Joint Aircraft Survivability Program

The Joint Aircraft Survivability Program (JASP) develops cross-Service aircraft survivability solutions and evaluation methods needed to dominate the multi-domain battlefield and mitigate U.S. aircraft losses in combat.

JASP products support: 1) weapons tactics schools, air operations, and training, 2) operational and live fire test and evaluation of aircraft systems, 3) aircraft combat damage reporting, and 4) transition of technologies to the battlefield intended to improve aircraft survivability and force protection.

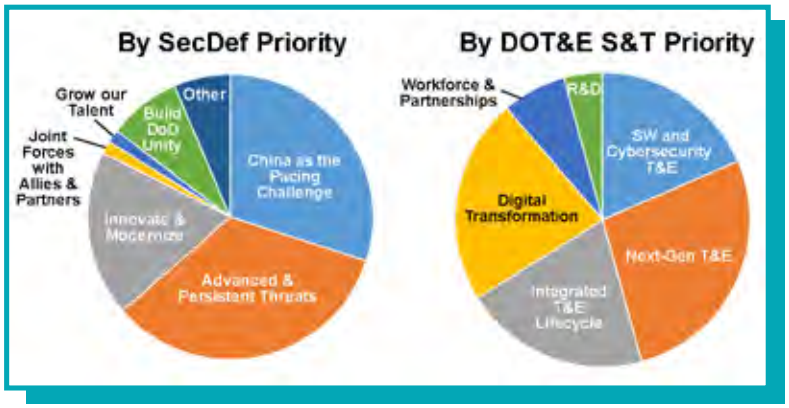

Figure 1. JASP FY21 funding by SECDEF and DOT&E S&T priorities

Specifically, JASP:

- Advances the capability and credibility of joint aircraft combat effectiveness tools used in combat mission planning, training, and weapon schools to support the development of air combat tactics, techniques, and procedures (TTPs).
- Manages enterprise-level modeling and simulation (M&S) tools required for credible evaluation of aircraft effectiveness and survivability.
- Supports the Joint Combat Assessment Team, which collects and analyzes U.S. aircraft combat damage and losses to develop the requirements for joint aircraft survivability solutions that provide force protection and remedy operational shortfalls.
- Leverages advances in science and technology to develop innovative survivability enhancement features.

JASP Advances the Capability and Credibility of Joint Aircraft Combat Effectiveness Tools

In coordination with the Joint Technical Coordinating Group for Munitions Effectiveness (JTCG/ME), JASP develops and maintains the Air Combat Effects Library that serves as a joint suite of Service-based data and models used for modeling air-to-air, surface-to-air, and air-to-surface engagements and the resulting aircraft survivability and lethality. JASP supports this library with the delivery of data and models, to include shooter detection, target tracking, aircraft performance/kinematics (threat and friendly), weapon trajectory/shot logic, pilot logic, and standardized threat models.

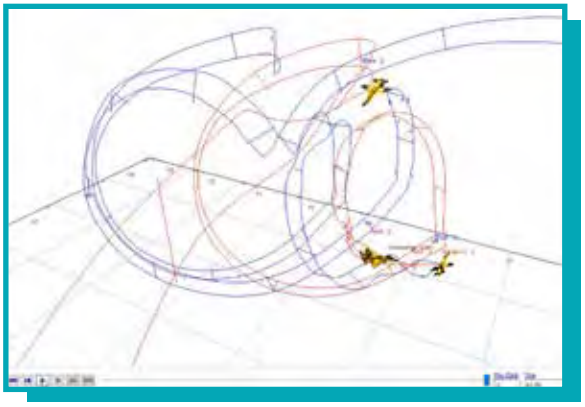

Figure 2. JAAM Dog Fight Example

JASP also supports the development the Joint–Anti-air Combat Effectiveness (J-ACE) tool used to conduct combat effectiveness analyses, which underpin air combat TTP development and training. J-ACE is an umbrella product consisting of models such as the Joint Anti-Air Model (JAAM), the output of which is shown in Figure 2. JAAM simulates the kinematic engagement of multiple U.S. (blue) and enemy (red) platforms, including their missiles and weapons. The aero-performance of the blue and red aircraft is calculated by BlueMax. The resulting damage effects analysis is conducted using the Endgame Manager to generate probability of kill estimates. J-ACE connects to test and training debrief tools through the use of an Application Program Interface. In FY21, the Joint Technical Coordinating Group for Munitions Effectiveness, in coordination with JASP, completed the J-ACE v5.4, adding or updating several aircraft and threat inputs, updating Endgame Manager, and adding the TSPI P5e format. Work continued on the next generation of J-ACE v6.0, which will fully implement the Air Combat Effects Library.

SLATE (Survivability and Lethality of Aircraft in Tactical Environments) is another notable model that provides J-ACE with capabilities to assess weapons effects in an advanced, contested environment. SLATE also provides the acquisition and RDT&E community the capability to assess aircraft survivability against the full spectrum of threats, including surface-to-air missile systems (SAMS), air defense artillery (ADA), and air-to-air missiles (AAMs). In FY21, JASP advanced SLATE by maturing aero performance and radar modeling of rotary wing aircraft, air defense artillery gun modeling, and environment modeling as shown in Figure 3. The initial version of SLATE will be fielded in early FY22.

Figure 3. SLATE Helicopter, ADA Gun, and Low Altitude Environment Modeling Example

JASP Manages Enterprise-level M&S Tools Required for Credible Evaluation of Aircraft Effectiveness and Survivability

Through Tri-service configuration control boards, JASP continues the management of major M&S tools used to estimate air combat effectiveness and survivability against an array of operationally representative kinetic threats. The toolsets include the air-to-air combat simulation Brawler, the surface-to-air engagement model Enhanced Surface-to-Air Missile Simulation (ESAMS), SLATE, and the vulnerability analysis code Computation of Vulnerable Area Tool (COVART), along with its supporting penetration and fire prediction codes Projectile Penetration (ProjPen), Fast Air Target Encounter Penetration (FATEPEN), and the Next Generation Fire Model (NGFM).

In collaboration with the Intelligence Community, JASP continues to improve the representation of the contested environment for these tools. Through work conducted under JASP efforts, the Intelligence Community developed a means to evaluate radio-frequency countermeasure effects under their Threat Modeling and Analysis Program that will be released in SLATE once validated by the intelligence center .

In FY21, JASP initiated the Machine Assisted Exploitability Simulation for Testing Resilient Operations (MAESTRO) project to improve the survivability evaluation of U.S. aircraft against cyber threats. This effort, in collaboration with the Air Force, Army, and Navy aviation cyber survivability communities, will provide M&S tools and data standardization to develop and evaluate aircraft survivability in a cyber-contested environment.

JASP Supports the Joint Combat Assessment Team to Collect and Analyze U.S. Aircraft Combat Damage and Losses

In FY21, JASP continued to enable aircraft combat damage incident reporting and aviation combat injury analyses through the Joint Combat Assessment Team and the U.S. Army Aeromedical Research Laboratory (USAARL). In FY21, the Joint Combat Assessment Team completed combat damage assessments supporting operational forces. The USAARL supported the related analysis of aircraft combat injuries and documented all reported CH-47 Chinook combat injuries in Operation Iraqi Freedom and Operation Enduring Freedom. USAARL also completed analysis of combat injury trends across the UH-60 Black Hawk, AH-64 Apache, and CH-47 Chinook helicopters to guide future personnel survivability investments.

To enable combat incident reporting and data sharing across the DOD, Services, and Combatant Commands, JASP transitioned the Combat Damage Incident Reporting System to the National Ground Intelligence Center for hosting. To support future aircraft combat incident reporting, in coordination with the Naval Air Systems Command, JASP demonstrated automatic collection of time-sensitive threat incident and engagement data to

improve combat incident reporting. Table 1 details DOT&E oversight programs by acquisition program type supported by JASP tools.

Table 1. DOT&E Oversight Programs Supported by JASP Tools

Acquisition Program Type	ACAT/ BCAT	BRAWLER	ESAMS	SLATE	COVART	NGFM
Bomber Aircraft	-	1	1		1	1
Fighter Aircraft	ID, IC, II	5	5		4	1
Rotary-Wing Aircraft	IB, IC		3	3	2	2
Transport/Tanker Aircraft	IC		1		2	1
Special Use Aircraft	ID, III		1		2	2
Weapons	IC	1				
Oversight Programs Supported Totals		7	11	3	11	7

JASP Leverages Advances in Science and Technology to Deliver Innovative Survivability Enhancement Features

Threat Detection and Countermeasures

In collaboration with the OSD and Service organizations, JASP develops countermeasure techniques and matures technologies to defeat advanced electro-optical/infrared and radio frequency guided threat systems, the distribution of which is shown in Figure 4.

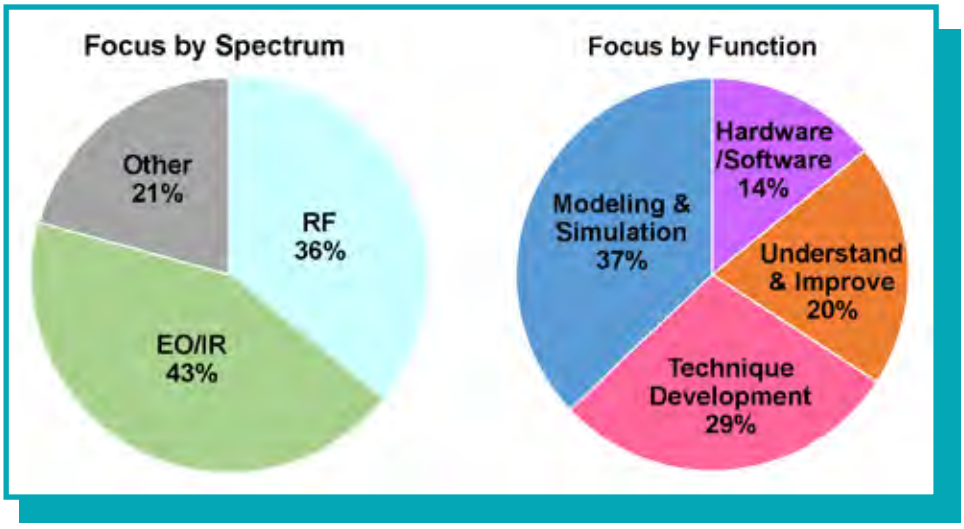

Figure 4. JASP FY21 Susceptibility Assessment and Reduction Projects by Spectrum and Function

Electro-Optical/Infrared Spectrum

In FY21, JASP assessed the current U.S. countermeasure effectiveness against a high priority electro-optical/infrared guided threat system. The Navy and the Army are using these data to inform future system requirements and countermeasure technique optimization. JASP also finished the development of a specific man-portable, air-defense system digital model to facilitate a more comprehensive operational and live fire test and evaluation of U.S. countermeasures against this category of threats.

In FY21, JASP also initiated two projects to improve aircraft situational awareness using electro-optical/infrared sensors against advanced missile threats by an innovative use of missile warning sensors in a non-standard operational scenario, and advanced machine learning algorithms to improve missile warning sensor detection and classification of specific threats.

Radio Frequency Spectrum

In FY21, JASP continued the development and demonstration of electronic attack (EA) technologies. Specifically, JASP completed the initial hardware-in-the-loop demonstration. Concurrently, JASP adapted these technologies/techniques to a different category of advanced radio frequency threats and completed test planning for a FY22 flight test. In coordination with the Intelligence Community, JASP also completed integration of an electronic attack capability into a particular threat system model, which provides the Services a unique capability for development of countermeasure techniques.

In FY21, JASP completed a three-year collaboration with the Army to advance a low size, weight and power (SWaP) modular antenna needed to keep pace with advanced electronic attack techniques. JASP advanced this technology to a technology readiness level of 5, positioning it to transition to a program of record.

Force Protection

In FY21, JASP continued to develop and test technologies that improve the protection of aircraft aircrew and passengers against persistent and emerging threats. These efforts also collected the prerequisite test data needed to develop and validate vulnerability and lethality M&S tools. Specifically, JASP:

- Developed a fire-mitigating mist control additive for Polyalphaolefin Oil avionics cooling fluid to reduce the vulnerability of aircraft to onboard fires. Testing to validate the additive's effectiveness is ongoing. If proven effective, JASP will investigate the possibility of applying the technology for other common aircraft flammable fluids..
- Continued the development of a methodology to optimize self-sealing fuel bladder fabric design for crashworthiness and revised fuel bladder qualification procedures (and test fixtures) to improve fuel cell test quality and assessment credibility. The self-sealing and crashworthiness capability of fuel cell bladders commonly used to improve rotorcraft safety and survivability are a continuing tri-service concern.
- Assessed the effect of high energy laser effects on baseline and hardened aircraft components, identified the most promising hardening solutions for maturation, and quantified the mission impacts and benefits. This effort also provided data enabling a more credible survivability assessment of U.S. aircraft against high energy lasers.
- Tested a new armor, demonstrating its capability to stop a projectile at up to 40 percent reduction in area density over the legacy armor for the same significant, unguided threat to aircraft and occupants, particularly in low altitude operations. This innovative technology considerably improves the options available to programs and commanders to protect personnel and flight critical components.
- Constructed a test setup that will provide validation of composite joint shear analysis under threat-induced hydrodynamic loading. JASP also continued validation of a rapid structural vulnerability assessment tool providing a new capability to evaluate structural vulnerability earlier in the aircraft development lifecycle.

USSOCOM Collaboration

In FY21, JASP partnered with the United States Special Operations Command (USSOCOM) Program Executive Office – Fixed Wing (PEO-FW) to synchronize the efforts and support the PEO-FW mission through cross-Service awareness and collaboration on aircraft survivability technologies and methodologies. This cooperation led to several technical developments with the potential for future transition, including reduced weight armors, advanced missile warning sensors, and radio frequency and infrared countermeasures.