

AFRL Autonomy Industry Day Topic Descriptions

Overview

AFRL is actively seeking partners for agile and innovative autonomy solutions that provide our warfighters with a decisive asymmetric advantage. The “Autonomy Industry Day” is a first step toward an overarching goal to accelerate development and transition of autonomy software enabling autonomy systems. As related by the DAF’s “Reoptimizing for Great Power Competition (GPC)”, the nation is at a critical juncture. Autonomy plays a crucial role for scaling our warfighters’ ability to fight with speed, scope, and complexity in pursuit of the DAF’s operational imperatives (OIs). Rising to the challenges posed by the GPC, consequently, necessitates a government and industry community that is able to readily and effectively partner and rapidly respond to meet the nation’s burgeoning strategic autonomy needs in the domains of Air, Space, Weapons, and C3BM (command control communications battle management).

Autonomous Collaborative Platforms Domain

The focus for autonomous collaborative platforms entails advancing teams of unmanned systems capable of autonomous flight fundamentals—aviating, navigating, and communicating—while executing tactics in challenging dynamic uncertain environments. Autonomy's decisive asymmetric advantage lies in its ability to dramatically enhance the warfighters' operational speed, scope, and complexity. To realize this advantage, the warfighter must be able to effectively delegate tasks to autonomous systems. Effective delegation requires autonomy solutions that minimize warfighter input and supervision, which is only possible when warfighters have strong confidence in the system's resilient and predictable behavior despite challenging environments—which hamper command, control, communication, and navigation.

1. **Contingency Management:** Focuses on ensuring the robustness and resilience of autonomous systems by mitigating safety risks and mission impacts in off-nominal conditions, such as degraded environments or internal faults. This is critical for building warfighter trust required for effective task delegation.
2. **Terminal Area Operations:** Developing robust and resilient autonomy solutions capable of operating effectively in terminal areas with degraded environmental conditions, limited ground infrastructure, and reduced manpower.
3. **Autonomous Teaming:** Developing solutions that enable operators to efficiently delegate tasks to large, self-managed teams of heterogeneous platforms. This requires distributed task decomposition, planning, execution, and monitoring, capable of overcoming challenging environments.

Command and Control Autonomy

AFRL is interested developing autonomous and AI-enabled software microservices deployed to mission management and Command and Control (C2) systems that enable human-machine teams to gain decision superiority while conducting joint and all domain operations.

- **Sense Making:** Exploits and fuses information from multiple sources, reasons over the environment, and enables improved, timely, and executable battlespace decisions.
- **Sensor Orchestration:** Efficient management of sensors to achieve desired mission goals. At the micro-level this entails planning and orchestration functions pertaining to the sensors on a specific platform. In the macro sense, this entails coordination of multiple platforms.
- **C2 Decision Aids:** Development of software microservices that enable human-machine teams to plan and execute effects, observe results, and near-continuously update missions in progress to achieve commander's intent.
- **Resilient and Distributed C2:** Addresses complexities of modern warfare by distributing decision-making and control across a network of interconnected systems.

Human Machine Teaming Crosscutter

In contemporary military operations, a competitive advantage will arise from the force that is best able to harness and augment its military force of humans via machines. Machines, such as AI, automation, and autonomy, offer great promise to extend and accelerate human capacity in warfighting contexts. In essence, the force that is most able to wield the power of machines as a force multiplier will operate at a decision advantage and have the potential to seize initiative relative to another force. Sustained decision advantage coupled with initiative is considered Decision Superiority – and this state will be driven insofar as our capability to manifest effective human-machine teams (HMTs). HMTs represent a set of humans and machine working interdependently toward some common goal while using team processes such as communication, coordination, and back-up behaviors to accomplish a task (or set of tasks).

1. Harnessing speed, breadth, and focus from machine-driven analysis. Example domain of interest - ISR analyst support tools
2. Accelerating operator decision making via decision support tools that foster optionality. Example domain of interest – multi-domain command and control

3. Enabling flexibility in task contexts using human-machine interfaces. Example domain of interest ACP command and control
4. Engendering Responsible use of AI. Example domains of interest include - Joint human-AI experience, instituting human-guided guardrails for autonomy.
5. Developing and validation human state sensing capabilities to enable bi-directionality between machines and their human teammates. Example domain of interest – state-driven contingency management

Digitally-Enabled Autonomy Pipeline (DEAP)

AFRL is interested in accelerating an agile pipeline of autonomy technologies to meet the continuously evolving challenges of the warfighters' operational environment. Rather than each program building its own digital path for design, development, integration, testing, and deployment, there's an opportunity to leverage reproducible digital ecosystems of versioned artifacts, infrastructure, and tools across programs (McQuade et al, 2019). The principles of repeatability and reusability—manifested through digital engineering and material management best practices, government reference architectures, mission engineering, continuous integration/testing/deployment pipelines, common infrastructure, and assured composition and interoperability—are fundamental to breaking down stovepipes, reducing redundancy, fostering confident innovation, and ultimately accelerating the delivery of autonomy to the warfighter.

McQuade, J Michael, Richard M Murray, Gilman Louie, Milo Medin, Jennifer Pahlka, and Trae' Stephens. "Software Is Never Done: Refactoring the Acquisition Code for Competitive Advantage," 2019, 15.

Hurst, Mr J Kyle, Dr Steven A Turek, and Col Chadwick M Steipp. "Digital Materiel Management - An Accelerated Future State." *AFMC*, June 2023.

Weapons Domain Autonomy

AFRL is interested in novel hardware, software, and algorithms to synthesize multi-domain data into effective mathematical representations to enable novel munition behaviors based upon battlespace awareness, network topology, and agile munition control techniques. Modular and open architected technology is required to support and enable networked, collaborative, and autonomous (NCA) weapon concepts and capabilities especially in highly contested environments. Limited communication in contested environments might require decentralized, high-level cognitive functions: technologies that enable context-aware reasoning, multi-agent coordination, graceful performance degradation, and inherently flexible or reconfigurable operation are highly desired. Unified architectures, machine learning techniques, or mathematical languages applicable to the control and coordination of heterogeneous information services and that enable verifiable, trusted autonomy are also sought. Network-aware capabilities, especially technology that

cognitively matches machines with human oversight, would enable assured cooperation and increased capacity for NCA weapon deployment. Finally, science and technology that allows for fractionated weapon performance (having capability spread across multiple assets that coordinate to deliver a desired effect) and composable functions (where disparate capabilities can be combined synergistically to create multiple desired effects) are also of interest.

Doolittle Institute. "Research Area 17: Weapons Autonomy Technology Research." Accessed April 10, 2025. <https://doolittleinstitute.org/research-area-17-weapons-autonomy-technology-research/>.