Department of the Air Force Scientific Advisory Board

Terms of Reference

Science & Technology Review: Mission Systems for Collaborative Combat Aircraft

FY 2024

These Terms of Reference (ToR) establish the Secretary of the Air Force (SECAF) objectives of the Department of the Air Force (DAF) Scientific Advisory Board (SAB) Parent Committee. The SAB's responsibilities include the requirement to provide independent technical advice on matters of Science and Technology (S&T), study topics deemed critical, and provide an independent review of the quality and relevance of DAF S&T programs.

Background:

The Department of the Air Force (DAF) is developing uncrewed Collaborative Combat Aircraft (CCA) to operate alongside fifth- and sixth-generation crewed aircraft. To realize the CCA concept with acceptable pilot workload, the uncrewed aircraft will operate semi-autonomously, taking direction from the pilot and then implementing this direction. The CCA will be a combat aircraft employing a distributed mission-tailorable mix of mission systems. The CCA will be significantly less expensive than crewed platforms enabling cost-effective large-scale deployment to provide increased airpower capacity. The DAF plans to develop, test, and manufacture at least 1000 CCAs near-term, with initial fielding in 2028 and early operational capability by 2030. Achieving this low-cost capability at scale requires the availability of low Cost, Size, Weight, and Power (C-SWaP) mission systems that are capable yet affordable. Promising developments across both the Department of Defense and Commercial Research & Development (R&D) are pointing to enhanced solutions that potentially enable competitive advantage. The CCA is also designed to utilize the Air Force Research Laboratory (AFRL)'s significant accomplishments in developing capable next generation mission systems within an Open Mission Systems framework and with software-defined capability, offering additional opportunities for affordability and scalability.

Mission Statement:

SAB seeks to utilize the Federal Advisory Committee process to maximize the value of the advice and oversight provided to the SECAF. The SAB will ensure SECAF receives independent advice on the nature, research, and programs associated with CCA.

Issue Statement:

Accomplish an independent assessment of AFRL's CCA efforts.

Objec ves and Scope:

The SAB Parent Committee's S&T Review will assess AFRL efforts for CCA systems for use against adversaries prioritized for operational impact and cost. It will evaluate:

- DAF Missions and Concepts of Operations (CONOPs) for CCA systems
    - Review Air Force Life Cycle Management Center/Fighters and Advanced Aircraft Directorate (AFLCMC/WA) CCA CONOPS, including the correlation to platforms and

CONOPS that Air Combat Command (ACC) and industry are exploring, particularly as they impact mission systems needs
    - Identify CCA mission system needs, including size, weight, power, thermal, and cost as well as performance
- Key AFRL technology developments for CCA mission systems; identify gaps and opportunities in technology development and maturation for near-term delivery and transition to Program of Record
    - Architectures, autonomy, weapons, processors, mission systems compatible with CCA mission needs
    - Review technology transition roadmaps and approaches
        - Prioritized for operational impact and cost effectiveness for competition for Great Power Competition (GPC)
        - Approaches for rapid transition to address threats and opportunities
- AFRL R&D and roadmaps for mid- and long-term
    - R&D focused on other platforms that could be reoriented to CCAs
- Strengths and issues in the reviewed programs, with associated recommendations for improvement.
- Review innovative research offering potential for future breakthroughs

Methodology:

- The SAB Parent Committee's S&T Review will be conducted in compliance with the Federal Advisory Committee Act (FACA) and the SAB Charter.
- Individual SAB Members do not have the authority to make decisions or provide recommendations on behalf of the SAB; however, individual Members may be tasked with specific research and coordination efforts under this project.
- It is not anticipated that this study will need to go into any "particular matters" within the meaning or title 18 United States Code Section 208, nor will it cause any member to be placed in the position or action as a procurement official.

Deliverables:

- Briefing to SECAF, SAF/AQ, SAF/SQ, USSF/CTIO, AFMC/CC, AFRL/CC
- The SAB Chair providing a report to the SECAF.

Support:

In support of this ToR and the work being conducted, the SAB has authority to meet with participating technical directorates and staff. The SAB Parent Committee may request these technical directorates provide requested information, assistance, or access to personnel.

- Participating Technical Directorates: AFRL – STO, RH, RI, RQ, RS, RW, RX, RY; AFOSR, AFWERX

Department of the Air Force Scientific Advisory Board

Terms of Reference

Science & Technology Review: Directed Energy Weapons

FY 2024

These Terms of Reference (ToR) establish the Secretary of the Air Force (SECAF) objectives of the Department of the Air Force (DAF) Scientific Advisory Board (SAB) Parent Committee. The SAB's responsibilities include the requirement to provide independent technical advice on matters of Science and Technology (S&T), study topics deemed critical, and provide an independent review of the quality and relevance of DAF S&T programs.

Background

Directed Energy Weapon (DEW) technology, both domestic and international, is advancing at a rapid pace, with both allied and adversary nations deploying DEW systems. DEW can potentially provide a deep magazine, near-instantaneous engagement, dialable effects (reversible to mission kill), and a broad range of attack characteristics that can be tailored to a threat's susceptibility. The availability of affordable laser and high-power microwave sources, emitters, fire control, and ruggedized power systems underlies a decade of proliferation of operationally active DEWs around the world, with substantial experimentation to demonstrate integration with other weapons to deliver effective layered attack and protect missions. Intelligence assessments predict that a future high-end fight will utilize DEW across domains for these missions, necessitating cross-domain considerations in campaign planning. As with kinetic weapons and armor, blue (US) DEW and blue platform protection to counter red DEW are separate capabilities based on different technologies that are both essential for next war-winning concepts.

Mission Statement: SAB seeks to utilize the Federal Advisory Committee process to maximize the value of the advice and oversight provided to the SecAF. The SAB will ensure SecAF receives independent advice on the nature, research, and programs associated with DEW.

Issue Statement: Accomplish an independent assessment of Air Force Research Laboratory (AFRL)'s DEW efforts.

Objectives and Scope:

The SAB Parent Committee's S&T Review will assess key Air Force Research Laboratory (AFRL) efforts for DEW systems and protection against DEW systems of high end adversaries, prioritized for operational impact and cost. It will consider:

- Missions and Concepts of Operations for DEW systems
    - Current and forecasted adversary DEW and Counter-DEW (C-DEW).
    - Required DEW performance levels for operationally effective DAF missions.
- Key AFRL programs addressing near-term technology gaps to deliver DAF-relevant DEW and C-DEW, to include:
    - Domain-based DEW missions (e.g., protection of High-Value Assets (HVA), base defense, and counter-Unmanned Aircraft Systems (UAS)).
    - Domain-based missions and associated components that are susceptible to adversary DEW (e.g., long-range kill chain/web).
    - Associated modeling, simulation, and analysis to inform DEW development and effects.

    - Associated vulnerability assessments with modeling, simulation, and analysis to inform approaches to counter adversary's DEW.
- Key AFRL Research & Development (R&D) efforts, with roadmaps addressing mid-, and far-term technology gaps to deliver DAF-relevant DEW and C-DEW, to include:
    - Foundation DEW technologies (e.g., High Energy Laser (HEL), High Power Microwave (HPM), adaptive compensation, pointing/tracking).
    - Foundational C-DEW technologies (e.g., materials/manufacturing, DEW damage/effects).
    - Experiments and demonstrations of DAF-operationally effective DEW and C-DEW.
    - Collaborative efforts and leveraging to develop DAF DEW and C-DEW technologies.
- Strengths and issues in the reviewed AFRL programs, with associated recommendations for improvement.
- Innovative basic and applied research offering potential for future breakthroughs.

Methodology:

- The SAB Parent Committee's S&T Review will be conducted in compliance with the Federal Advisory Committee Act (FACA) and the SAB Charter.
- Individual SAB Members do not have the authority to make decisions or provide recommendations on behalf of the SAB; however, individual Members may be tasked with specific research and coordination efforts under this project.
- It is not anticipated that this study will need to go into any "particular matters" within the meaning or title 18 United States Code Section 208, nor will it cause any member to be placed in the position or action as a procurement official.

Deliverable:

- Briefing to SECAF, SAF/AQ, SAF/SQ, USSF/CTIO, AFMC/CC, AFRL/CC
- The SAB Chair providing a report to the SecAF.

Support:

In support of this ToR and the work being conducted, the SAB has authority to meet with participating technical directorates and staff. The SAB Parent Committee may request these technical directorates provide requested information, assistance, or access to personnel.

- Participating AFRL Technical Directorates: AFRL – STO, RD, RX, RY, RV, RW, RQ, RS; 711th Human Performance Wing, AFOSR

Department of the Air Force Scientific Advisory Board

Terms of Reference

Science & Technology Review: Spectrum Warfare Dominance

FY 2024

These Terms of Reference (ToR) establish the Secretary of the Air Force (SECAF) objectives of the Department of the Air Force (DAF) Scientific Advisory Board (SAB) Parent Committee. The SAB's responsibilities include the requirement to provide independent technical advice on matters of Science and Technology (S&T), study topics deemed critical, and provide an independent review of the quality and relevance of DAF S&T programs.

Background:
Spectrum Warfare Dominance (SWD), in its broadest interpretation, includes control of the physical battlespace, electromagnetic spectrum, and information space to achieve dominance in the air, surface, sub-surface, terrestrial, and space domains. A key part of US military strategy, SWD is an enabler for the US to engage targets across all domains while significantly constraining the assets of opposition forces to do likewise. The full scope of SWD is extremely broad, as is the scope of supporting technologies. For the purposes of this study, scope will be limited to Electromagnetic Spectrum Operations (EMSO) (Air Force Doctrine Publication 3-85, *Electromagnetic Spectrum Operations*, 14 December 2023). EMSO defines use of the Electromagnetic Spectrum (EMS) to support a multi-domain kill web by achieving effects of detect, exploit, deceive, deny, disrupt, degrade, destroy, and protect in a contested environment. A necessary condition for successful spectrum dominance is technology supremacy in deployed, operational assets. 'Technology supremacy' is more than technical performance of physics-based sensors and weapon systems – it is also the ability to assimilate and utilize information to optimally assess battlespace conditions, to control assets in a contested environment, and to interrupt or misguide adversary decision making capabilities. Impactful technologies are those that transition to operations. Accordingly, the study will assess technologies with near term transition opportunities and those with longer term high-impact potential.

Mission Statement: SAB seeks to utilize the Federal Advisory Committee process to maximize the value of the advice and oversight provided to the SecAF. The SAB will ensure SecAF receives independent advice on the nature, research, and programs associated with SWD.

Issue Statement: Accomplish an independent assessment of Air Force Research Laboratory (AFRL)'s SWD efforts.

Objectives and Scope: The SAB Parent Committee's S&T Review will assess AFRL efforts for SWD systems for use against high end adversaries. prioritized for operational impact and cost. It will evaluate:

- Missions and Concepts of Operations for SWD systems
    - Key foreign systems threatening DAF operations and spectrum utilization
    - Opportunities for disrupting foreign kill webs using EMSO, with emphasis on the radio frequency portion of the spectrum
- Key AFRL programs enabling ground-, air-, and space-based systems and battle management for defensive and offensive EMSO in the near term
    - Review for technical feasibility, operational viability, and cost-effectiveness
    - Include resilience to foreign EMSO threats, especially with respect to secure and affordable data links

- Key AFRL Research & Development (R&D) efforts, and roadmaps for mid- and long-term
    - Prioritized for operational impact and cost effectiveness in competition with near peer advisories.
    - Approaches for rapid transition to address threats and opportunities
- Strengths and issues in the reviewed AFRL programs, with associated recommendations for improvement.
- Innovative research offering potential for future breakthroughs, including cognitive support for EMSO mission autonomy

Methodology:

- The SAB Parent Committee's S&T Review will be conducted in compliance with the Federal Advisory Committee Act (FACA) and the SAB Charter.
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Support:

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- Participating Technical Directorates: AFRL - STO, RY, RI, RS, RW, RV, RQ; AFOSR, AFWERX S&T