ENDLESS FORGE

Battlefield Responsive Manufacturing For The Warfighter

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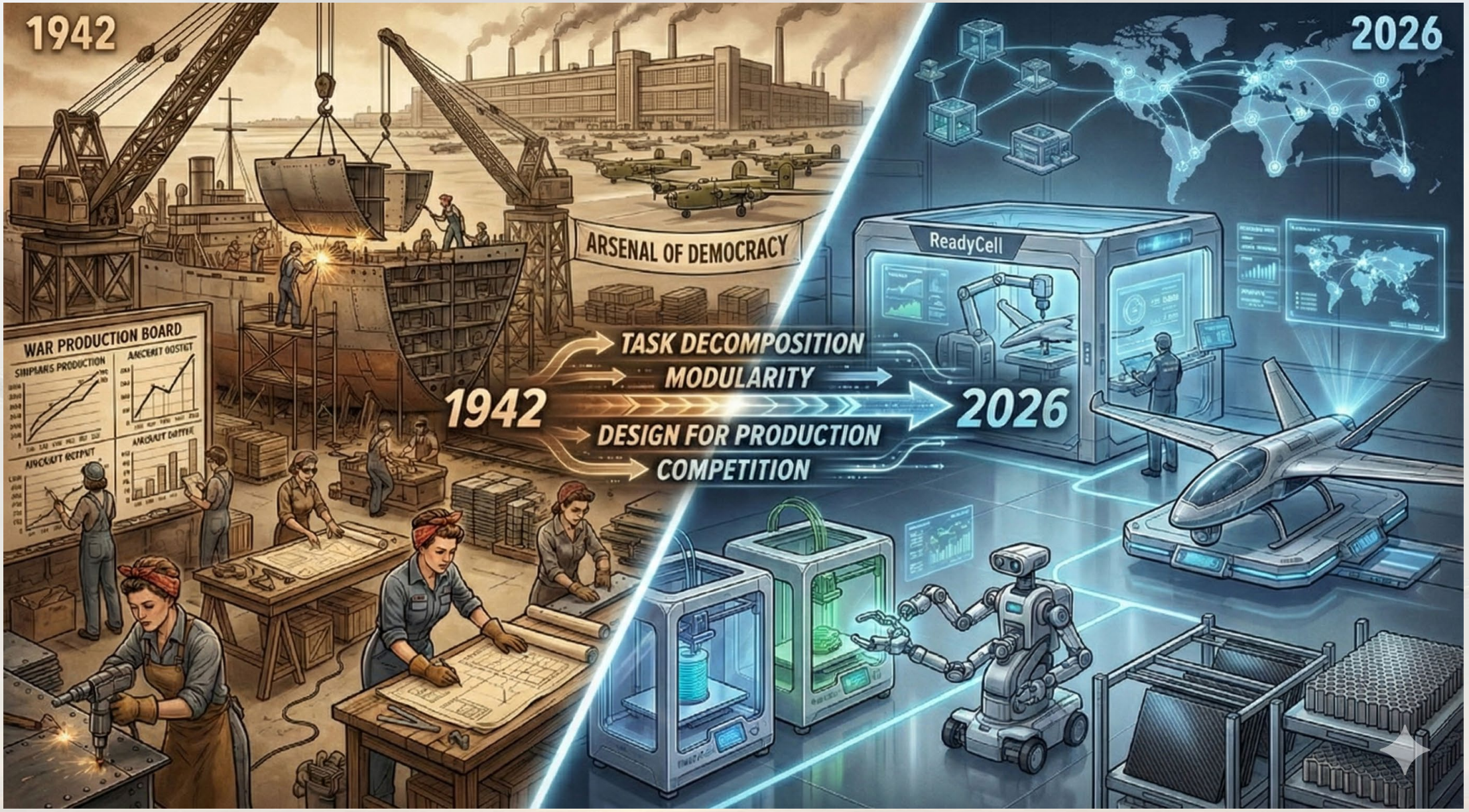
Distribution A

USSF

Endless Forge is <u>Manufacturing-as-a-Service</u>: a surge-capable, adaptive, resilient, and scalable manufacturing capability – to give Blue the edge in ALL fights through *industrial base dominance*!

Continuous Battlefield Adaption is essential to effective military production

Freedom’s Forge Transforms into Endless Forge



Why is Endless Forge Needed

Current Acq System Not Agile to Battlefield Response

- Weapon system acceptance is a slow, linear, vertically-integrated process
- Weapon system requirements are over-defined often with unsubstantiated intent

Current Capacity Production Not Enough

- Production lines are currently near or at capacity
- Current production insufficient to sustain a protracted conflict; adding third shift is current best option

Inconsistent Demand Signals to Industry

- DOW frequently changes planned future procurement schedule
- Uncertainty affects long-term planning for facilities, tooling, training, and supply chain contracts

21st Century Acquisition and Manufacturing Must:

- ❖ **Support immediate regeneration of mass and accept new requirements**
- ❖ **Link into regionalized manufacturing ecosystem, take advantage of MaaS**

Distribution A

Manufacturing Models Overview

Mass Production

CONTROL
Centralized, in-house

SCALE
High volume, standardized

FLEXIBILITY
Low - tooling investment

Contract Manufacturing

CONTROL
Distributed via contracts

SCALE
Variable, third-party capacity

FLEXIBILITY
Medium - supplier dependent

Manufacturing as a Service

CONTROL
API-driven, on-demand

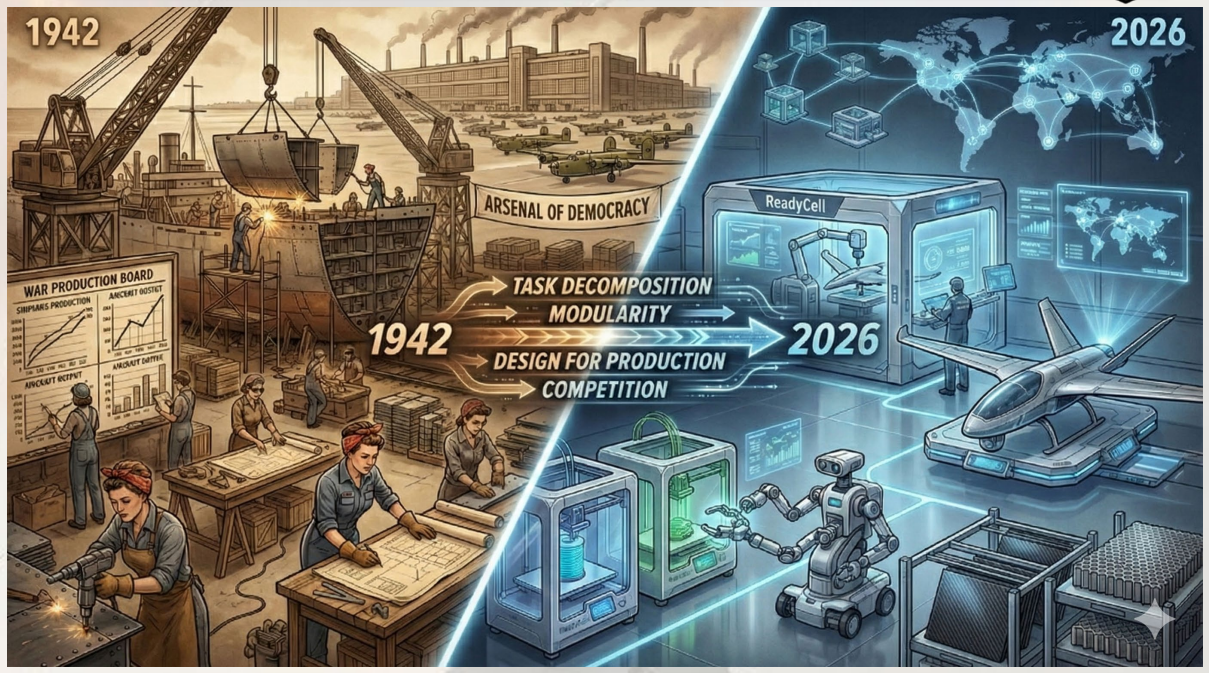
SCALE
Elastic, network capacity

FLEXIBILITY
High - rapid iteration

Endless Forge - Adapting Manufacturing to changing requirements

- Provides "Manufacturing-as-a-Service" (MaaS)—a surge-capable, resilient, and scalable approach to give the US the edge in enduring conflicts
- Delivers credible combat mass rapidly from receiving new requirement
- Creates a distributed network of factories: no single point of failure
- Enables continuous adaptation of weapons to new requirements
- Ensures operational capability is restored quickly after combat losses
- Provides the ability to surge mass

Modernizing Weapon System Production

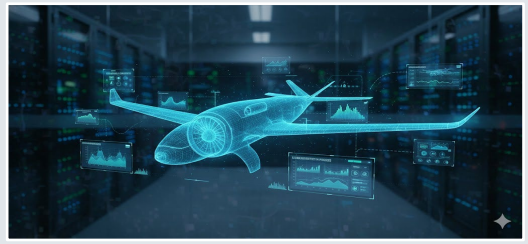


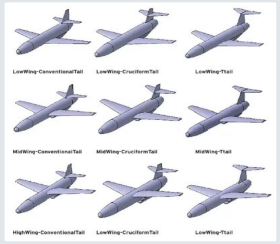
Tailoring Platforms to emerging requirements or all new models of delivering Weapons Systems

Continuous Battlefield-Driven Adaption is now essential to effective military production: What do I now know I need tomorrow?

Endless Forge AOI 1 and AOI 2

AOI 1 – Activated Digital Thread Sprint





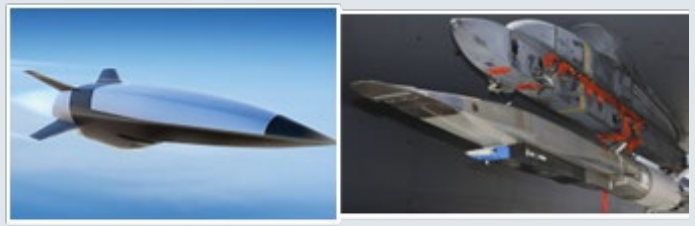
- Model-Driven Quality Assurance / Digital Certification
- Modular Integration & Factorial Manufacturing
- IntelDevOps: Battlefield-Informed Adaptive Engineering
- Software Defined Manufacturing & Physical AI
- Secure Data Exchange and Validation
- Engines and Subsystems

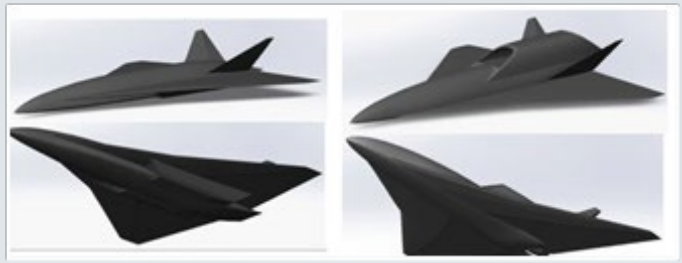
Tech Insertion

Tech Insertion

AOI 2 – Endless Forge Demonstration

- Partner with active programs and leverage previous work to demonstrate Endless Forge. Four areas of interest for demonstration:
  - Attrition-Tolerant Mass & Subsonic Systems (sUAS/Munitions/Decoys)
  - Autonomous Collaborative Platforms (ACPs)
  - Space Systems and Ground Support Equipment for Space
  - High-Speed Affordable Weapons





AOI 1: EF Technology Sprints - Activated Digital Thread

(1) Model-Based Quality Assurance & Digital Certification.

Goal: Transition from physical-test-dependent to analysis-led certification.

To realize surge manufacturing, the bottleneck of physical requalification for every design change must be eliminated. Solutions are sought that leverage Certification by Analysis (CbA) and probabilistic simulation to validate manufacturing variability and design changes. Approaches should address how seamless data interchange can support certification allowing for rapid acceptance of re-configured components without extensive physical testing campaigns.

SAM.gov, *Endless Forge* Multiple Authority Announcement (MAA) Open Period Solicitation, *Attachment 1, Endless Forge Program Areas of Interest*, dated 18 Feb 2026, p. 2

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AOI 1: EF Technology Sprints - Activated Digital Thread

(2) Modular Integration & Factorial Manufacturing.

Goal: Enable "Plug-and-Play" hardware responsiveness.

Modularity across design, manufacturing, and logistics is identified as a critical enabler for rapid reconfiguration. Approaches treating the weapon system as a composable platform are requested. Solutions must address the configuration definition, interface management, and system integration logic required to support factorial manufacturing. Responses should demonstrate how these frameworks enable intelligent, fast reaction to engineering changes across the lifecycle.

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AOI 1: EF Technology Sprints - Activated Digital Thread

(3) IntelDevOps: Battlefield-Informed Adaptive Engineering.

Goal: Directly link intelligence streams to engineering sprints.

Current feedback loops are identified as being too slow for modern conflict. IntelDevOps strategies are required to ingest battlefield data (trend analysis, gap analysis, adversary adaptation) and translate them into immediate engineering requirements. Approaches should demonstrate the ability to capture weapon system performance data in contested environments and automatically suggest re-design or re-configuration strategies to counter emerging threats. Approaches must articulate a precise mathematical problem formulation for how re-design or re-configuration strategies are generated to ensure the computational approach is well-defined and tractable.

AOI 1: EF Technology Sprints - Activated Digital Thread

(4) Software-Defined Manufacturing & Physical AI.

Goal: Decouple process planning from human latency.

To support rapid changes, automation of the "manufacturing compiler" is necessary. Solutions utilizing Physical Artificial Intelligence (AI) to couple real-world physics with statistical models, including but not limited to automating process planning, tooling configuration, inspection, and assembly logic, are of interest. Responses should focus on Manufacturing as a Service (MaaS) workflows where software-defined control planes allow for immediate production reconfiguration based on new requirements.

AOI 1: EF Technology Sprints - Activated Digital Thread

(5) Secure Data Exchange and Validation

Goal: Trust the data, secure the thread.

A responsive digital thread requires a resilient backbone. End-to-end solutions for a secure data ecosystem ensuring data integrity across organizational silos are requested. Approaches should address the following:

- Zero-Trust Architectures: for multi-party access and change authorization.
- Schema Validation: for conflict resolution and interoperability.
- Semantic Inferencing: for connecting disparate data silos.
- Uncertainty Quantification: for validating the reliability of surrogate models used in decision making.

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AOI 1: EF Technology Sprints - Activated Digital Thread

(6) Engines and Subsystems.
Goal: Rapid development of low-cost sub-systems.
Engines, actuators, avionics, fuel pumps, and other subsystems can drive high system cost and timeline. The AFRL team will entertain novel and innovative ideas to address this systemic design and manufacturing issue. Rapid fielding and manufacturing on mass are key for subsystems to match the overall EF technical goals.

(7) Other.
Goal: Any digital thread technology or approach not covered above that would facilitate the rapid design and manufacture of the physical systems sought in AOI 2.

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AOI 2: EF – Technology Demonstration & Leave Behind

The intent of AOI2 is to demonstrate EF across several of these domains, each being important to the overall AFRL and Air and Space Force mission space.

These different domains are not in competition.

The AOI2 demonstration is planned as a 2-year development effort ending in a final demonstration of EF technology goals at the end of 2 years.

A gated approach with thresholds based on key performance parameters (KPPs) will be implemented.

With producibility timelines being the primary concern, other KPP examples include but are not limited to product demand, cost, quality, rate, safety, supply chain resilience, and modularity re-design capability.

The intention is to award multiple performers across the warfighting domains listed above.

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AOI 2: EF – Technology Demonstration & Leave Behind

To successfully achieve AOI2 demonstration of EF technology objectives proposers are encouraged to leverage existing fielded or high TRL design systems as a starting point.

This will allow re-designs of current needed capability, significantly increasing overall leave behind capability, while lowering timeline and complexity of new designs.

Leveraging AOI1 activities or partnering with AOI1 performers will be highly encouraged. Leave behind capability is a large goal of this demonstration program.

Note that even with a partnership with an active program, there needs to be a joint willingness between proposer team to incorporate EF manufacturing technology into overall program.

AOI 2: EF – Technology Demonstration & Leave Behind

Solutions are expected to demonstrate a production network that utilizes the Manufacturing as a Service (MaaS) model to produce at speed, achieving system requirements, modular fieldable designs that do not have lengthy traditional timelines of existing acquisition channels/timelines.

Key enablers of EF are dictated previously, and in AOI1, including but are not limited to data registration, model-based engineering, in-situ thermal and structural validation, tool-less assembly, and advanced metrology technologies that can speed up system acceptance.

The solution should both (1) radically expedite production, assembly, and final checkout and (2) expand total capacity of the production network.

Incorporation of IntelDevOps and its ability to surge needed systems is a key overall demonstration feature of AOI2.

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AOI 1 and AOI 2 Timeline

- AOI 1 and AOI 2 accepting white papers now
- AOI 1 program schedule will be determined based on proposed technology area
- AOI 2 notional timeline below:

AOI 2 Demonstration Key Event	Start	End
MaaS Factory Network Design	KO	≤ 4 months
Re-Design CODR of Weapon System with Key EF Included (AOI 1)	2 months	≤ 6 months
Manufacturing Readiness Review and PDR	6 months	≤ 12 months
Demo 1 – Factory Network Demo	12 months	≤ 12 months
Sprint to CDR, Finalize Manufacturing Plan	12 months	≤ 18 months
Demo 2 – IntelDevOps Drive Build	18 months	≤ 18 months
Manufacture and Field Initial System	18 months	≤ 24 months
Demo 3 – EF Field Demo / Capability EF Tech Adaptive Modular Surge	24 months	Classified Appendix

Note: All times are post kickoff. This schedule is notional, and the team will entertain faster timelines to meet demonstrations.

AOI 2 demonstration objectives will be held in a classified appendix that can be sent through secure channels prior to white paper submittal.

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Concluding Thoughts

PROBLEM: Current manufacturing ramp from a cold start is years, not weeks. Modern conflict demands inventory adaption and tactically responsive weapon system delivery.

BIG IDEA: Endless Forge will use an Activated Digital Thread establish Manufacturing-as-a-Service (MaaS) regional production networks to **enable an adaptive, surge-capable supply.**

FOCUS: Develop and activate a model-driven digital thread that rapidly qualifies sub-system batches by mission capability at need speed through a regionalized MaaS approach. Captured in AO1 and AOI2 activities.

DEMO(S): Partner with active programs to demonstrate Endless Forge in one of the relevant warfighting domains

- **Review Endless Forge Program Areas of Interest (AOI) document in the open period solicitation.**
- **Submit white papers as soon as possible to enable discussion of the results of the white paper review to optimize the full proposals the AF receives (if a white paper is selected for full proposal).**