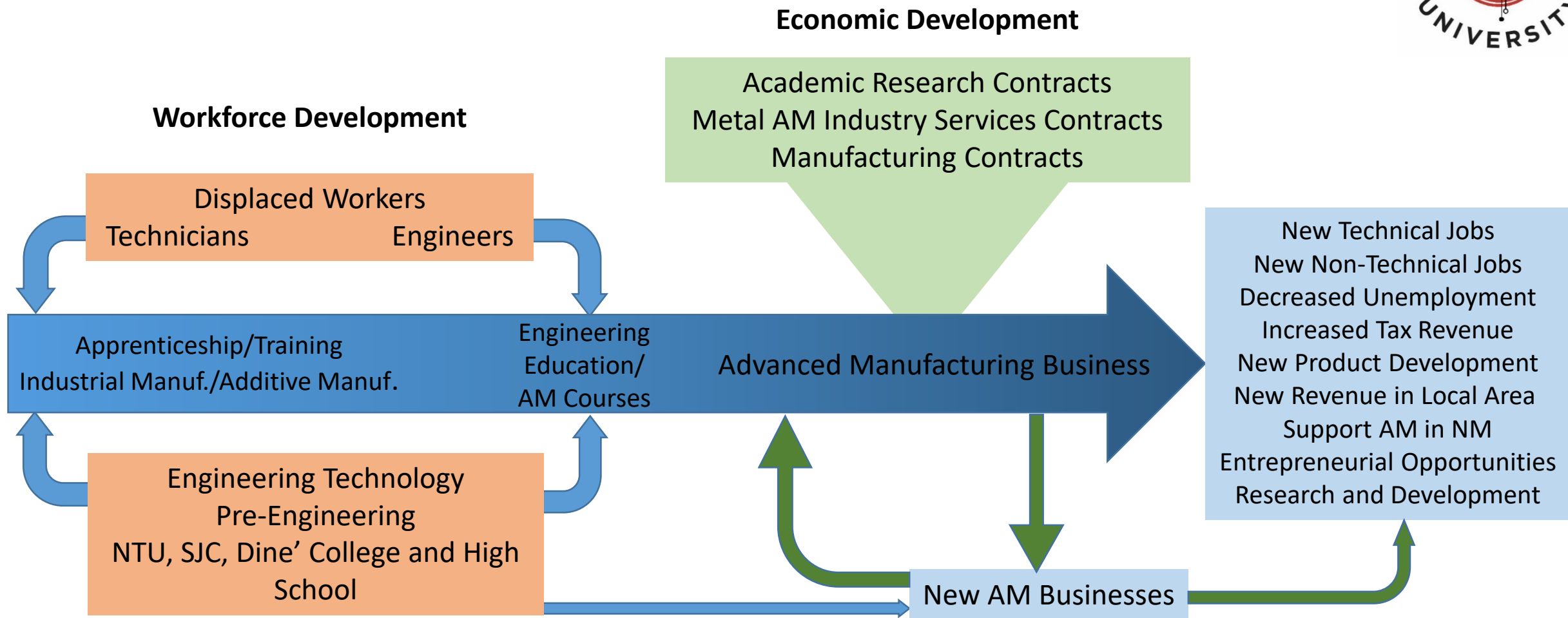
Heat map with the darkest blue symbolizing -0.500 and the darkest red representing +0.500 from the CAD model.
The intervals of the colors is scaled as follows:
+/- 0.500
+/- 0.300
+/- 0.150
+/- 0.075
+/- 0.025
0.000

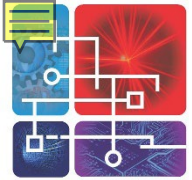


Materials Testing Lab

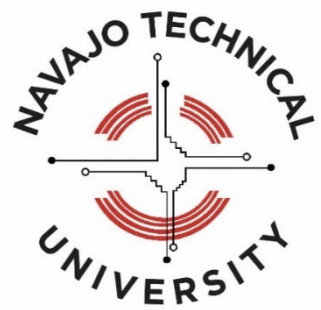
- Materials Testing & Characterization
 - Instron Tension/Compression
 - Instron Dynamic Testing
 - Cutoff Saw
 - Mounting
 - Polishing
 - Etching
 - Keyence 3D Microscope
 - ARAMIS DIC
 - Jeol SEM







Center for
Advanced
Manufacturing



Contact Information

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505.409.1451