Scaling Drone Manufacturing Through the Gigafactory Model

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Abstract

- Modern warfare has demonstrated an increasing demand for Unmanned Aerial Systems (UAS) that provide critical battlefield advantages. The war in Ukraine has highlighted drones' role in defense operations, demonstrating their ability to enhance situational awareness, conduct reconnaissance, and deliver kinetic effects efficiently.

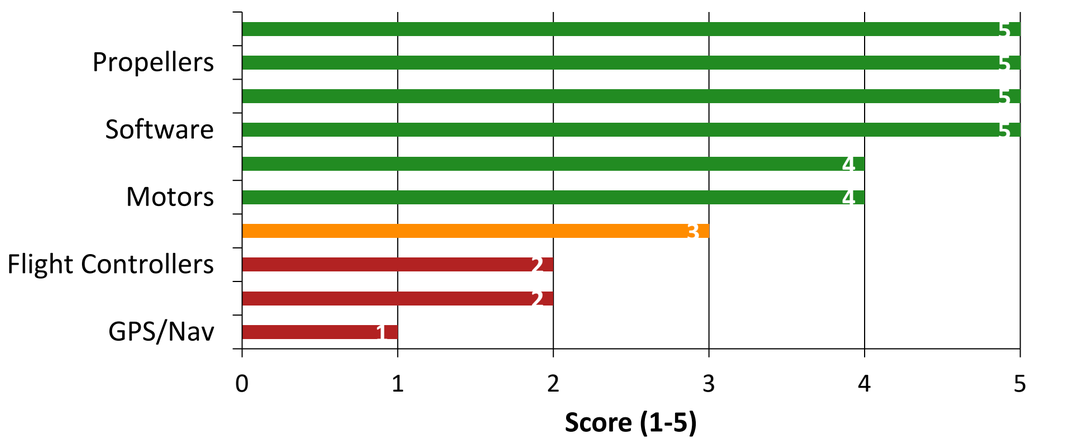
  However, the U.S. faces significant challenges in rapidly scaling drone production. Many UAS components rely on foreign supply chains, and domestic manufacturing infrastructure remains fragmented. To address these issues, companies like Anduril have pioneered the Gigafactory model—centralized, high-volume production facilities that integrate supply chains to achieve economies of scale and enhance supply chain security.

  This thesis explores the viability of Gigafactories as a model for increasing the domestic production of UAS to meet Department of Defense requirements, analyzing which subsystems are best suited for centralized versus external production.

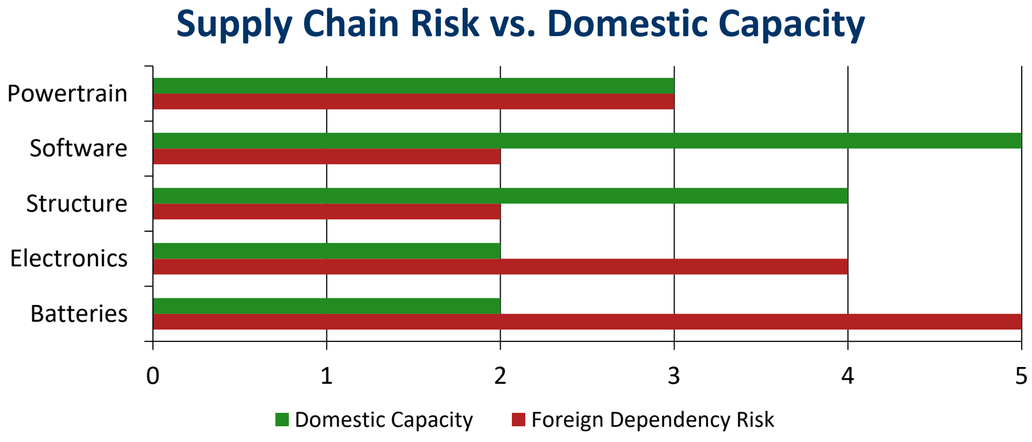
Methods

- Bill of Materials (BOM) Analysis: Comprehensive component-level analysis across multiple UAS platforms using open-source technical specifications, teardown imagery, and supplier databases
- Subsystem Decomposition: Classification into five categories—Powertrain, Electronics, Structure, Software, and Miscellaneous—to enable system-level insights
- Risk Assessment Framework: Scoring methodology (1-5 scale) evaluating Origin of Source Risk, Production Bottleneck Risk, Material Criticality, and Availability Risk
- Gigafactory Suitability Index: Evaluation of standardizability, automation potential, centralization value, co-location feasibility, and scale-curve intensity

Gigafactory Production Suitability



Supply Chain Risk vs. Domestic Capacity



Recommended Hybrid Production Model

GIGAFACTORY CORE: Airframes • Propellers • Wiring • Software • Final Assembly

EXTERNAL PROCUREMENT: GPS Modules • Battery Cells • Specialized Electronics

Research Focus

1. Which subsystems are best suited for centralized production?
2. What are the comparative advantages of the Gigafactory model?
3. What are the cost implications of U.S.-based production?

Results & Impact

- Structural components (airframes, propellers, wiring harnesses) demonstrate high suitability for Gigafactory production due to physical standardization and automation compatibility
- Electronics and batteries present significant foreign dependency risks—lithium-ion cells, rare-earth magnets, and semiconductors remain globally constrained
- Domestic vendors possess production capabilities but lack the capital investment required to scale output to DoD surge requirements
- Hybrid production model recommended: Gigafactory core for high-volume standardized components, supplemented by external procurement for specialized items
- Policy alignment essential—success depends on integration with CHIPS Act, DPA Title III, and MOSA architecture initiatives

Future Research

- Analyze legislative pathways to expand domestic manufacturing incentives for critical UAS components
- Evaluate security measures for technology sharing with allied partners in joint production scenarios
- Develop detailed cost models comparing distributed vs. centralized production approaches at scale

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