America Makes

Additive Manufacturing Strategic Development and Opportunities for Engagement

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Information Classification: General

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America Makes – Who We Are

- OIB and DIB Modernization and Scale-up partner
- Public-Private-Partnership focused on delivering Additive and Adaptive Manufacturing Innovation
- Expanding collaboration with non-traditional partners
- Voice-of-Industry with access to available technologies and capabilities
- Industry-grounded Additive Manufacturing EWD programs
- Effective and efficient program management and execution



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Institute Strategic Focus Areas – Scope and Boundaries

What is the Institute vs. What it is not

Technology Development

We do…
- Gather needs and gaps from technology ecosystem
- Establish priorities
- Structure and integrate with Technology and Standards Roadmaps
- Execute member-driven research at address priority needs
- Disseminate data to the ecosystem
- Strategically partner to scale our programs

We do not…
- Perform research internally at our facility/lab
- Perform printed flexible electronics, bio-printing

Education and Workforce Development (EWD)

We do…
- Maintain the Additive Manufacturing Body of Knowledge
- Identify gaps and best practices through assessments across industry
- Maintain and prioritize needs within the EWD Roadmap and Heatmap
- Generate reusable EWD inventory assets accessibly both internally and external by membership
- Strategically partner to scale our programs and minimize our staff

We do not…
- Sell training
- Venture beyond AM and the enabling technologies/software/hardware

Industrial Base Integration

We do…
- Maintain a diverse ecosystem consisting of technology providers, equipment and material providers, users, system integrators, thought leaders and researchers
- Support the ecosystem development to address the needs of various industries
- Align regional networks to assess and address supply chain needs and gaps
- Strategically partner to scale our programs

We do not…
- Solve everything ourselves. Effective partnership (e.g., AMGTA, AMT, etc.) is a necessity to accelerate adoption and effectively deploy scarce resources

The opportunity with additive manufacturing is vast, therefore it is critically important that we establish boundaries.

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Technology is More Than Research

Convene

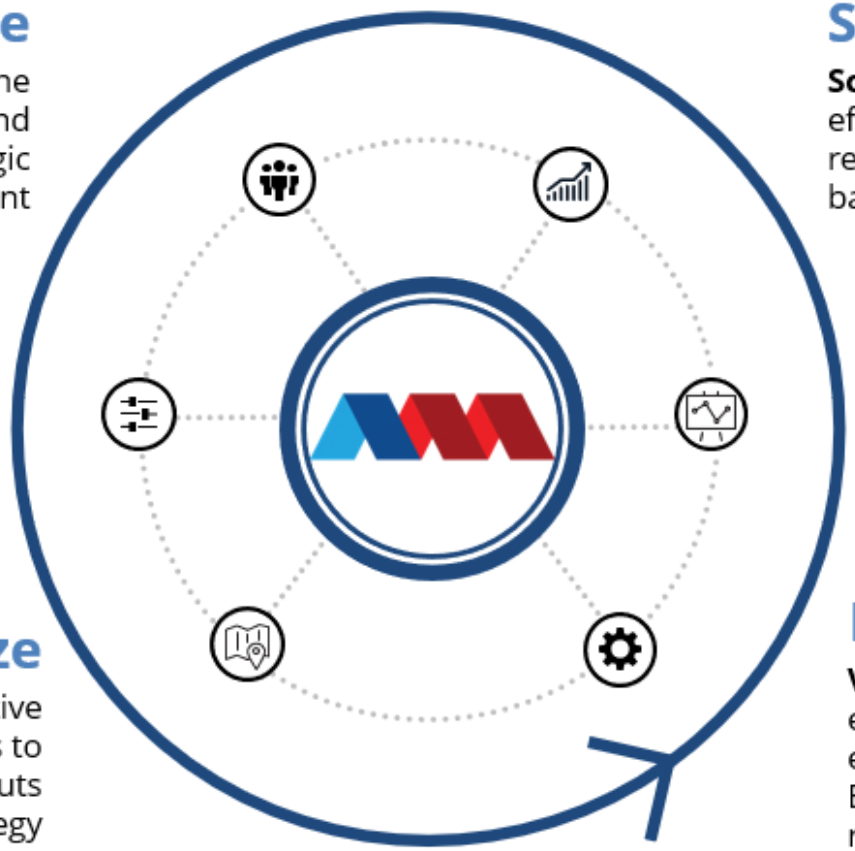
Membership engagement captured as the voice of industry via roadmaps, working and advisory groups, workshops and strategic account management

Identify

Understand and **document** the **strategic needs** and gaps while serving as an unbiased convener to ensure comprehensive perspectives are considered

Prioritize

Strategic prioritization through pre-competitive roadmaps and national investment plans to reduce barriers, connect dots, and curate inputs to ensure an effective national strategy



Scale

Scale and amplify impacts through effective reuse of pre-competitive research, training assets, and industrial base integration programs

Disseminate

Thought leadership, shared through CORE data repository, Technical Review and Exchange, Strategic Communications, standards, conferences, events, and publications

Execute

Verify and validate results, execution excellence in managing member-lead efforts addressing prioritized research, EWD, and Industrial Base Integration requirements

We maintain a practice which coverts strategic priorities into delivered capabilities

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Motivations and Trends

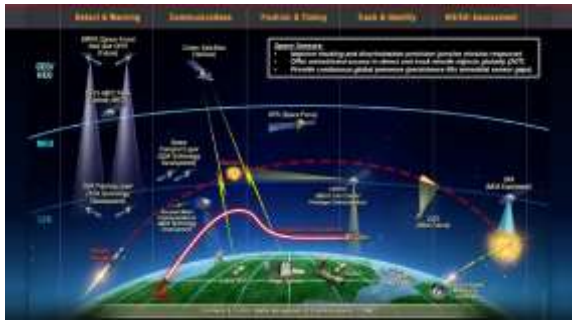
Digital engineering, data analytics, and AM are changing how we operate

DoW CONOPS



https://www.navsea.navy.mil/Portals/103/Images/NSWC_Dahlgren/LeadingEdge/IandI/Ormsby/Figure3_large.jpg

Defense and Commercial Space



Phil Hansen, Program Manager HBTSS, MDA/SS

IoT in Manufacturing



Microsoft

Supply Chain Shortages



Solving Manufacturing Labor Shortages Through Digital Transformation

Rich Crawford Forbes Councils Member
Forbes Technology Council COUNCIL POST | Membership (Fee-Based)

Forbes.com

DoW A&S Programs



Commercial Operations



Shell.com

Additive manufacturing offers substantial advantages in each of these opportunity spaces

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Why aren't we done yet?

Important things still need to be solved in all three strategic focus areas: Technology, EWD, and Ecosystem Development

Challenges

- Repeatability and reproducibility
- **Qualification**
  - Material
  - Process
  - Product
- **Qualification cost and efficiency**
- **Inspectability – technology and efficiency**
- Fracture critical parts
- Certification
- Cost and cost reduction
- **Scaling to full production**
  - Equivalence and requalification efficiency
- Can vs. should
- Access to capital
- **Vendor qualification**

Known Limitations

- **Limited number of commercially available materials**
- **Limited number of qualified sources of supply**
- Limited knowledge base
- Limited implementation of DFAM
- **Limited trained workforce**
- Limited manufacturing operations experience
- **Limited size of parts**
- Limited feature sizes (e.g. section thickness)
- Most suited towards high mix, low volume applications
- **Serviceability, maintenance, and limitations** not well understood

These challenges and limitations are recurring in numerous markets and industries leading to product development delays or even abandonment

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Ruggedizing Market Development through Adaptive/Agile Manufacturing

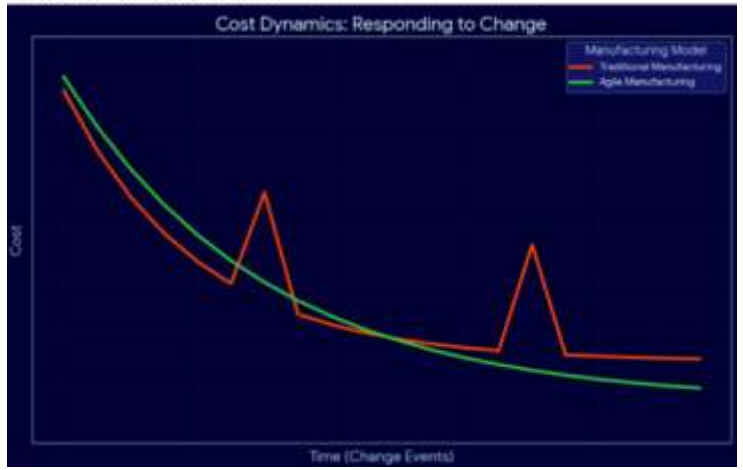
New opportunity space and role for America Makes

- Enabling adaptable production capabilities to meet a variety of customer needs
  - Convergent/hybrid manufacturing
  - Robotics/automation
  - AI
  - Advanced materials
  - Digital design methods
  - IoT
  - Modular manufacturing
  - Advanced controls
- Focus on realized benefit of integration vs. development of individual technologies
- Opportunity to expand collaboration
- Existing efforts - IMPACT 3.0, DAWGS …



https://digiqt.com/blog/ai-use-cases-in-defence-manufacturing/

Conceptual Cost Chart



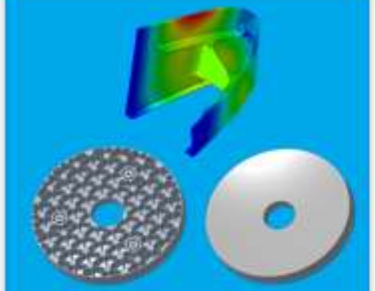
Maness, Agile Manufacturing (AFRL), America Makes Spring TRX 2026

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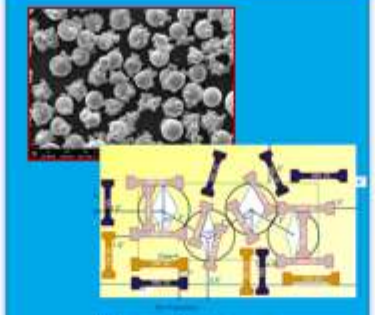


AMNOW

Supply Chain & Sourcing



Design Methods



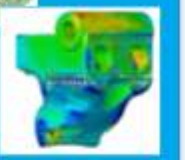
Material Qualification





Product Qualification





Inspection/ Certification





Business Case

Key Investment Areas Impacting Supply Chain Readiness at a National Scale

Strengthen Warfighter Capability Needs and Domestic Manufacturing Competitiveness

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Alignment of Existing Research Portfolio to DoW Priorities and U.S. Government Policies



Maritime Industrial Base

- AM HY-80 Heat Treatment - SWAAHT
- Wire Arc AM Qual and Digital Twin
- AM application development

https://en.wikipedia.org/wiki/Virginia-class_submarine



Missile Defense

- AXIOM
- CP1 Large Scale AM for radar apps
- AM for high-speed propulsion intercept
- High performance electronics
- Hybrid manufacturing

https://www.aerospacetestinginternational.com/opinion/golden-dome-an-aerospace-engineer-explains-the-proposed-us-wide-missile-defense-system.html



Unmanned Aircraft Systems

- Advanced Manufacturing Confluence
- Large scale AM non-metallic materials
- Advanced manufacturing airworthiness – DAWGS
- AM composites roadmap

https://3dprint.com/308226/firestorm-gets-12-5m-from-lockheed-and-others-to-automate-drone-production-with-3d-printing/



Qualification of Alt. Sources/Critical Materials

- Data-driven Qual, Delta Qual, JAQS, PACQS, Operational Qualification, AAMI, Watchlist
- JMADD, GAMAT, PODS
- PADAM, CAPP, Refractory Alloy Demand Assessment

https://ezassi.com/advanced-manufacturing/



AI and Autonomy

- Data management
- AI/ML for AM qualification and data generation
- Closed loop control
- Advanced quality control and assurance, Trusted Metal AM

https://defensescoop.com/2023/09/01/inside-the-dods-trusted-ai-and-autonomy-tech-review-that-brought-together-hundreds-of-experts/



AM for Propulsion Applications

- Large scale AM
- High temperature material AM
- Joining, Finishing, and Coating
- Heat pipe qualification
- AM for propulsion systems qualification, ground and flight testing

https://www.armscontrol.org/act/2022-05/news/aukus-collaborate-hypersonics



Casting and Forging

- Sand and Investment Casting
- Forging Dies and Forging of AM preforms
- Hybrid manufacturing
- Industry 4.0 integration – productivity and yield improvements



Indo-Pacific Advanced Manufacturing

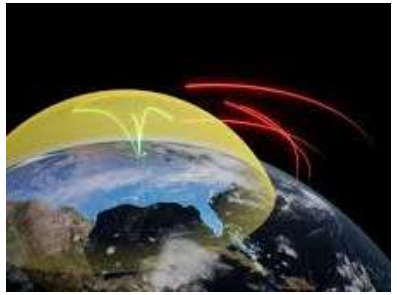
- Common AM Qual Template
- Expeditionary 3D printer
- Regionalization efforts

https://en.wikipedia.org/wiki/United_States_Indo-Pacific_Command

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Opportunities for AM Ceramics

Missile Defense



https://spacenews.com/how-golden-dome-could-make-nuclear-weapons-irrelevant/

UXVs



https://3dprint.com/308226/firestorm-gets-12-5m-from-lockheed-and-others-to-automate-drone-production-with-3d-printing/

Casting



Quantum Sensing and Computing



https://www.citigroup.com/global/insights/quantum-sensing-tech-s-new-eyes-and-ears

Directed Energy



https://www.kingsresearch.com/blog/top-10-innovators-propelling-directed-energy-weapons

Hypersonics



https://defense-update.com/20190830_lockheed-martin-dynetics-to-develop-a-hypersonic-missile-system-for-the-us-army.html#google_vignette

Additive manufacturing offers substantial advantages in each of these opportunity spaces

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Process Development Results: A-10 Control Input Arm DDM Process Flow from Design to Casting

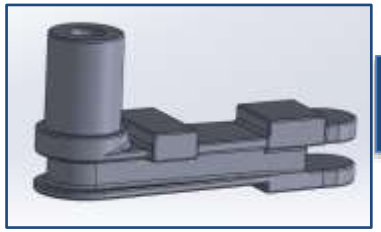


Fig. 7: Design: As-Received Casting Model. (DDM Systems)

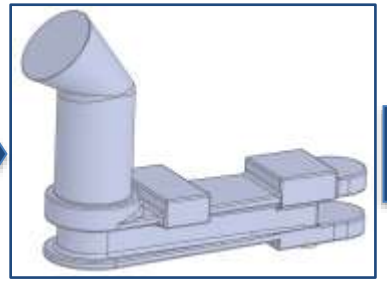


Fig. 8: Design: Gating Augmented Casting Model. (DDM Systems)

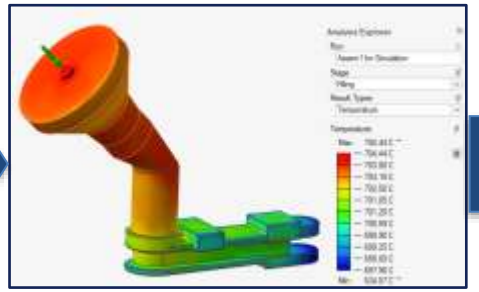


Fig. 9: Casting Simulation: With Pour Cup Stock. (DDM Systems)



Fig. 10: Shell Design: Rev.10. (DDM Systems)



Fig. 11: Printing: Shell Rev.10. (DDM Systems)



Fig. 12: Firing: Shell Rev.10. (DDM Systems)



Fig. 13: Metal Pour: Prepped Mold. (DDM Systems)

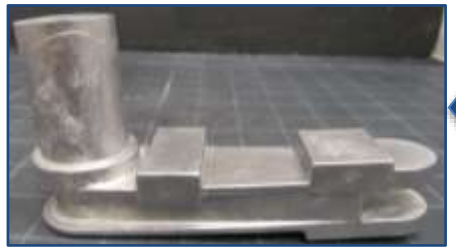


Fig. 14: Casting: A-10 Control Input Arm. (DDM Systems)

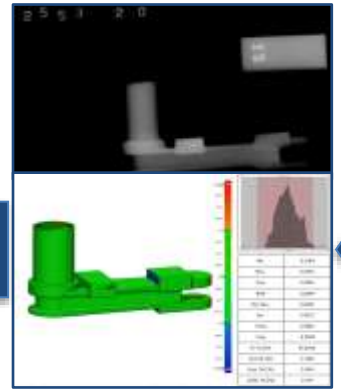


Fig. 15: Qualification: Radiography & Metrology. (DDM Systems)

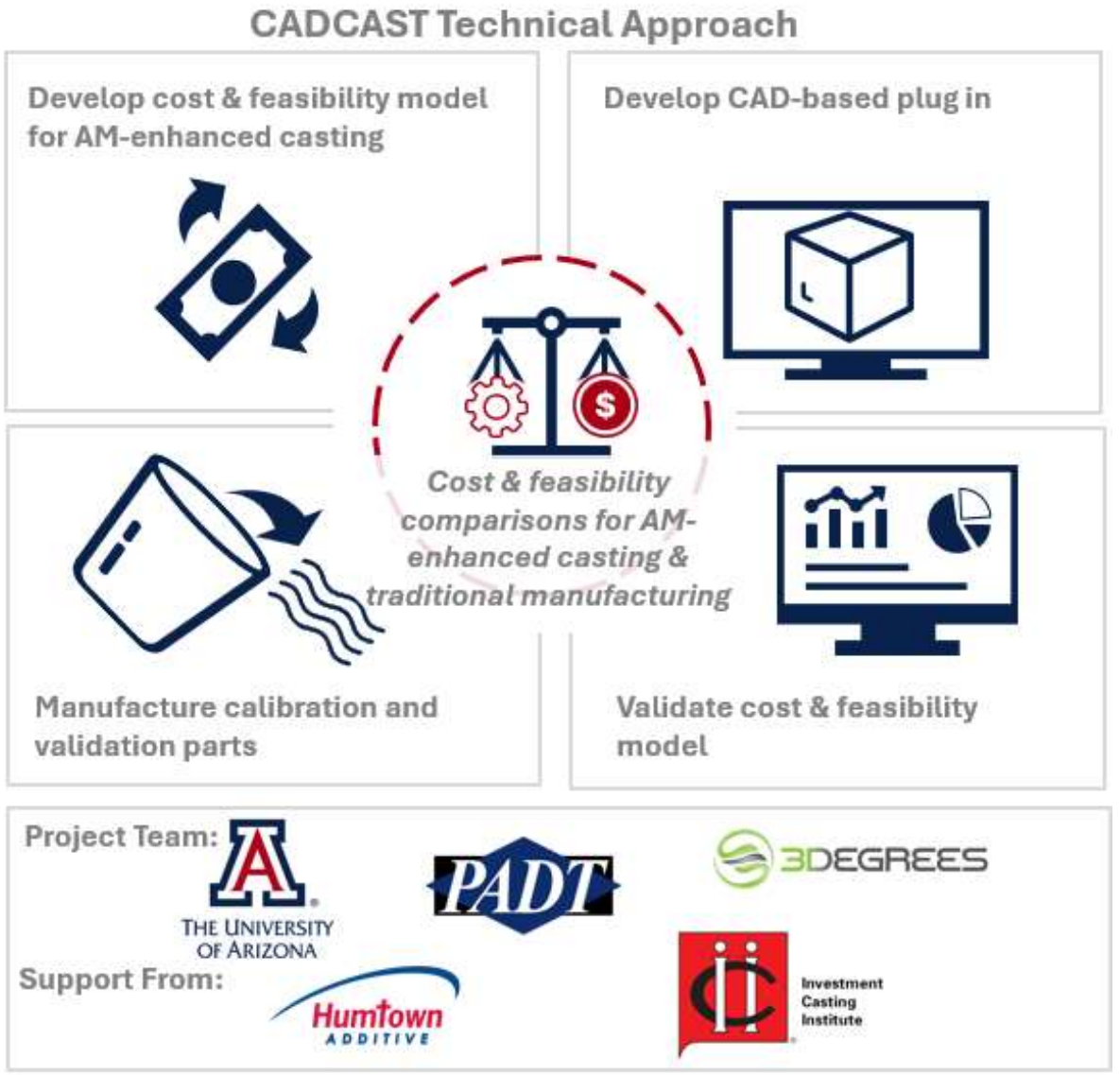


Fig. 16: Qualified Machined Castings. (DDM Systems)

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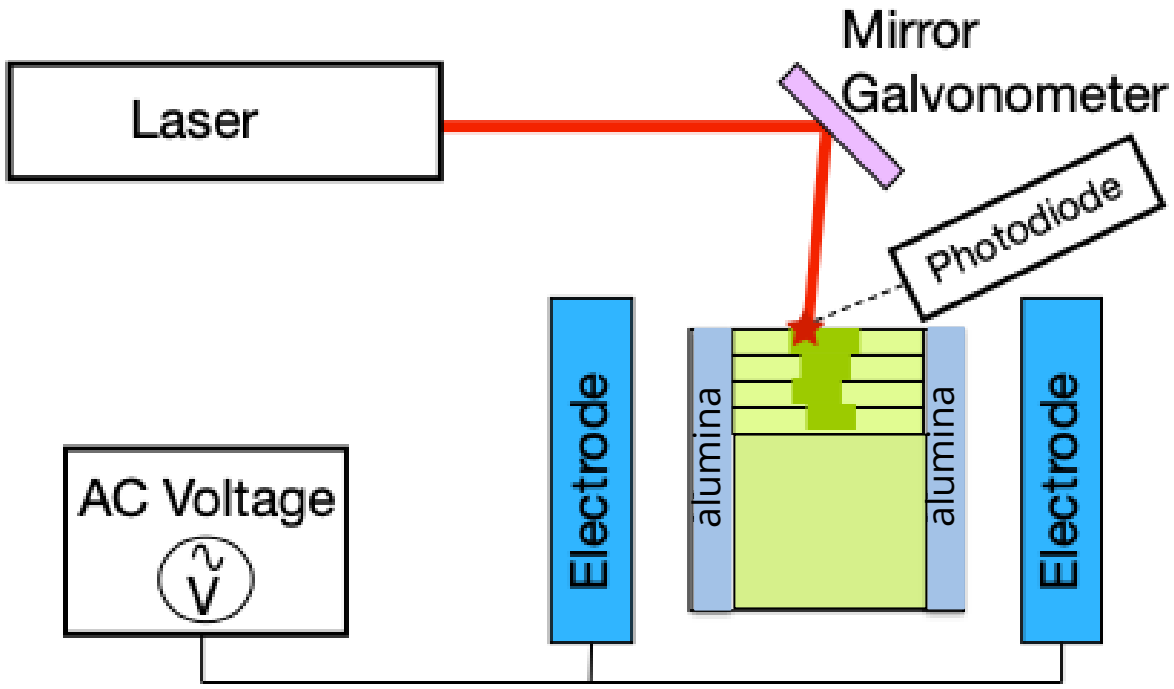
Technical Approach – Overview

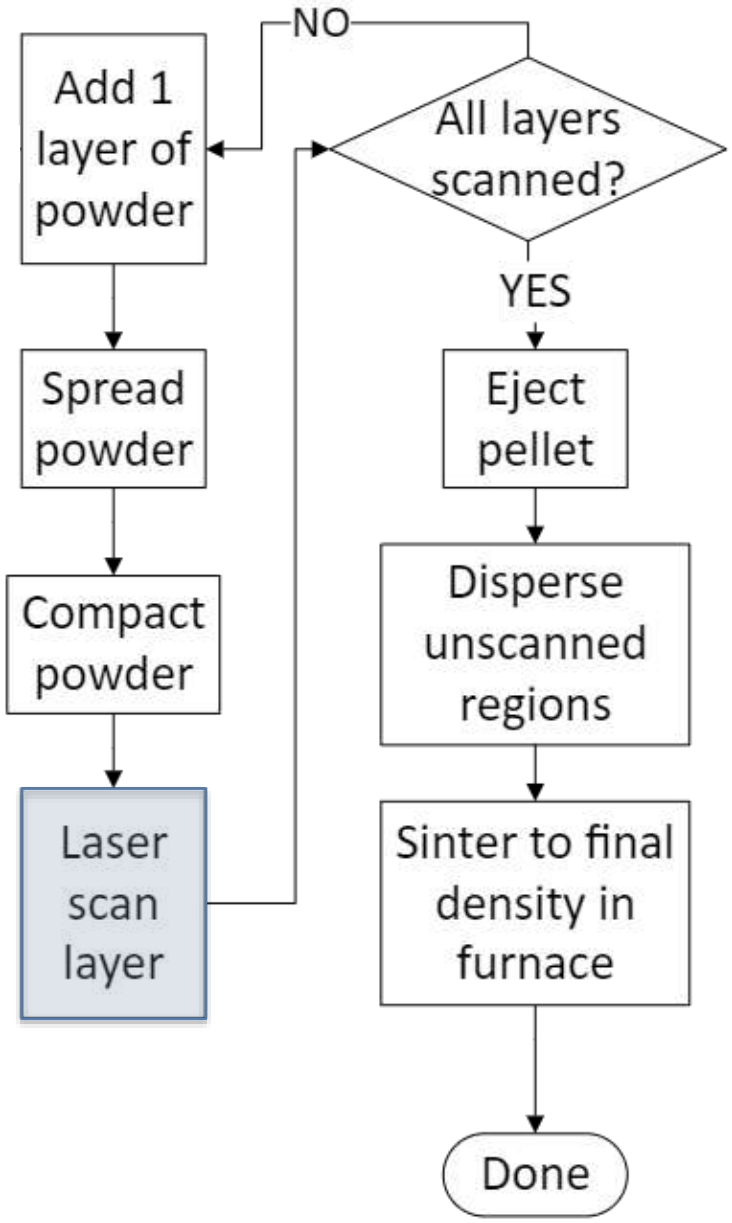
- Four key tasks:
  1. Develop cost and feasibility models for AM-enhanced casting
  2. Develop CAD-based plug in
  3. Manufacture calibration and validation parts
  4. Calibrate and validate cost and feasibility models



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Binderless Additive Manufacturing of Ceramics by Selective Laser Flash Sintering





Process variables: 1. Laser power, 2. laser scan speed, 3. E-field strength, 4. E-field AC frequency

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Affordable and Agile Composite AM Structures

- What is CFAM?
  - For the purposes of this roadmap study, CFAM includes any process capable of depositing an unbroken fiber and polymer matrix into a 3D part.

- Problem Statement
  - Continuous Fiber Additive Manufacturing (CFAM) provides decisive advantage by enabling lightweight, structurally optimized composite parts and vehicle structures to be digitally designed, fabricated, and iterated at mission speed—without reliance on long-lead tooling or labor-intensive hand layup. Accelerating CFAM capability to the field requires strongly coordinated and well-guided investments to rapidly evolve a robust supply chain that offers agile and routine engineering production.

- Objectives
  - Gather deep insight from the entire industry and translate it into a broadly vetted, unbiased industry and government
  - roadmap—with clearly articulated shortfalls for specific CFAM applications and recommended project concepts.

- Project Benefits
  - Eliminate the shortfalls and accelerate the proliferation of CFAM in the Aerospace industry to rapidly evolve a robust supply chain that offers agile and routine engineering production.

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ACAMS (CFAM-AIR) Event Schedule – Join Us!

Technology Workshops :

- ✓ March 24, 2026 - Wichita State University/NIAR in Wichita, KS
- ✓ April 9, 2026 - University of Delaware in Newark, DE
- May 6, 2026 - Eastern Washington University in Cheney, WA

Application Workshops:

- May 27, 2026 – University of Southern California in Los Angeles, CA – Defense Focus
- July 7, 2026 – University of Washington in Seattle, WA - Commercial and Aviation Focus

Refinement Workshop:

- Wednesday September 2nd in Dayton, OH





CFAM-AIR Workshop Attendee Interest Form (America Makes AACAMS Project) Respond by 3/06/26 – Fill out form [forms.office.com]

Dennis Butcher, dennis.butcher.1@us.af.mil
G.P Tandon, gyaneshwar.tandon@udri.udayton.edu
Steven Floyd, steven@floydtechconsulting.com
John Martin, john.martin@ncdmm.org
Scott Crynock, scott.Crynock@ncdmm.org

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High Velocity Erosion (HiVE™) Testing Capability

Provide the defense industrial base with a high-speed evaluation, analysis, and prediction solution that is:

- Cost-effective • Long-duration • Ground-based

- Self-contained, mobile test environment to evaluate materials for high-speed atmospheric flight

- Continuous stream of erosive particulates entrained in a high-velocity, high-temperature gas stream

- System assembly complete

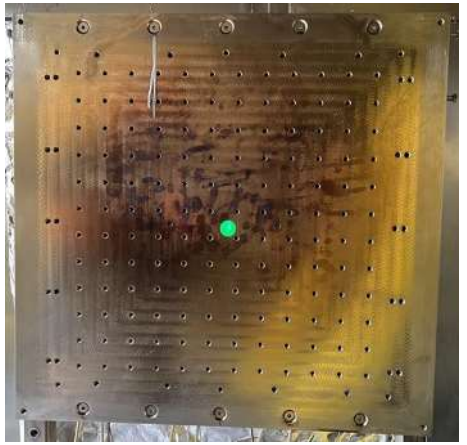
- Test station assembly is complete

- Sample heater operation verified, testing to identify operational capabilities underway

- MIL-STD-3033 equivalence testing 90% complete



HiVE™ system test cell layout.



Sample heater with pyrometer laser alignment visible.

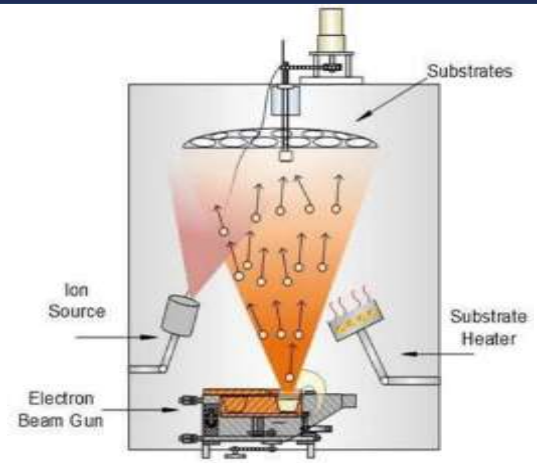


Post-test samples demonstrating application uniformity on Polymethylmethacrylate (PMMA) (left), and Aluminum 7075-T6, shown with the cover plate installed (middle), and with the cover plate removed (right).

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Advanced Optical Coatings

- Optical coatings enhance or suppress reflection, transmission, absorption, or polarization of light.
- Evaluate Electron Beam Ion-Assisted Deposition (E-IAD) for optical coating applications.
- Optical Coating Design + Electron Beam Ion-Assisted Deposition for Anti-reflection (AR) coatings
- Modeling and recipe refinement for <2% reflectivity target.
- Deposited coatings to be tested for environmental durability with Mil-Spec C 484987
- Adhesion • Abrasion • Temperature Cycling • Humidity
- Target wavelength ranges:
- Visible (Vis): 450 – 700 nm
- Minor increases after Mil-Spec thermal cycling.
- Near IR (NIR): 1 – 1.2 µm (Mil-Spec testing TBD).
- Long-wave IR (LWIR): 8 – 12 µm (in progress).



A diagram of E-IAD depicts the two methods used to apply the coating, the ion source and the e-beam gun on the target.



The Syrus E-IAD coating chamber is shown.



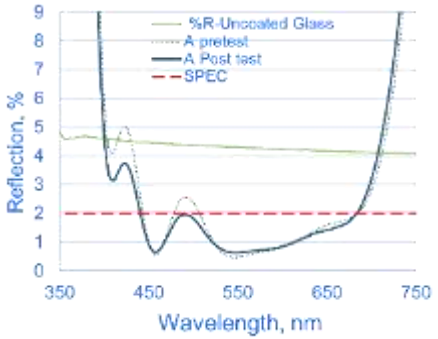
Vis AR-coated slides are visible in the environmental testing chamber.

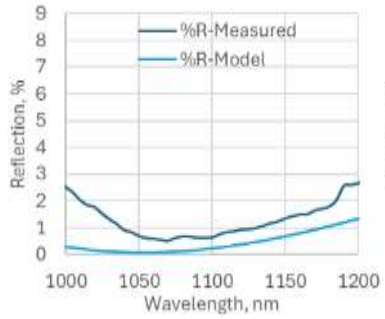


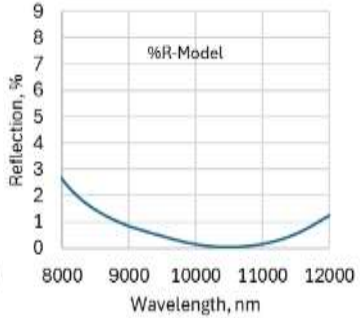
NIR AR-coated slides are shown.



LWIR AR-coated Si wafer is shown.



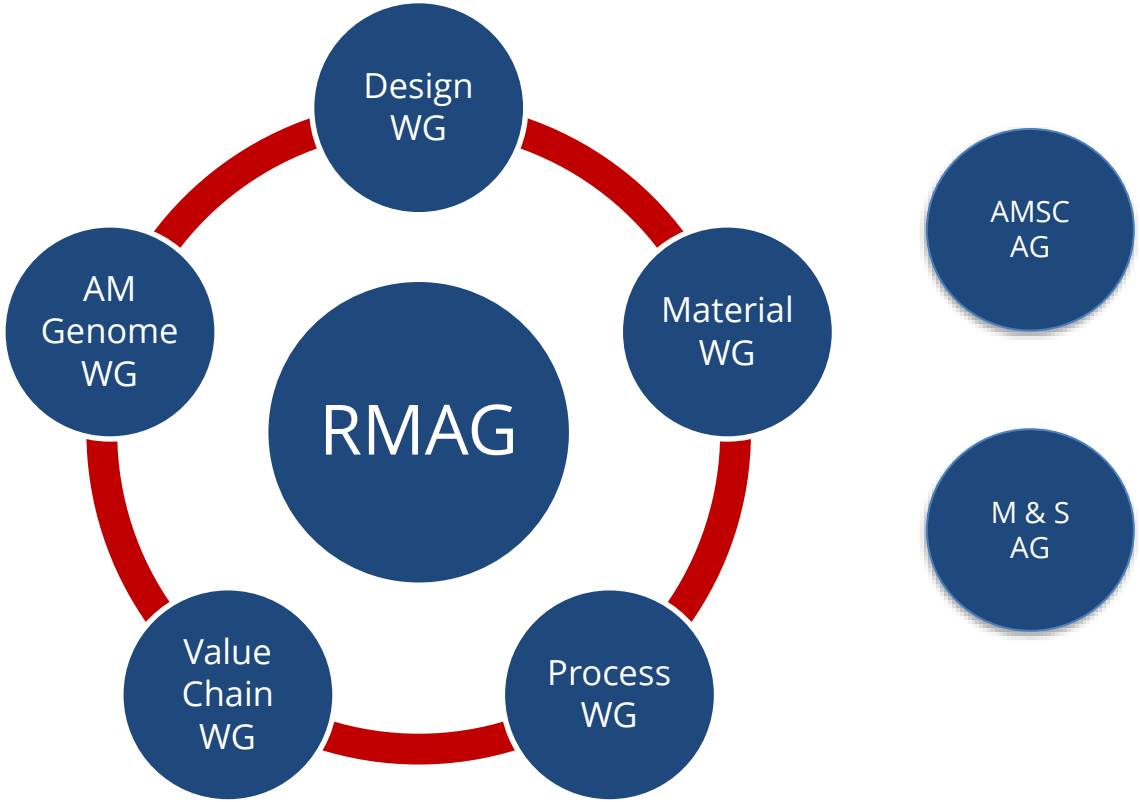




Information Classification: General

Structurally Designed to Engage the Necessary Skills and Expertise to Ensure Success

Addressing manufacturing technology, operations, and standardization



Information Classification: General

Sources of Project Focus and Support – Project Types

Not all America Makes projects are supported using core funding

Core-funded

RIC - Government



- Rapid Innovation Call
- Government-identified, industry-prioritized focus
- Competed
- Short duration
- 5 – 7 months
- ≤ $100K

RIC – Non-Govt



- Rapid Innovation Call
- Non-government-identified, industry-prioritized focus
- Competed
- Short duration
- 5 – 7 months
- ≤ $100K

Open Project Call



- Open Project Call
- Working group identified focus
- RMAG prioritized
- Competed
- Short duration
- 5 – 9 months
- ≤ $500K

Directed Project



- Focus defined by a government partner
- May or may not be competed
- 12 – 27 months
- $200K - $6M+

Congressional Appropriations



- May or may not be competed
- 12 – 27 months
- $200K - $10M+

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How does the next 18 months look?

Contract Vehicles

- New Cooperative Agreement – FY 27
- New Contract Vehicle – FY 27

- Expanded opportunities
  - Beyond prototyping
  - Classified effort
  - Proprietary effort – novel IP terms and conditions

Product Qual. Centric Efforts

- Identifying components on various platforms

- Part family approach to qualification

- Material and processing development

- Validation through manufacturing and product qualification

Supply Chain Development

- Creating resources for workforce development

- Public-private partnership
  - OIB modernization

- Supplier development and qualification

- Disseminating demand signals

- Informing supply chain partners
  - Demand forecasting

An expanding array of opportunities exist on the horizon…please continue to engage and stay tuned for further information

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How to Get More Information?



- Our website (AmericaMakes.us) is a great way to learn more, stay up to date
- Use the QR code to sign up for news and announcements

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When America Makes America Works

America Makes

AmericaMakes.us @AmericaMakes /AmericaMakes

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