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# Strengthening DOD Castings and Forgings Supply Chains: Scaling Up and Industrializing Large-Scale Additive Manufacturing(AM) and Next-Generation Hybrid AM Processes

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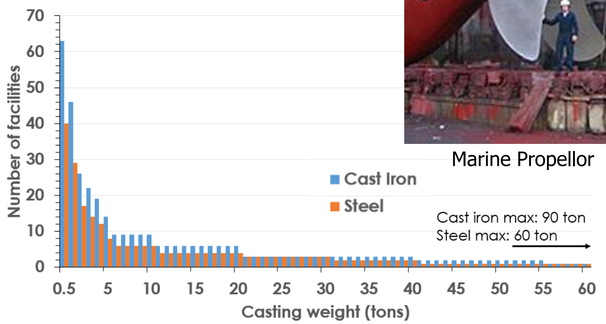
## Hybrid multi-process AM systems will enable domestic production of critical energy and national security metallic components

**Problem: Domestic foundry industry lacks high-tonnage capacity and workforce**

- Labor and regulatory costs have led to foundry offshoring
- Minimal domestic capacity remains for >1 ton infrastructure-scale castings

Marine Propellor

Hydropower Francis runner




**Supply chain issues impact critical energy and national security components**

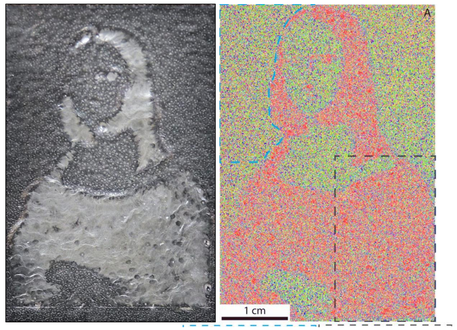
## Production Modalities

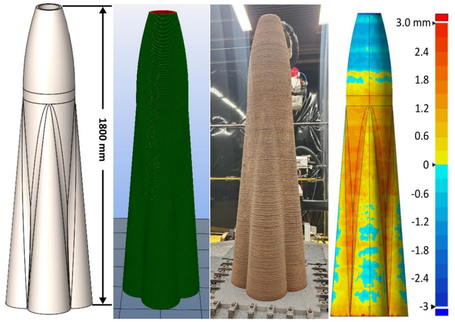
**Repair & Life Extension**
- ✓ Precise Material Placement
- ✓ Single-setup Process
- ✓ Reduced Down-time

**Feature Addition**
- ✓ Leverages Existing Castings/Forgings
- ✓ Minimizes Printed Material
- ✓ Multi-Material Performance

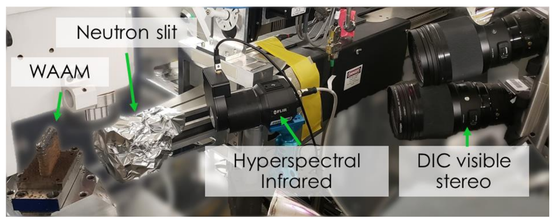
**Direct Manufacturing**
- ✓ Casting/Forging Replacements
- ✓ Rapid Prototyping
- ✓ Mitigates Disjointed Processing

## Maximizing productivity with hybrid AM: combine processes for productivity + resolution

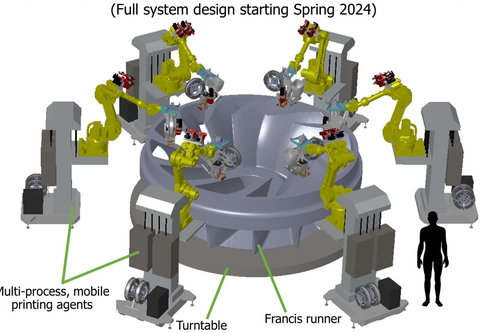


(a) As modeled (b) As sliced (c) As printed (d) As scanned




**Hydropower runner manufacture via hybrid AM**
(Full system design starting Spring 2024)

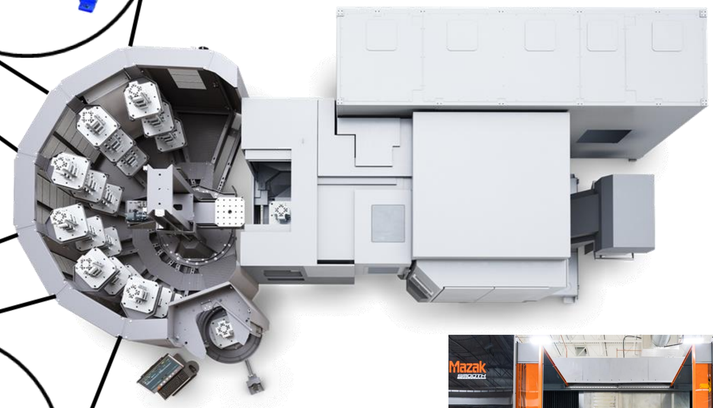



## Flexible Future FOUNDRIES

PREFORMING


MICROSTRUCTURE ENHANCEMENT

FINISHING



INSPECTION