Aviation DIGEST

UNITED STATES ARMY

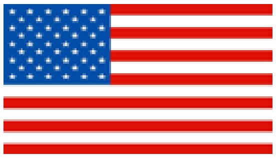
April–June 2024
Volume 12/Issue 2

AVIATION IN THE COMBINED ARMS FIGHT

IN THIS ISSUE:

THE PROFESSIONAL BULLETIN OF THE ARMY AVIATION BRANCH

UNITED STATES ARMY **Aviation** DIGEST
The Professional Bulletin of the Army Aviation Branch, Headquarters, Department of the Army, PB 1-24-2
April-June 2024
Volume 12/Issue 2



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Division Chief: LTC Julie A. MacKnyght
https://armyeitaas.sharepoint-mil.us/sites/TR-ACOE-DOTD/SitePages/DTAC.aspx

The Doctrine and Tactics Division, Directorate of Training and Doctrine (DOTD), U.S. Army Aviation Center of Excellence (USAACE), Fort Novosel, AL 36362 produces the *Aviation Digest* quarterly for the professional exchange of information related to all issues pertaining to Army Aviation. The articles presented here contain the opinion and experiences of the authors and should not be construed as approved Army policy or doctrine.

Aviation Digest is approved for public release. Distribution is unlimited. This publication is available through electronic media by accessing the DOTD SharePoint site or the *Aviation Digest* web page at https://home.army.mil/novosel/index.php/aviationdigest and is intended for the use of command levels C, D, and E for the Active Army, the Army National Guard, and the U.S. Army Reserve.

Archive issues of *Aviation Digest* (1955-2021) are available on the DOTD SharePoint site at https://armyeitaas.sharepoint-mil.us/sites/TR-ACOE-DOTDRUCKER/SitePages/DTAC-Library.aspx.

Issues from 2013-present may be found on the *Aviation Digest* web page.

Submit articles or direct comments pertaining to the *Aviation Digest* to: usarmy.novosel.avncoe.mbx.aviation-digest@army.mil

By Order of the Secretary of the Army:

RANDY A. GEORGE
General, United States Army
Chief of Staff

Official:

MARK F. AVERILL
Administrative Assistant
to the Secretary of the Army
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A U.S. Army Soldier conducts sling load operations during Operation Lethal Eagle III on August 7, 2023, at Fort Campbell, Kentucky. The operations demonstrate the brigade's ability to move equipment over long distances to assist with Large-Scale Combat. U.S. Army photo by SGT Kaden D. Pitt.

The Command Corner

Army Aviation-A Decisive Team for Ground Commanders

Army Aviation fights to win; but we don't do it alone or for ourselves. Army Aviation exists for the Soldier, Operator, or Warfighter on the ground. The intricacies of how we win together is more complicated. As Army Aviation began transitioning from the counterinsurgency to large-scale combat, we acknowledged that we must continue to learn, and our equipment; doctrine; and tactics, techniques, and procedures (TTPs) must continue to evolve. The adversary, our start point, has changed. Just as we have observed and made changes to counter our peer/near-peer adversaries' vulnerabilities, the threat has done the same. Additionally, technology is evolving faster and becoming more prolific as we are seeing on the battlefields of Ukraine. Cell phones, and off-the-shelf drones have significantly impacted the ability to detect and kill enemy soldiers.

Unlike Desert Shield and Desert Storm, or even Operation Iraqi Freedom, our adversaries will not afford us the luxury of building up our force in a theater before hostilities commence. Our adversaries can better execute antiaccess capabilities that disrupt our entry into theater using a variety of capabilities from cyber, information warfare, and space, to missile systems. While these measures to preclude our entry and build up in theater are formidable, they are not insurmountable. Army Aviation, due to our extensive use of terrain and proven TTPs, offers unique avenues of approach. This is especially true for our future systems like the Future Long-Range Assault Aircraft (FLRAA) and Future Aviation Tactical Ecosystem (FATE).

Our Joint and Army ground forces rely on Army Aviation, as an incredibly lethal part of the combined arms team, to enhance their survivability by presenting multiple dilemmas to the enemy. To do this, we must understand threat capabilities. This understanding cannot be limited to just our Intelligence personnel (e.g., S2 and G-2). Leaders at all levels must have detailed understanding of the adversary's doctrine, tactics, and their equipment capabilities. Leader development training, starting with Field Manual (FM) 3-0, "Operations," Army Techniques Publication (ATP) 7-100.1, "Russian Tactics," ATP 7-100.3, "Chinese Tactics," and ATP 2-01.3, "Intelligence Preparation of the Battlefield,"[1] will help prepare them for this task.

The employment of Army Aviation on the battlefield is captured in FM 3-04, "Aviation Operations," and provides the meat of how we operate as part of the combined arms team and collectively conduct fire and maneuver to defeat a peer threat. Field Manual 3-04 describes how our seven core competencies—binned into the easy-to-remember categories of ***See/Sense, Strike, Move, and Extend***—integrate into divisional or corps' close, deep, and rear operations. Additionally, ATP 3-04.1, "Aviation Tactical Employment," is descriptive of fundamental principles and techniques Army Aviation can use to defeat adversaries in competition and enemies in armed conflict. Both manuals are being updated and will be released in this calendar year to provide additional detail on how manned and unmanned capabilities integrate into schemes of maneuver, fires, intelligence, sustainment, and protection at echelon.

Army Aviation will have to reduce its footprint at the tactical level and operate dispersed, in smaller assembly areas, to increase survivability against surface-to-surface fires—our number one threat. This will require Aviation elements to use their inherent mobility to traverse extended distances, rapidly mass ground forces, remain on station with sufficient fuel and munitions to kill and disrupt the threat, and rapidly disaggregate our combined arms teammates to enhance their own survivability. Our Future Vertical Lift (FVL) capabilities, in the form of FLRAA and FATE, will team manned and unmanned platforms enabling us to accomplish this task on the future battlefield.

Despite the decision to discontinue Future Attack and Reconnaissance Aircraft (FARA) at the end of this fiscal year, other components of FVL remain critical, are on track, and moving quickly. The FLRAA provides power projection from relative sanctuary with increased range, speed, endurance, mobility, sustainability, and payload over current Army and U.S. Special Operations Command Black Hawks. We will mitigate the reconnaissance gap in the near-term by layering the improved AH-64E, unmanned systems (Future Tactical Unmanned Aircraft Systems), Launched Effects, and space-based assets when available and allocated.

While some may be discouraged over the FARA decision, let me say—we have been here before. The Army has undergone a significant transformation every 40 years over the last century and learned lessons on balancing modernization and readiness. The Army has moved on from programs before. In Army Aviation, we have seen such programs as the AH-56, YUH-61, XCH-62, and ARH-70 inform future efforts, and we are leveraging our inherent flexibility once more. The takeaway is that each of these programs contributed to our ability to improve.

Army Aviation is committed to the Soldiers on the ground—it's our sacred trust. We fight as an effective, lethal, and highly maneuverable force by understanding the threat, utilizing terrain, and precise execution. We train continuously with rigor and discipline to produce tactically and technically proficient leaders and Soldiers. We remain a formidable threat to the enemy because of these factors, and we dominate during large-scale combat—today and tomorrow.

Above the Best!

Fly Army!

Michael C. McCurry
Major General, USA
Commanding

[1] Per FM 2-0, "Intelligence," published last Fall, "Battlefield" has been replaced with "Operational Environment," so the term is now "Intelligence Preparation of the Operational Environment."

Aircrews from the 4th CAB and 3D ABCT unite for sling load, air assault operations on Fort Carson, Colorado. U.S. Army photo by SGT Jonathan Thibault.

Aviation DIGEST

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Author Guidelines

Articles prepared for *Aviation Digest* should relate directly to Army aviation or reflect a subject that directly relates to the aviation professional. Submit the article to the *Aviation Digest* mailbox at usarmy.novosel.avncoe.mbx.aviation-digest@army.mil.

Please note that *Aviation Digest* does not accept previously published work or simultaneous submissions. This prevents an overlap of material in like publications with a similar or same audience.

Aviation Digest is an open-source publication. As such, we do not accept articles containing For Official Use Only or Classified materials. Please do not submit articles containing Operations Security (OPSEC) violations. If possible, have articles reviewed by an OPSEC officer prior to submission.

Please submit articles via MS Word document format. Articles should not exceed 3500 words. Include a brief biography (50 word maximum) with your article. We invite military authors to include years of military service, significant previous assignments, and aircraft qualifications in their biographies.

Aviation Digest editorial style guidelines follow the American Psychological Association Publication Manual, 7th edition; however, Digest staff will incorporate all necessary grammar, syntax, and style corrections to the text to meet publication standards and redesign visual materials for clarity, as necessary. Please limit references to a maximum of 20 per article. These changes may be coordinated with the authors to ensure the content remains accurate and reflects the author's original thoughts and intent.

Visual materials such as photographs, drawings, charts, or graphs supporting the article should be included as separate enclosures. Please include credits with all photographs. All visual materials should be high-resolution images (preferably set at a resolution of 300 ppi) saved in TIFF or JPEG format. For Official Use Only or Classified images will be rejected.

Non-military authors should submit authorization for *Aviation Digest* to print their material. This can be an email stating that *Aviation Digest* has permission to print the submitted article. Additionally, the author should provide a separate comment indicating that there is no copyright restriction on the use of the submitted material.

The *Aviation Digest* upcoming article deadline and publication schedule is as follows:

October-December 2024 (published on or around 15 November 2024). Accepting articles now through 15 August 2024.

January-March 2025 (published on or around 15 February 2025). Accepting articles now through 01 November 2024.

April-June 2025 (published on or around 15 May 2025). Accepting articles now through 15 February 2025.

Authors are asked to observe posted deadlines to ensure the *Aviation Digest* staff has adequate time to receive, edit, and layout materials for publication.

Notices to Air Missions (NOTAMs)

Directorate of Training and Doctrine Director (COL Sean C. Keefe):

The Directorate of Training and Doctrine continues to lead significant transformation efforts within the U.S. Army Aviation Branch. Our key priorities involve developing tasks and training to mitigate unanticipated yaw and spatial disorientation challenges, updating the Army Aviation Training Strategy (AATS) and its embedded Flying Hour Model, establishing crew readiness standards for training readiness reporting, overhauling Warrant Officer professional military education, reworking Aviation Mission Survivability maneuvers, and continuously refining our doctrine.

Recently, the Combined Arms Center has implemented the Army Quick Fire Observation Tool (link and QR code included here) to enable every Soldier to rapidly share key lessons learned from any computer or mobile device. This tool allows Soldiers at all echelons to share observations directly with the Center for Army Lessons Learned and Centers of Excellence to drive change and implement best practices.

https://armyeitaas.sharepoint-mil.us/teams/lessonslearned/SitePages/Quick-Fire-Obs.aspx

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Are you an *Aviation Digest* subscriber? Are you missing our issue release notices each quarter? Our distribution list has been updated, so please re-subscribe at https://home.army.mil/novosel/index.php/aviationdigest if you still wish to receive our emails.

Training Division Chief (Mr. Bo Thurman):

If you have questions for the Directorate of Training and Doctrine's Training Division, please feel free to contact us at usarmy.novosel.avncoe.mbx.dotd-training-division@army.mil

If you need access to the Aircrew Training Manuals (ATMs), they are located at the following common access card-enabled link: https://armyeitaas.sharepoint-mil.us/:f:/r/sites/TR-ACOE-DOTD/Flight%20Training%20Branch%20Documents/ATMs?csf=1&web=1&e=OoMPRY

The Directorate of Training and Doctrine wants to hear from ALL military occupational specialty (MOS) 15N, 15C, 151A, and 15G Soldiers. We value your opinion, your experience, and your time and would like all of you to complete these surveys.

The Avionic Mechanic MOS 15N survey will close 30 June 2024. Participants can access the survey using the QR code or the link below: https://survey.tradoc.army.mil/EFM/se/0AFDD71A275E9210

The Aviation Maintenance Technician MOS 151A survey is now open and will close 17 January 2025. Participants can access the survey using the QR code or the link: https://survey.tradoc.army.mil/EFM/se/0AFDD71A5CD34007

The MQ-1 UAS Operator MOS 15C survey is now open and will close 01 August 2024. Participants can ac-cess the survey using the QR code or the link: https://survey.tradoc.army. mil/EFM/se/0AFDD71A00E3D159

The Aircraft Structural Repairer MOS 15G survey is now open and will close 9 March 2025. Participants can access the survey using the QR code or the link: https://survey.tradoc.army.mil/EFM/se/0AFDD71A51405267

Doctrine and Tactics (DTAC) Division Chief (LTC Julie MacKnyght):

"How do I get the updated version?"

This is a question I'm asked frequently when briefing our primary aviation doctrine reference, the **doctrine placemat**, to various professional military education courses. The doctrine placemat is an incredibly powerful tool generated by our doctrine branch, and if you've never heard of it, please check it out!

-Page one hyperlinks you directly to every DOTD-generated doctrinal or training publication (to include our ATMs, TSPs, annual ACT training, and Branch standard operating procedures [SOPs]), as well as Army regulations and multiservice tactics, techniques, and procedure (TTP) manuals of import to Army Aviators.

CTSSB

Critical Task Site Selection Board

Name	Abr.	Last Board	Next Board	Location
Aviation Master Gunner	AMG	Nov 2021	Jul 2024	Ft. Novosel/MS Teams
Aircraft Powerplant Repairer	15B	Apr 2019	22-26 Jul 2024	Ft. Eustis
Army Avionics Mechanic	15N	Feb 2020	23-27 Sep 2024	Ft. Eustis
MQ1 UAS Operator	15C	Jun 2021	27-31 Jan 2025	Ft. Novosel/MS Teams
Aviation Maintenance Technician - Warrant Officer Course (WOBC)	151A WOBC	May 2021	24-28 Feb 2025	Ft. Eustis
ALSE Technician	ALSE	Oct 2022	10-14 Mar 2025	Ft. Novosel/MS Teams
Black Hawk Pilot	UH-60	Aug 2020	11-13 Mar 2025	Ft. Novosel/MS Teams
Chinook Pilot	CH-47	Sep 2020	8-10 Apr 2025	Ft. Novosel/MS Teams
15 Series Common Aviation Maintenance	15 CAM	Jul 2022	5-9 May 2025	Ft. Novosel/MS Teams
Aircraft Structural Repairer	15G	Jul 2022	5-9 May 2025	Ft. Eustis
Army UH-60 Helicopter Repairer	15T	July 2021	14-18 Jul 2025	Ft. Eustis
UAS Operations Technician	150U	Oct 2022	11-15 Aug 2025	Ft. Novosel/MS Teams
Aircraft Electrician	15F	Sep 2021	15-19 Sep 2025	Ft. Eustis

FY24 - FY25

To realize military occupational specialty (MOS) training modernization goals, we need our Aviation Soldiers, Senior Enlisted Advisors, and Leaders in the Field to respond to Aviation Critical Task Site Selection Board (CTSSB) surveys distributed by DOTD, to help determine what Soldier MOS tasks should stay in training and what should go. Our leaders must also enable the CTSSB process by ensuring that their most talented and proficient Soldiers will participate in these boards when called. This is your opportunity to affect change in Army Aviation.

For more information on upcoming CTSSBs please contact the Directorate of Training and Doctrine (DOTD) @ (334) 255-3502.

-Page two shows a curated starting point of non-aviation doctrine relevant to our commanders and staffs (horizontally by warfighting function and vertically by echelon), as well as the DoD, Army, and sister service online dictionaries, all hyperlinked.

-The last link on the bottom right, to ALSSA, the Air Land Sea Space Application Center, is where the multiservice TTP manuals reside; we highlighted five on page one but there are many more that may be applicable to your unit's missions, so take a look! The ALSSA's vision is to improve tactical integration and lethality across all domains. When they recently added "Space" to their name, our suggestion to put it at the front of the acronym was respectfully declined.

So, where do I get this doctrine placemat? Two options:

• **Doctrine Branch SharePoint site** (https://armyeitaas.sharepoint-mil.us/sites/TR-ACOE-DOTD/SitePages/Doctrine-Branch.aspx), "Useful References" folder halfway down the page on the left: https://armyeitaas.sharepoint-mil.us/:f:/r/sites/TR-ACOE-DOTD/Doctrine%20Branch%20Documents/Useful%20References?csf=1&web=1&e=EcQQ4t: select "Current Aviation Doctrine Placemat" PowerPoint.

• **USAACE LSCO LPD MS Teams "DOCTRINE OUTREACH" Channel**, files section. If you're not a member yet, click the plus sign → "join team" at the top of your teams list, select "join a team with a code," and use "dp8dpxd."

If, after confirming you have the current posted version, and you find an error of any kind, please notify our team at: usarmy.novosel.avncoe.mbx.doctrine-branch@army.mil, and share liberally!

Gunnery Branch (Branch Chief: CW4 Steve Dickson):

It has been more than a year since the latest version of Training Circular (TC) 3-04.3, "Aviation Gunnery," was released, and the Master Gunners here at the Gunnery Branch have received significant feedback from units around the world. The feedback we receive is starting to drive the next revision of TC 3-04.3. The Gunnery Branch is looking to have the next TC 3-04.3 revision ready to start the publications process by the end of 2024. Any feedback or suggestions that units have for completing gunnery training and qualification requirements should be submitted to Gunnery Branch before the end of the year. Please keep sending those Department of the Army Form 2028s!

As the Army continues to transition from counterinsurgency operations (COIN) to Large-Scale Combat (LSCO), one topic that has been brought up frequently is the role of an Aviation Master Gunner during LSCO. Training Circular 3-04.3 explains that Aviation Master Gunners help, teach, put into place, and carry out live-fire training, competency, and mastery exercises while in garrison environments and during COIN operations where time exists to conduct gunnery training and simultaneously conducting combat operations. But what happens in the fast-paced, resource constrained LSCO environment when time does not exist to conduct gunnery training? To answer this question, we must look at what an Aviation Master Gunner is and how their expertise contributes to brigade mission planning, preparation, and execution. Field Manual 3-04, "Army Aviation," states that the Aviation Master Gunner "advises the commander and staff in the selection of weapons and employment techniques during the mission planning process" (2020, p. 2-20), while TC 3-04.3 explains that the Aviation Master Gunner is an aviation platform weapon systems subject matter expert at the brigade, battalion, and squadron levels. When we look at how brigades will support divisions and higher echelons during LSCO and the grand scale of mission planning, preparation, and execution that is associated with it, having a subject matter expert who is knowledgeable with all aviation weapon systems is crucial. Having someone who has detailed information on aviation weapon systems' capabilities, limitations, destructive capacity, effects on enemy countermeasures, environment, and methods of employment, will be vital when conducting "Battlefield Calculus" during brigade-level mission planning. Command-ers and staff need to include Aviation Master Gunners into the mission planning process to ensure mission success.

Tactics Branch (Branch Chief: CPT John [Logan] Meehan):

Our Lessons Learned Team would like to recognize and commend the support of the 1st Armored Division Combat Aviation Brigade (CAB), National Training Center team, and 3D CAB for hosting members of the Directorate of Training and Doctrine (DOTD) at their exercises and Post Deployment Collections Visits. Valuable insights and lessons were garnered from these experiences and will be used to shape and inform future doctrine, collective training, and deployment preparations. We are always looking for new opportunities to observe and learn from the force.

The Tactics Branch at DOTD strives to gather, integrate, and disseminate current best practices; tactics, techniques, and procedures; challenges; and perspectives from across the Aviation Branch. The "Lessons Learned" section of our SharePoint serves as a resource to units as they prepare for missions, exercises, and deployments, with recent additions including outputs from Operation Lethal Eagle II, Joint Pacific Multinational Readiness Center rotation 24-01, and more. Please send us your unit's products to be published on SharePoint, Center for Army Lessons Learned, and Joint Lessons Learned Info System to enable and enhance success across the force.

The Collective Team works within the Tactics Branch and is continuously reviewing, refining, and updating Unit Task Lists, Mission Essential Tasks, and Combined Arms Training Strategies. Feedback from the operating force is vital to ensure that tasks remain relevant and correct. Provide any feedback to usarmy.rucker.avncoe.mbx.dotd-collective@army.mil and we will get back to you as soon as possible to make appropriate additions and revisions. The DOTD Tactics Branch Lessons Learned SharePoint Link is located at Tactics & Lessons Learned https://armyeitaas.sharepoint-mil.us/sites/TR-ACOE-DOTD/SitePages/Tactics-&-Lessons-Learned.aspx

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Doctrine Branch (Branch Chief: MAJ Ashley Howard):

The Doctrine Branch continues to shape the channels of change with revision across all aviation publications with widespread impacts to risk management, in addition to keystone and capstone doctrine.

Pending releases: Field Manual 3-04, "Army Aviation," Army Techniques Publication 3-04.1, "Aviation Tactical Employment," Training Circular (TC) 3-04.5, "Instrument Flight for Army Aviators," TC 3-04.71, "Commander's Aviation Maintenance Training Program," and aviation maintenance and aviation safety standard operating procedures (SOPs). Keep an eye out for digital "knee-board cards" for these publications, which will be available in the Fall, FY24.

Have an idea on how Army Aviation can do business better? Now is the time to submit documented, well thought-out changes! Submit a Department of the Army Form 2028 today to usarmy.novosel.avncoe.mbx.doctrinebranch@army.mil. Particular areas of interest are: TC 3-04.4, "Fundamentals of Flight," Aviation Branch Operations SOPs, aviation sustainment in maritime operations, and command and control as far forward as the division deep area.

U.S. ARMY

Address Book:

Fort Novosel has gone through several SharePoint migrations in the past year.

As of 4 March 2024, the active DOTD public-facing SharePoint is: https://armyeitaas.sharepoint-mil.us/sites/TR-ACOE-DOTD

Training: https://armyeitaas.sharepoint-mil.us/sites/TR-ACoE-DOTD/SitePages/Training-Division.aspx

DTAC: https://armyeitaas.sharepoint-mil.us/sites/TR-ACoE-DOTD/SitePages/DTAC.aspx

Aviation Leader Kit Bag: new address! https://armyeitaas.sharepoint-mil.us/sites/TR-ACoE-ALKB

Aviation Training Strategy: https://armyeitaas.sharepoint-mil.us/sites/TR-ACOE-DOTD/DOTD%20Documents/Forms/AllItems.aspx?id=%2Fsites%2FTR%2DACOE%2DDOTD%2FDOTD%20Documents%2FArmy%20Aviation%20Training%20Strategy%2Epdf&parent=%2Fsites%2FTR%2DACOE%2DDOTD%2FDOTD%20Documents

Aviation Branch Operations SOP, Annex A (Aviation Handbook), Annex B (Aviation Liaison Officer/Brigade Aviation Element Handbook), Annex C (Risk Common Operating Procedure), and Branch Maintenance SOP:
https://armyeitaas.sharepoint-mil.us/:f:/r/sites/TR-ACOE-DOTD/Aviation%20Branch%20SOPs/Aviation%20Branch%20Operations%20SOP?csf=1&web=1&e=M3gYgb

DOTD Education and Technology Branch *(questions regarding the development and/or the development, implementation, and administration of interactive multimedia instruction)*
- Branch Chief: Mr. Chuck Sampson at 334-255-0198 or charles.l.sampson10.civ@army.mil
- TRADOC SharePoint: https://armyeitaas.sharepoint-mil.us/sites/TR-ACOE-DOTD/SitePages/Educational-Technologies.aspx

DOTD Enlisted Training Branch *(questions regarding NCO professional military education [PME] and AVN Operations/Unmanned Aircraft Systems initial military training [IMT], ATC/UAS Warrant Officer Basic Course, and Aviation Life Support Equipment)*
- Branch Chief: Mr. Morris Anderson at 334-255-1909 or morris.anderson2.civ@army.mil
- TRADOC SharePoint: https://armyeitaas.sharepoint-mil.us/sites/TR-ACOE-DOTD/SitePages/Enlisted-Training-Branch.aspx

DOTD Flight Training Branch *(questions regarding ATMs, Training Support Packages, SOPs)*
- Branch Chief: CW5 Lucas Abeln at (334) 255-0363 or lucas.k.abeln.mil@army.mil
- TRADOC SharePoint: https://armyeitaas.sharepoint-mil.us/sites/TR-ACOE-DOTD/SitePages/Flight-Training-Branch.aspx

DOTD Flight Training Integration Branch *(questions regarding aviation flight programs of instruction [POIs])*
- Branch Chief: Mr. Brian Stewmon at 334-255-3119 or william.b.stewmon.civ@army.mil
- TRADOC SharePoint: https://armyeitaas.sharepoint-mil.us/sites/TR-ACOE-DOTD/SitePages/Flight-Training-Integration-Branch.aspx

DOTD New Systems Integration Branch *(questions regarding new system training deliverables, e.g., system training plans)*
- Branch Chief: Ms. Kelly Raftery at 334-255-9668 or kelly.a.raftery.civ@army.mil
- TRADOC SharePoint: https://armyeitaas.sharepoint-mil.us/sites/TR-ACOE-DOTD/SitePages/New-Systems-Integration-Branch.aspx

DOTD Officer Training Branch *(Questions about officer and WO IMT, PME, and non-flight functional courses)*
- Branch Chief: CPT Tyler R. Straits at 334-255-0433 or tyler.r.straits.mil@army.mil
- TRADOC SharePoint: https://armyeitaas.sharepoint-mil.us/sites/TR-ACoE-DOTD/SitePages/Officer-Training-Branch.aspx

DOTD Maintenance Training Branch *(questions about Joint Base Langley-Eustis/128th Aviation Brigade IMT, PME, and functional courses)*
- Branch Chief: Mr. Philip Bryson at 757-878-6176 or philip.e.bryson.civ@army.mil
- TRADOC SharePoint: https://armyeitaas.sharepoint-mil.us/sites/TR-ACoE-DOTD/SitePages/Maintenance-Training-Branch.aspx

Faculty & Staff Development Branch *(questions regarding USAACE faculty and staff courses and/or questions about Instructor and Developer training and certification)*
- Branch Chief: Ms. Suzanne Vaughan at 334-255-2124 or suzanne.a.vaughan2.civ@army.mil

DOTD Doctrine & Sustainment Branch *(questions regarding Field Manual [FM], ATPs, TCs)*
- Branch Chief: MAJ Ashley Howard at 334-255-1796 or ashley.h.howard.mil@army.mil
- Group Mailbox: usarmy.novosel.avncoe.mbx.doctrine-branch@army.mil
- SharePoint: https://armyeitaas.sharepoint-mil.us/sites/TR-ACoE-DOTD/SitePages/Doctrine-Branch.aspx?csf=1&web=1&e=fFpkxS
- FMs, ATPs, and TCs are published by APD at https://armypubs.army.mil/
- Living Doctrine FM 3-04 (2015) Archive: https://armyeitaas.sharepoint-mil.us/:f:/r/sites/TR-ACOE-DOTD/Doctrine%20Branch%20Documents/ARCHIVE/Living%20Doctrine?csf=1&web=1&e=SYzlcG

DOTD Tactics and Collective Training Branch *(questions regarding Lessons Learned, Unit Mission-Essential Task Lists/Mission-essential tasks/Training & Evaluation Outlines/Task Lists/CATS, or Aviation Digest)*
- Branch Chief: CPT John (Logan) Meehan at 334-255-1252 or john.l.meehan@army.mil
- Group Mailbox: usarmy.novosel.avncoe.list.dotd-tactics-division@army.mil
- SharePoint: https://armyeitaas.sharepoint-mil.us/sites/TR-ACOE-DOTD/SitePages/Tactics-&-Lessons-Learned.aspx
- AD Archives: https://armyeitaas.sharepoint-mil.us/sites/TR-ACOE-DOTD/Aviation%20Digest%20Documents/Forms/AllItems.aspx
- Aviation Digest public site: https://home.army.mil/novosel/index.php/aviationdigest

DOTD Survivability Branch *(questions about all things AMS, Quick Reaction Tests, Computer-Based ASE Training, 2800/2900 Training Support-Packages, Aircraft Survivability Equipment home-station training)*
- Branch Chief: CW4 Chris Crawford at 334-255-1853 or christopher.p.crawford8.mil@army.mil
- Group Non-Secure Internet Protocol Router (NIPR) Mailbox: usarmy.novosel.avncoe.mbx.ams@army.mil
- Group Secure Internet Protocol Router (SIPR) Mailbox: usarmy.novosel.avncoe.mbx.ams@mail.smil.mil
- Intelinks NIPR/SIPR: https://intelshare.intelink.gov/sites/army-ams/ and https://intelshare.intelink.sgov.gov/sites/army-ams/

DOTD Gunnery Branch *(questions about all things gunnery, Master Gunner Course, Ranges, Standards in Training Commission)*
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New Need for Pathfinders in a Contested Environment

The Super Saturday Air Show at Campbell Army Airfield, Fort Campbell, Kentucky, celebrates the 101st Airborne Division's 70-year legacy of the air assault division and its history of valor. U.S. Army photo by SGT Shanika Futrell.

By CW3 Jody S. Clark

"Semper Primus" (Always First) has been the official motto of U.S. Army Pathfinders since their inception in WWII, attesting to clandestine operations of small groups behind enemy lines guiding the larger forces into battle.

Currently, the more fitting motto of "First In, Last Out" references a Pathfinder's being the last to leave a landing zone (LZ) during an operation (Burns, 2002, pp. 8 and 11; National Pathfinder Association, 2017). With future operations in Large-Scale Combat (LSCO), smaller military units will operate as part of a larger team assigned to accomplish a tactical objective, requiring these units to have the internal ability to move, set, and relocate rapidly. The U.S. Army should allow for key personnel within aviation battalions to become Pathfinder qualified to improve LZ setup capability, allow for rapid relocation operations, and to operate with minimal outside support.

Improving LZ set up is a capability that requires specially trained personnel to rapidly reconnoiter, select, design, and improve sites for use. Pathfinders are certified in the specific tasks, along with the additional capabilities to control the LZ from the beginning to the end of operations at each selected location (Department of the Army, 2006, pp. 1-1 to 1-2). A LSCO environment creates a more complex environment where we may not have the imagery or intelligence we are used to having and will necessitate having individuals who can complete these tasks manually and with great precision (Rempfer, 2020).

As the operation progresses, Pathfinders will enable rapid relocation operations as each progressive force bounds, requiring another Pathfinder to stage on a future LZ. These relocations will be required often, for both offensive and defensive reasons. According to the National Pathfinder Foundation's history page, the idea of forging ahead for relocating, using tempo and audacity to surprise the enemy, and keeping the enemy on the retreat has been around since the inception of Pathfinders in WWII (2017, para. 1). The job has adjusted to the various needs required through the Korean War, Vietnam, the wars in the Middle East, and now needs to adjust again for future operations in LSCO.

To have the capability to operate with minimal outside support, Army Aviation rotary-wing units will be obligated to move

Soldiers conduct Pathfinder training from a UH-60 Black Hawk helicopter. The U.S. Army Pathfinder school teaches Soldiers to infiltrate areas and set up parachute drop zones for airborne and air assault operations. U.S. Army photo by Patrick Albright, Maneuver Center of Excellence, Fort Moore Public Affairs Office.

their own equipment in an austere environment. This will require sling-loading vehicles and other equipment if terrain does not facilitate ease of movement for ground vehicles, possibly utilizing another unit's assistance (Department of the Army, 2020). The utilization of Pathfinders for slingloading equipment is crucial to operations; not having qualified personnel within the unit's formation requires the commander to rely on outside forces to complete the mission.

In the future conflicts within the LSCO environment, bounding to successive LZs will need to be accomplished more rapidly than ever. Every unit will be required to be able to deploy to an area, get set for operations, and continue to repeat as necessary until the mission is complete. The U.S. Army should allow for key personnel within aviation battalions to become Pathfinder qualified to improve LZ set-up capability, allow for rapid relocation operations, and to operate with minimal outside support to make operations easier, faster, and without undue issues from depending on outside forces.

Biography:

CW3 Jody Clark began his career as an Army Air Traffic Controller with some exposure to Pathfinder operations for setting up LZs and multiple sling-load movements. Currently, CW3 Clark is an AH-64D/E pilot and Aviation Mission Survivability Officer with a background as an Aviation Safety Officer—both positions at the company/troop and battalion/squadron level.

U.S. Army CPT, Ethan Hall, operates a Black Hawk during a Pathfinder field training exercise course at Mihail Kogălniceanu Air Base, Romania. U.S. Army photo by SPC Andrew Mendoza.

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On the Wings of Destiny: Operation Eagle Eclipse and the 101st Combat Aviation Brigade's Future in Large-Scale Long-Range Air Assault Operations

By 1LT Charlie O'Brien, MAJ Ronald Braasch, MAJ Sean Boniface, and COL Clinton Cody

On the evening of January 13, 2024, the skies of Fort Johnson, Louisiana, erupted as 16 AH-64 Apache helicopters from 2D Squadron-17th Cavalry Regiment (2-17th) "Out Front" conducted a live-fire exercise on a templated enemy position located on Peason Ridge. This out-of-contact spoiling attack, which launched from Fort Campbell, Kentucky, initiated the largest and most overwhelming rotary-wing training operation in recent history. Moments later, 16x CH-47 Chinooks and 22x UH-60 Black Hawks delivered 481 Soldiers, 20 Infantry Squad Vehicles (ISVs), and five M119 howitzers from the 101st Airborne Division's 2D Brigade Combat Team (2BCT), "Strike." Four helicopter landing zones (HLZs) swarmed with Strike Soldiers secured by 10 Apaches from the 1st Battalion, 101st Aviation Regiment (101st) "No Mercy." In one period of darkness (POD), the 101st Combat Aviation Brigade (CAB) "Wings of Destiny," launched 76 aircraft executing 743 flight hours and covering 500 nautical miles (nm), allowing Strike to seize a lodgment against the tenacious and well-trained Geronimo forces of the Joint Readiness Training Center (JRTC). Over the next 36 hours, the CAB air assaulted additional combat power from an intermediate staging base (ISB) amassing 838 Soldiers, 72 ISVs, 28 High Mobility Multipurpose Wheeled Vehicles, five M119 howitzers, and 23 other vehicles/trailers, totaling 128 pieces of equipment delivered. The successful execution of Eagle Eclipse was built upon a well-developed road to war and "left of crank" preparations prior to the mission. Moreover, it required innovative sustainment and mission command programs. This large-scale long-range air assault (L2A2)[1] and synchronized out-of-contact attack on key enemy assets ensured the success of Operation Eagle Eclipse and proved the "Wings of Destiny" Brigade is in a unique position to continue pushing the envelope for Army Aviation in the only Air Assault Division (Worley, 2024).

Execution of Eagle Eclipse

Operation Eagle Eclipse was an L2A2 from Fort Campbell to the training area at Fort Johnson. MG Sylvia, the Division Commander, was the Air Assault Task Force Commander. COL Stultz, the 2BCT Commander, was the Ground Force Commander, and COL Cody was the Aviation Task Force Commander (Figure 1).

The operation required four forward sustainment nodes: the forward arming

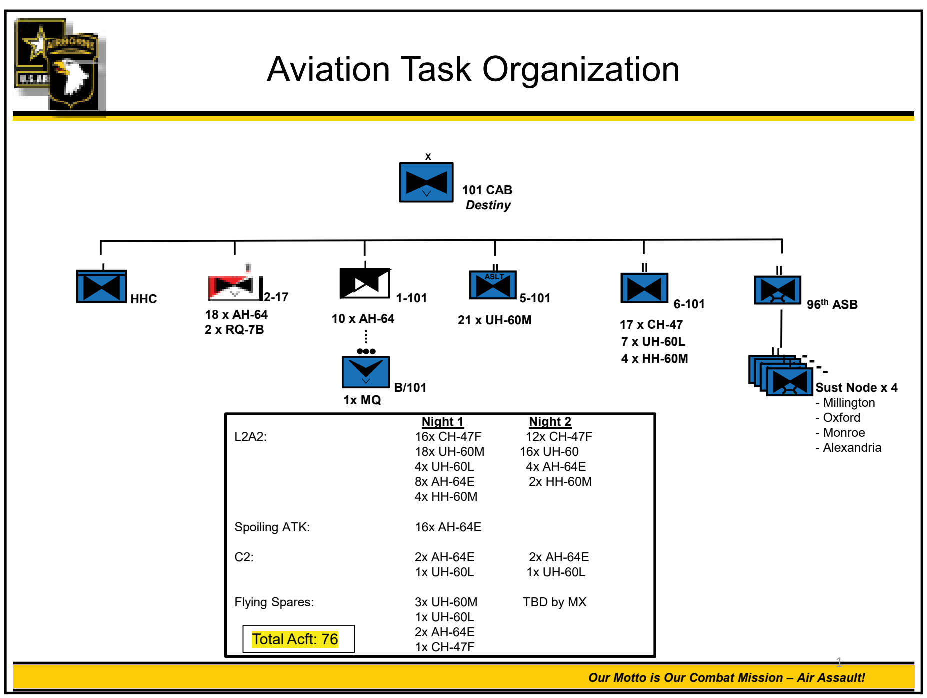


Figure 1. Task organization for Operation Eagle Eclipse (101st Airborne G5 shop—edited by the 101st CAB).

[1] L2A2 is an evolving method of employing AASLT that is not yet codified in doctrine.

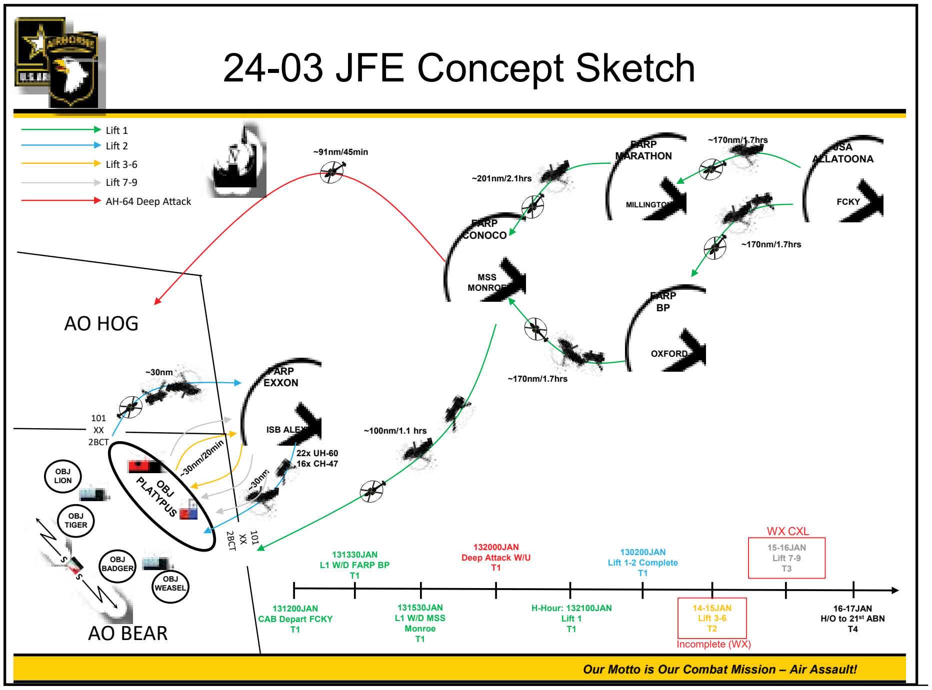


Figure 2. Concept of Operation Eagle Eclipse (101st Airborne G5 shop—edited by the 101st CAB).

and refueling point (FARP) Marathon in Millington, Tennessee; FARP British Petroleum (BP) in Oxford, Mississippi; mission support site (MSS) Monroe in Monroe, Louisiana; and ISB Alexandria in Alexandria, Louisiana, which contained three separate FARP sites (Figure 2).

The operation began with a spoiling attack of 16 AH-64s from the 2-17th. The 2-17th was tasked to conduct an attack against enemy forces out of close friendly contact, in order to set conditions for the air assault. Through high confidence intelligence, detailed fuel planning, and thorough engagement area (EA) development, the 2-17th's movement and subsequent actions on the objective were swift and decisive, allowing for the air assault to continue on time. The phased attack employed four platoons consisting of four AH-64s each. The 2-17th staggered the departure of each platoon from Sabre Army Airfield, Fort Campbell, armed and refueled at Monroe, and serviced the EA located on Peason Ridge to ensure continuous fires on the objective. Through battle handovers and cumulative battle damage assessment,the 2-17th verified the destruction of a mechanized reconnaissance unit north of the HLZs, clearing the way for the assault force.

While the attack was underway, eight lifts took off in 30-minute intervals, refueling at the FARP's BP or Marathon before continuing to MSS Monroe. At Monroe, crews refueled and received an operations and intelligence (O&I) update, then flew to one of four HLZs under the security of AH-64s from "No Mercy." Following this initial lift, the aircraft flew to ISB Alexandria to refuel, picked up more Soldiers and equipment, and completed a second lift. The following night, lifts were launched from ISB Alexandria to reinforce the lodgment and complete L2A2 operations for Eagle Eclipse.

Scaling up and out: 101 CAB's Road to war

Operation Eagle Eclipse's scale (in fleet size and distance flown) resulted from a deliberate road to war undertaken by the 101st CAB and the division (Figure 3). In September 2022, the CAB executed Operation Lethal Shadow, a proof-of-concept long-range air assault with 23 aircraft from Fort Campbell to Fort Johnson. Four months later, the brigade validated extended-range fuel systems over a 340-nm mission to Florida with the 75th Ranger Regiment. In February 2023, Operation Ultimate Destiny launched a 32-aircraft air assault (56, including attack and medical evacuation support) from Fort Campbell to Fort Knox, Kentucky, while maintaining aerial command and control (C2). Destiny also employed 2 eight-point FARPs, 1 four-point FARP, and 2 CH-47 Fat Cows (used to refuel other aircraft) at an expeditionary sustainment node at Wendell H. Ford Training Center (Kentucky). The following month, an exercise known as Driving Innovation in Realistic Training (DIRT) Days[1] stressed the CAB's

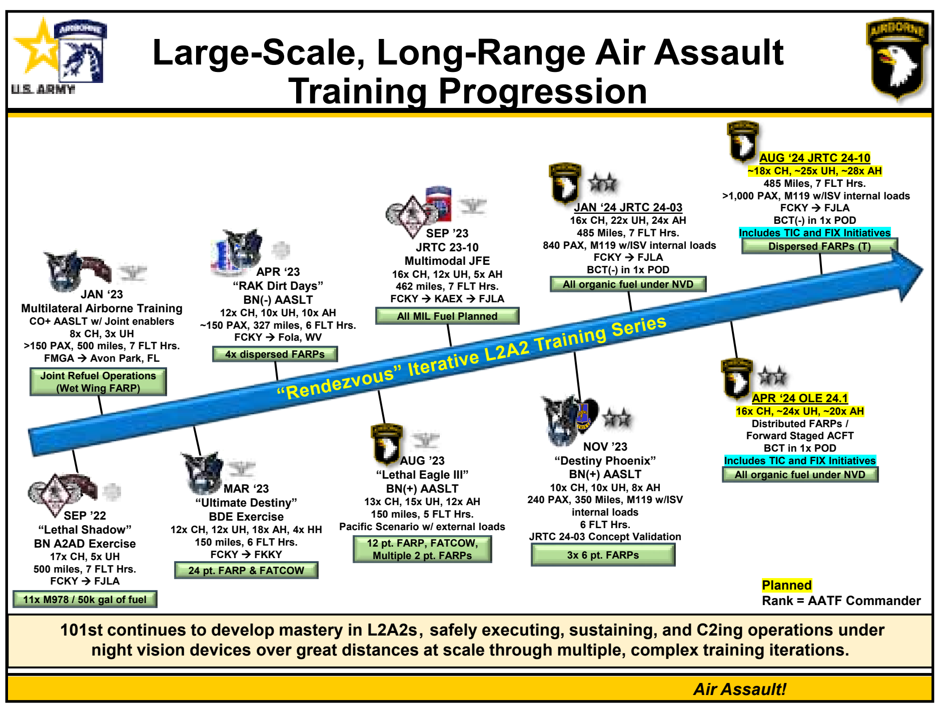


Figure 3. 101st CAB's L2A2 road to war for Operation Eagle Eclipse (101st CAB—edited by the 101st Airborne G5 shop).

[1]DIRT Days is an "event aimed to involve Soldiers in developing and field-testing new tactics and technology while taking part in challenging, realistic training exercises" (Steelhammer, 2023).

Destiny fleet at ISB Alexandria prior to the second mission night. Photo by CPT Austin Lachance.

sustainment capacity at range, fueling aircraft at FARPs dispersed across four states to exfil Soldiers from Fola, West Virginia.

Following DIRT Days, the division took lead as the unit of action and in August 2023, executed a 150-nm air assault during Operation Lethal Eagle (OLE) III. This operation validated an island-hopping scenario and synchronized CAB and division planners during simulated joint-fires exercises. Immediately following OLE III, the division enabled Task Force Shadow, led by the 6th Battalion, 101st Aviation Regiment (6th-101st), to execute a joint forcible entry exercise for JRTC 23-10. While smaller in scale than Eagle Eclipse, the CAB sustained the operation without drawing fuel from civilian airports. This final exercise validated that the CAB could C2 an L2A2 and sustain it with organic assets, setting conditions for Eagle Eclipse.

"Left of Crank" Preparations Can be the Difference Between Mission Success or Failure

For Army Aviators, "left of crank" means completing mission planning and rehearsals, finalizing maintenance, and identifying and mitigating risk to ensure a successful operation. Destiny employed centralized planning, a surge maintenance program, and an innovative approach to risk mitigation to accomplish the division commander's training objectives.

Critical to Eagle Eclipse's success was dedicated planning at the brigade level. MAJ Boniface empowered a CAB flight lead and flight packet "czar" to ensure deliberate planning occurred with the right subject matter experts and employed a single digital mission packet for the operation. This product—hot-linked to every required document, including performance planning cards, airfield diagrams, and frequency cards—was crucial in ensuring flight crews could easily access information during mission execution.

Well-planned rehearsals also helped ensure success, despite the planning window ending at holiday block leave. Though Destiny returned on January 3 (just 8 calendar days before execution), the CAB's detailed plan-to-plan forecasted time for battalion and air mission commander (AMC) rehearsals. Destiny executed an aviation task force rehearsal (AVN TF RXL) on January 8, followed by a division combined arms rehearsal (CAR) the next day, enabling 2 days for lift and attack battalion-level rehearsals.

Executing rehearsals for missions at this scale underscored the friction between the ground and aviation forces. The CAR terrain model emphasized actions on the objective, yet the AVN TF RXL focused on high-volume air traffic areas, including sustainment nodes and attack aviation EAs. By participating in the CAR, aircrews refined HLZs and EAs for the ground and aviation forces.

Moreover, the CAB's sync matrix-driven AVN TF RXL discovered errors in the execution checklist. Ultimately, the CAB's rehearsal was early enough, and the terrain model detailed enough, to enable battalion and aircrew rehearsals.

Aircraft maintenance for an L2A2 requires a deliberate readiness build-up. The measure of effectiveness for scale and range in an L2A2 is the number of aircraft required and the number of maintenance hours available. For a mission of the scale of Eagle Eclipse, the CAB's commanders at echelon directed a maintenance surge, which shifted unit efforts from flight operations to maintenance. For example, the 6th-101st maintenance team minimized flights before mission night, sequenced flight-hour inspections, and pre-positioned assets to sustain multiple lifts and mission nights.

Minimizing flights before the mission reduced the risk of unscheduled maintenance, postured the fleet for follow-on operations, and ensured crew chiefs could focus on maintenance tasks. For Operation Eagle Eclipse, the CAB reduced flying hours 45 days before execution. This tactic took advantage of the holidays but ensured 17 CH-47s and 22 UH-60s launched on mission night 1. Protecting maintenance by reducing flight hours before an L2A2 will be challenging but is necessary to build the required combat power. The more rotary-wing aircraft fly, the more likely there will be unscheduled maintenance, which could limit aircraft availability. Commanders must also balance assets for future operations. In a single L2A2 mission night, a company expended about 10 percent of the hours of a phase maintenance inspection, reducing the unit's ability to project combat power over 14 days. Minimizing flights can ensure the unit is postured to continue operations following an L2A2.

Sequencing flight hours and interval inspections—the art and science at the heart of aviation management—was also useful. Technical Manual (TM), 1-1500-328-23, "Aeronautical Equipment Maintenance Management Procedures," for example, lays out the science (and regulatory guidance) of how to execute these procedures (Department of the Army, 2014). The art comes from maintenance managers who operationalize inspection intervals to maximize flight hour duration. During Eagle Eclipse, production control teams coordinated and aligned maintenance actions and priorities 45 days from mission execution. This effort made it feasible to order and install parts, resulting from common inspections that historically incur downtime, well in advance. The 6th-101st, for example, executed six CH-47 160-hour inspections in the 45-day window before the mission. This sequencing allowed maneuver companies to minimize flight hour limitations and maximize the range capability during the L2A2.

Pre-positioning maintenance assets at key logistical hubs allowed the CAB to execute contingency and planned maintenance and should not be overlooked for future L2A2 operations. At Monroe, maintenance teams from the 96th Aviation Support Battalion (ASB) repaired the CAB's 17th Chinook and returned it to the fight during mission night 1. Moreover, SGT Day's team at Alexandria completed four UH-60 torque checks following that evening's lifts, ensuring these Black Hawks would be ready for mission night 2. Aircraft require an exorbitant amount of support equipment and Class IX (repair) parts, and positioning these assets at established FARP sites was critical for the success of Eagle Eclipse.

Capturing and mitigating operational risk was also central to planning for Eagle Eclipse. Combat aviation brigade planners recognized that 7 hours of flight within a 12-hour duty day would not meet the brigade's obligations to the ground force. The brigade standardization team, led by CW5 Trail, CW4 Koeppen, and SFC Gravitt, developed an adjustment to the aviation standard operating procedure, signed by COL Cody.[2] This adjustment extended the aviation duty day to 14 hours and authorized 9 hours of day flight, 8 hours of combination flight, and 7 hours of night vision device flight for each day of the mission. To mitigate the increased risk, COL Cody met with AMCs and missions briefing officers and approved risk assessments at his level. He dictated that crew members who exceed 28 hours in duty day or 16 hours of flight time became "high risk" until they could take a 24-hour reset. Crew members who received extensions on both mission nights would be designated "extreme-high risk" until they executed a 24-hour reset.

The brigade standardization team also sought to codify tactics, techniques, and procedures for unique loads to manage risk, as sling load publications (with lists of standardized loads) have yet to keep pace with new equipment fielding. The manuals for helicopter sling loads (TM 4-48.09, TM 46-48.10, and TM 4-48.11), for example, are all over a decade old. This delay places the onus for rigging procedures on CABs, increasing risk.

To standardize these unique loads, COL Cody signed Aviation Standardization Bulletin 23-04, which delegated the approval for unique slings loads with external load rigging procedure cards (RPCs) to a moderate risk approval authority. MG Sylvia further approved a memorandum dated January 5, 2024, assessing seven unique loads, including ISVs in various configurations, as low risk. These loads have RPCs, which include required materials,

Infantry Squad Vehicle (ISV) "Shotgun"
Reference: Report No. 21-WFF-31

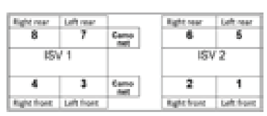
Description of Load Configuration:
- Dual-Point Load: CH-47

Primary Load: ISV "Shotgun"
- Max Weight: 9,840 lbs.
- Sling Set: 25K
- Link Count:
- Left Front (Leg 1) = 10
- Right Front (Leg 2) = 30
- Left Front (Leg 3) = 30
- Right Front (Leg 4) = 10
- Left Rear (Leg 5) = 40
- Right Rear (Leg 6) = 65
- Left Rear (Leg 7) = 65
- Right Rear (Leg 8) = 40

Materials Required:
- 2x Sling sets (25,000-pound capacity)
- Tape, adhesive, pressure-sensitive, 2-inch-wide roll, capacity 80 lbs.
- Cord, nylon, Type III, 550-breaking strength.
- Webbing, cotton, ¼-inch, 80-pound breaking strength
- Felt sheet, Cattle Hair Type IV, or suitable padding material
- Tie-Down, cargo, CGU-1/B or suitable tie-down lash
- Additional apex for each sling set

Common Deficiencies:
- Ratchet strap needs to be taped or not used at all. Too much slack may result in ratchet strap snapping loose.

Prepare the load using the following steps:
- Secure camo nets to left side of ISV #1. Secure camo net to tires with Type III Nylon in "X" shape.
- Park ISV #2 on left side of ISV #1 as close as possible. Camo net on tires will act as buffer.
- Ensure the fuel tanks are not over ¾ full. Inspect the fuel tank cap, oil filler cap, and battery caps for proper installation.
- Engage the vehicles' parking brakes and put the transmission in neutral.
- Ensure the front wheels are pointed straight ahead. Tie down the steering wheel with Type III Nylon cord to the securing device provided under the dashboard.
- Secure hoods with Type III Nylon cord and / or tape.
- Cover all lights, markers, and reflectors with tape.
- Tape the windshields in an "X" formation from corner to corner.
- Secure all seat belts.
- Fold down and secure rear ISV cage.



Rigging Procedures:
1. Position the apex fitting on top of the ISV. Route sling legs 1, 2, 3 and 4 to the front of the ISV.
2. Route the chain end of sling leg 1 through the front left provision of ISV #2. Place link [10] into the grab hook.
3. Route the chain end of sling leg 2 through the front right provision of ISV#2. Place link [30] into the grab hook.
4. Route the chain end of sling leg 3 through the front left provision of ISV #1. Place link [30] into the grab hook.
5. Route the chain end of sling leg 4 through the front right provision of ISV #1. Place link [10] into the grab hook.
6. Position the second apex fitting on the rear of the ISV.
7. Route the chain end of sling leg 5 through the rear left provision of ISV #2. Place link [40] into the grab hook.
8. Route the chain end of sling leg 6 through the rear right provision of ISV#2. Place link [65] into the grab hook.
9. Route the chain end of sling leg 7 through the rear left provision of ISV #1. Place link [65] into the grab hook.
10. Route the chain end of sling leg 8 through the rear right provision of ISV #1. Place link [40] into the grab hook.
11. Secure excess chain with tape or Type III Nylon cord.
12. Attach front apex to front CHRP. Attach rear apex to rear CHRP.

101st ABN DIV (AASLT) External Load Rigging Procedure Card **CAO: 5 Jan 24**

Figure 4. Example RPC showing two "Shot Gunned" ISVs (101st CAB Standardization Shop).

[2]The aviation standard operating procedure, Aviation Standardization Bulletin (23-04), memorandum dated 5 January 2024, and revised 101st Airborne Division (Air Assault) Gold Book, may all be obtained by contacting the 101st CAB.

preparation, rigging steps, and common deficiencies (Figure 4). Approved less than 2 weeks before Eagle Eclipse, this memorandum's delegation of risk approval streamlined mission preparation and execution.

In addition to standardizing external load procedures and risk approval, the brigade developed loading plans for dual-ISV internal loads (Figure 5). After multiple frustrated loads during the division's Operation Destiny Phoenix (2 months before Eagle Eclipse), CH-47 crews from the 6th-101st worked with partners in 2BCT to develop and rehearse a dual-ISV load that maximized ease of loading, safety, and cargo space. Further refined with comments following Eagle Eclipse, this standardized load procedure is set to serve the division for future L2A2s.

Sustainment at Scale

Redundant sustainment defined Eagle Eclipse. At Sabre and Campbell Army Airfields, dedicated launch teams (with maintenance, refuel, and communications packages) stood by for support. On launch, aircraft flew to the FARP's BP or Marathon but could divert if either were fouled. The FARP BP, run by the ASB, was a 12-point FARP; whereas, the Marathon was airmobile, led by the 6th-101st Forward Support Company (FSC). The FSC loaded two Heavy Expanded Mobility Tactical Trucks (HEMTTs), two 250 gallon-per-minute pumps, three 3,000-gallon fuel bags, and a tactical aviation ground refueling system into a C-17 at Fort Campbell 2 days before mission execution and flew them to Millington. After unloading, the C-17 fueled the HEMTTs to establish a six-point FARP.

Whether taking off from the FARP's BP or Marathon or bypassing these sites for MSS Monroe, all aircraft stopped in Monroe. Monroe issued 149,000 gallons of fuel using 18 HEMTTs and two Tactical Refueling Tank Rack Modules (TRMs) with separate refuel teams for each airframe. UH-60 and CH-47 ramps facilitated space for aircraft bumps, and the 28 AH-64s parked near their own FARP for live arming. Prepared at each ramp was a maintenance contact team and Downed Aircraft Recovery Team (DART) with a UH-60 on standby to assess aircraft requiring maintenance en route from Fort Campbell. Aircrews received tailored O&I briefs over Android Team Assault Kits for Military (ATAK-MIL), and battalion commanders traveled to the brigade tactical operations center (TOC) for in-person mission updates.

The forwardmost sustainment node at ISB Alexandria serviced aircraft with 3 four-point FARPs. Two pickup zones (PZs) for lifts two through nine were co-located at Alexandria Airport. The FARP Exxon employed 16 HEMTTs and six TRMs. The brigade main command post provided C2, while Company Fox, 6th-101st, coordinated air traffic. Finally, dedicated maintenance personnel worked overnight maintenance and launch support for mission night 2 and redeployment.

In an *Aviation Digest* article on aviation sustainment in Large-Scale Combat, the author noted that "logistics will be the key component for success in aviation operations" (Glover, 2024, p. 15). Eagle Eclipse proves this point. For subsequent iterations of L2A2s, resupplying sustainment nodes and protecting these critical pacing items must drive greater integration with air defense and joint assets. While the CAB's footprint collapsed to Alexandria for enduring operations, it is foreseeable that the mission could require dispersed sustainment nodes for extended periods to reinforce the lodgment and secure lines of supply and communication for follow-on operations. These considerations will be tested in future iterations at Fort Campbell, where the division will execute another L2A2 and continually support Soldiers on the ground via heliborne resupply and fires.

Mission Command and C2 in LSCO

Eagle Eclipse's scale required the division to define who owned which fights. The CAB empowered leaders at various locations to do the same. In the air, command relationships were straightforward, an anomaly for a brigade shaking off the multifunctional aviation task force (MFATF) mentality of recent deployments. Troop and company commanders were lift-or-attack weapons team AMCs, and flight battalion commanders served as AMCs for their units. To maintain a common operating picture for this dislocated force, the AMC's primary method of over-the-horizon digital traffic was the ATAK-MIL, which allowed immediate situational awareness and digital O&I updates.

Combat aviation brigade personnel at five ground nodes fell

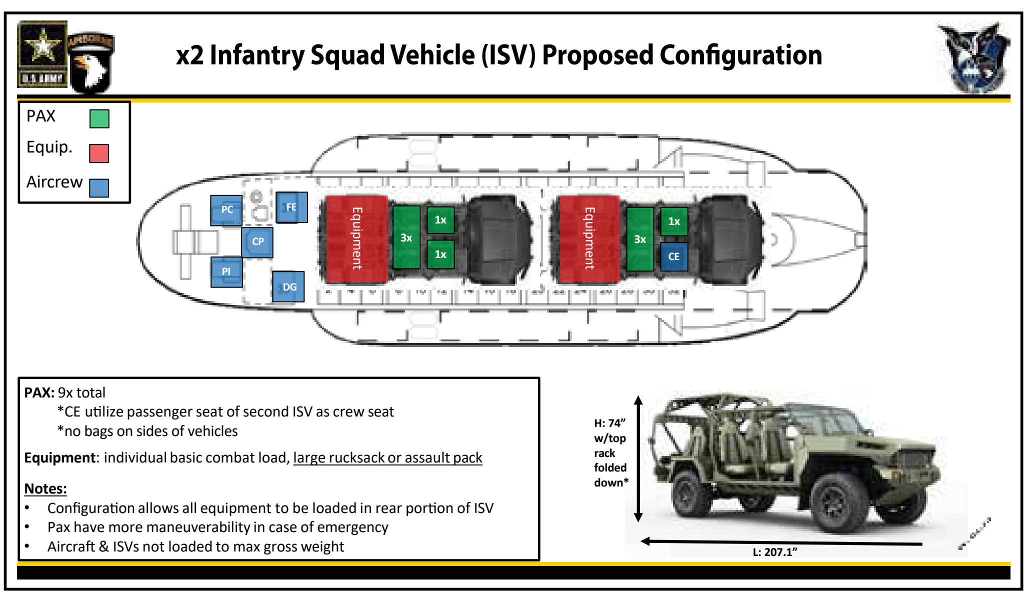


Figure 5. Proposed dual-ISV internal load diagram (modified slightly from the format used during Eagle Eclipse) based on after-action review comments from aircrews and the ground force (6th-101st General Support Aviation Battalion shop).

MG Brett Sylvia, Commanding General of the 101st Airborne Division, gives his opening remarks during the Division Combined Arms Rehearsal. Photo by CPT Austin Lachance.

under an officer-in- charge (OIC), who tracked mission progress and directed maintenance, refueling, and contingencies during the operation. The brigade executive and operations officers oversaw the CAB's two critical nodes at Monroe and Alexandria. As the aircraft departed from home station, AMCs reported to the brigade operations cell at Fort Campbell. After the aircraft passed Oxford or Millington, the TAC at Monroe assumed control of the fight and tracked aircraft until they departed for the objective. Once clear of Monroe's airspace, the main command post at Alexandria owned the fight for the mission's duration.

Destiny synchronized its efforts with the division support brigade (DSB), which tracked and reported node statuses. When diversions due to weather resulted in unanticipated fuel requirements, the DSB (whose command post was collocated with the TAC) linked in with the CAB's Assistant Operations Officers (AS3s), node OICs, and support operations officer cell to assess mission impacts. Aircraft maintenance concerns were reported to MAJ Haynes, the Company Bravo 96th ASB Commander and DART OIC, who owned sourcing the appropriate maintenance solution.

Ultimately, the CAB's employment of battalion field-grade leaders, especially in the "push package" at Fort Campbell and augmentation at Monroe, enabled mission command and streamlined C2. Combat aviation brigades executing similar operations in the future should note this technique.

Conclusion: L2A2s and the Future Fight

In his opening remarks of the 2023 revised 101st Airborne Division (Air Assault) Gold Book, MG Sylvia stated that the division's goal was to "fly 500 nautical miles in one POD, in any environment to endure for 14+ days and win." Operation Eagle Eclipse highlighted how far we have come, flying 500 nm and moving a battalion-plus-sized force onto the objective. We captured incredible data from this operation, and after-action reviews highlighted friction, generated solutions, and inspired future training.

Some of the lessons the CAB learned were critical. Aerial C2 at the brigade level for an L2A2, for instance, cannot be overstated. In smaller air assaults, the MFATF commander might lead as an AMC with one of their field-grade leaders in support. It was apparent to those who participated in Eagle Eclipse that the operation needed multiple aerial C2 nodes fed through voice and digital communications from AMCs and command posts. Dispersed sustainment nodes must also include a diverse resupply plan. Like a Primary, Alternate, Contingency, Emergency, (PACE), plan with four distinct communication systems or frequencies, four or more FARPs will require in-

Crew chief from 6th-101st GSAB supervises the loading of a second ISV into a CH-47 at Campbell Army Airfield. Photo by CPT Austin Lachance.

novative methods to maintain. Training airmobile FARPs gave the 6th-101st's FSC firsthand experience with joint refuel capabilities they will likely see in an island-hopping fight. Limitations previously not considered, such as wet wing refuel (wing structure is sealed and used as a fuel tank) rates, are now codified into Destiny's sustainment procedures.

The future of L2A2 operations is the future of LSCO for Army Aviation. The missions executed during Operation Desert Storm and the opening days of Iraqi Freedom can serve as a guide. Yet, air assaults of the scope and scale of an L2A2 require deliberate attention from leaders experienced in operations like Eagle Eclipse. For L2A2s to be a suitable, acceptable, or preferred option for combatant commanders seeking a lodgment, Army Aviation owes the ground force, Army leadership, and aircrews particular emphasis in future training. We must train like we fight—flying lower, at night, in formation—and with covert lighting (an acknowledged challenge in the contiguous United States). We must also innovate our Sustainment Enterprise, so our long-range ambitions do not rapidly outpace our refuel and rearm capabilities. Fuel is the lifeblood of a CAB, and leaders must emphasize the modularity, survivability, and adaptability of our sustainment nodes. Finally, we must drive doctrine that will outlive the aircraft for which it was created. Eagle Eclipse has set conditions for the future of L2A2 operations, and the Wings of Destiny team is ready to answer the call.

Acknowledgements:

The authors would like to thank CPT Richard Fischl for his input on surge maintenance and all the Soldiers and families of the 101st CAB who made Operation Eagle Eclipse a success.

Biographies:

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COL Clinton Cody is the Brigade Commander for the 101st CAB and was the Aviation Task Force Commander for Eagle Eclipse.

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Tracking Commissioned Aviators will Improve Army Aviation Readiness, Safety, and Culture

SSG Derrick Day, 1st Squadron, 98th Cavalry Regiment, Mississippi Army National Guard, provides security during a training exercise at the National Training Center, Fort Irwin, California. U.S. Army National Guard photo by PFC Jarvis Mace.

By MAJ Sara C. Adams

INTRODUCTION

Army Aviation is experiencing a gap between tracked WO populations and unit and institutional requirements. "Tracked" Instructor Pilot (IP) and Maintenance Test Pilot (MTP) billets are persistently understaffed, and these shortages directly impact readiness.Army Aviation units are less able to effectively train aviators and maintain aircraft with sufficient IPs and MTPs. On the whole, a shortage of key skilled aviators inhibits collective training above the company/troop level where units need to focus on Large-Scale Combat (LSCO).

Filling these gaps requires a comprehensive effort across the Aviation Branch. As the Army seeks to increase IP and MTP populations, it should take advantage of an ignored population of talented aviators able to augment WO IPs and MTPs—commissioned aviators. Doing so would bridge gaps in the force, improve commissioned officer professional development, and aid recruiting/retention efforts. Most importantly, formalizing the tracking of commissioned officers in doctrine (Department of the Army Pamphlet [DA PAM] 600-3, 2023) "Officer Talent Management," would cement a teamwork approach to tracked duties in Army Aviation culture.

THE PROBLEM

As Figure 1 from Army Human Resources Command (HRC) shows, the WO populations in YG03-16 are short across the board. In the aggregate, these shortages mean nearly 1,000 WO billets are not filled. The Aviation Branch cannot mitigate this shortfall within the next 5–8 years; it is impossible to generate the expertise required with increased accessions due to experience requirements at each grade. Moreover, given recruiting challenges, accessions may prove insufficient even in the long term, regardless of bonuses.[1]

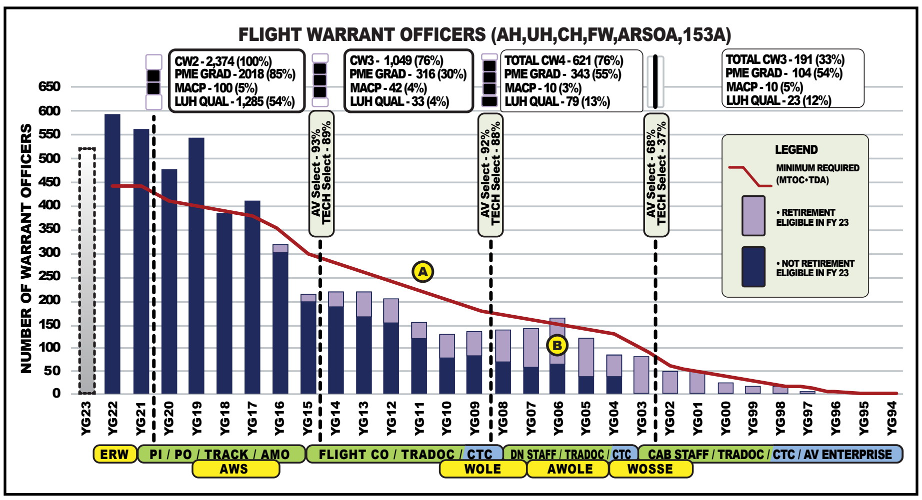

Figure 1. Overall WO population data (U.S. Army Human Resources Command, 2023a). 2

[1]Aviation Bonus Program, "The AvB is used to offer bonuses to aviators with critical skills or MOSs. The AvB is essential to retain Officers with an Army aeronautical rating, who are critical to the overall success of the Army's mission" (U.S. Army Human Resources Command, 2023c).
[2]Figures 1 and 2 provided by Army Human Resources Command (HRC) from quarterly "Breakout Brief." Contact the author for further information.

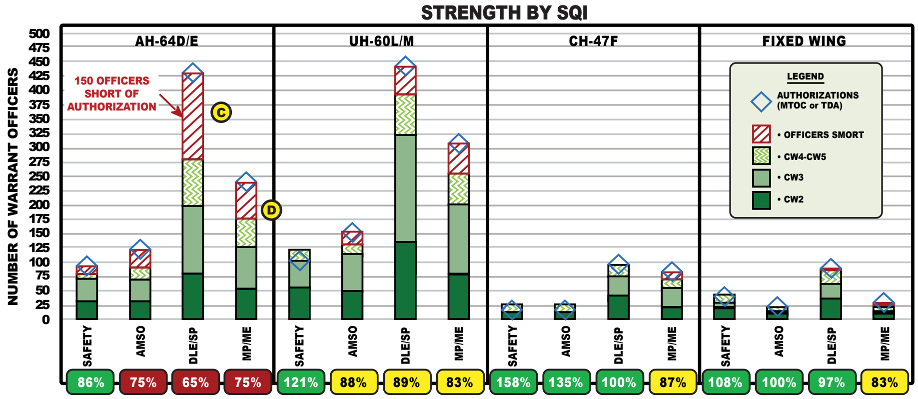

Figure 2. Strength by skill identifier and airframe (U.S. Army Human Resources Command, 2023b).

As shown in Figure 2, shortages of MTPs and IPs, positions that maintain Army aircraft and train aviators and units, are particularly acute within the AH-64 community. These shortages correlate to training capabilities gaps at the unit level, creating an inherent assumption of additional risk for commanders. There is a constant demand for IPs as the primary tactical trainers in a unit to conduct mandatory training and evaluations, advanced task training, unit training, and collective training. Instructor pilots manage the commander's aircrew training program and are also expected to self-start new or additional training tasks and requirements, such as tasks required to execute LSCO. Without enough CW3s and CW4s, the current IPs are overtasked, and junior aviator CW2s lacking experience are filling gaps, and in some cases, greatly increasing risk.

BRIDGE THE GAP

The Aviation Branch cannot bridge the gap with accessions or loiter in filling these critical positions. Augmenting IPs and MTPs requires immediate intervention. Fortunately, there is a population of aviators who can serve this purpose. Taking advantage of commissioned officer aviators as tracked IPs and MTPs is a viable option to mitigate risk within the branch. Commissioned officers rarely track, and if tracked, rarely persistently utilize those skills. For example, a maintenance company commander may perform MTP duties while in command but is unlikely to do so later. And it is only if the stars align that a maintenance company commander as a CPT later serves as an aviation support company (ASC) commander as a MAJ and is therefore able to use their skills again.

This pigeonholing of aviation officers is not only detrimental at present, but it is ahistorical. Prior generations of Army Aviation commissioned officers focused on their tactical craft throughout their careers. Though they were obviously Army officers first, they never stopped being competent, proficient aviators. The contemporary wholesale outsourcing of aviation expertise entirely to the WO corps is, at the same time, detrimental to not only commissioned officers but the branch as a whole. The current situation would confound early Army Aviation leaders like Brig. Gen. Otto Weyland, who commanded the XIX Tactical Air Command in support of Patton's Third Army during World War II. Weyland ensured his officers rotated between flying squadrons and Third Army liaison billets (Bolton, 2016, pp. 43–44). They supported the mission but retained their aviation competencies.

Commissioned officers do attend aviation track courses but not currently at a sufficient enough volume to generate an impact. In fiscal year (FY) 23, only 31 commissioned officers attended advanced track courses, occupying just 0.05% of trackproducing course slots (Adams, 2023). Likewise, tracked commissioned officers stationed at Fort Novosel only occasionally perform IP duties despite a clear need due to competing requirements.

Within year-groups 13–18 (mid to senior-level CPTs), there is a pool of nearly 1,000 aviation officers (Adams, 2023). Supposing less than half (400) of those officers are sufficiently experienced and competent aviators eligible to attend IP or MTP courses, even just 25% of those (100) would alleviate the MTP/IP shortages significantly. Moreover, there are sufficient school slots available to train commissioned MTPs/IPs without detracting from WO schooling and opportunities. Thus, commissioned aviation officers are an underutilized resource that could alleviate the IP/MTP shortage.

Combat aviation brigade (CAB) flight battalions have potential for up to 10 or more commissioned officers per battalion to augment and support company training and readiness. There are also dozens of aviators outside each divisional CAB available to support the CAB. Suppose each brigade aviation cell (BAE) has two commissioned aviator billets, while each division headquarters has another 3–4. If only 25% of these billets were tracked aviators, the branch would increase the available MTP/IP population available to support the CABs by 3–4. This assumes each divisional CAB is located with four BAE cells (three brigade and one division artillery).

Similar to the branch's effort to develop a cadre of unit trainers, tracked commissioned officers could handle routine MTP and IP tasks, leaving these valuable experts free to focus on more complicated maintenance tasks or unit-level training, respectively. For example, a commissioned IP could easily handle annual proficiency evaluations for other

GEN Patton and Maj. Gen. Weyland (Photo courtesy of Margaret Bourke-White & Life Magazine, 1945).

CW2 Oceana Chamberlin practices flight maneuvers throughout Idaho's snowy Owyhee Mountains, south of Gowen Field. The Idaho National Guard recently replaced 20 of its UH-60L Black Hawk helicopters with the latest design UH-60M Black Hawks. U.S. Army photo by MSG Becky Vanshur, Idaho National Guard.

staff aviators, freeing IPs to conduct evaluations of pilots-in-command or design unit training events. Likewise, an MTP staff officer could perform limited test flights or ground runs, leaving MTPs free to focus on evacuation missions or post-phase maintenance test flights.

Commissioned officer augmentation also prevents a single point of failure and expands aviation capabilities beyond the flight company. Looking toward the future of LSCO and high likelihood for dispersed operations in austere environments, redundancy, and enhanced capabilities will be critical to mission success.

THE AVIATION BRANCH NEEDS CULTURAL CHANGE

At present, neither Army nor Army Aviation culture support commissioned officer tracking. There is a pernicious, yet pervasive, stigma against commissioned aviators actually flying. Ironically, by eschewing aviation duties and requirements while officers are assigned outside of the CAB, Army Aviation culture differs significantly from other maneuver branches such as infantry, armor, and field artillery. Officers in other branches consider mastering their primary weapon system a leadership requirement (Bolton & Britten, 2022). In an airborne unit, for example, no one would criticize a staff CPT being absent to participate in a jump, yet aviation officers are routinely ridiculed for attempting to fly while serving outside a CAB (and often within one).

This is a long-standing cultural problem within the Aviation Branch. A 2000 thesis from the Command and General Staff College (CGSC) noted that Army Aviation junior officers, no matter how new, had multiple duties to perform in addition to learning to tactically fly their airframes. The author argued that "The Air Force's equivalent to DA Pam 600-3 (The Air Force Officer Career Path Guide), very succinctly sums up what is technically expected of their officers in their initial assignments out of flight school; to become aircraft commanders and instructor pilots in their assigned aircraft" (Quackenbush, 2020, p 46-47). Outside of platoon and company time, commissioned officers rarely fly, especially as deployments to combat areas have abated. Captains commanding company/troop formations must achieve pilot-in-command status, but this is often not the case as Training Circular 3-04.11, "Commander's Aviation Training and Standardization Program," offers extensions and exceptions (Department of the Army, 2022).

The trend for junior officers to spend insufficient time learning their craft is nothing new. The aforementioned CGSC thesis showed the "average aviation officer's line unit experience therefore shows that the officer only spends twenty-eight months of his or her entire company grade years learning technical and tactical skills" (Quackenbush, 2020, p. 75). Since this study, the Captains Career Course has expanded to nearly 6 months, further curtailing company- grade time spent in a flight unit. Interestingly, previous versions of Army doctrine for commissioned officer development (DA PAM 600-3) recommended tracking commissioned officers by delineating 15D (Aviation Maintenance Officer) requirements. Crucially, 15Ds were required to attend the MTP course; however, this requirement has been removed.

IMPLEMENTING CHANGE

The branch should formalize current ad-hoc efforts to track commissioned officers. Formalizing these efforts by codifying the ability for commissioned officers to track in DA PAM 600-3 will enable the branch to develop and utilize commissioned officers as tracked aviators. With marked success after utilizing more commissioned aviators as IPs and MTPs, the Aviation Branch needs to expand the initiative to include all tracks. Commissioned officers will be a combat multiplier as an additional asset supporting continual operations, increasing unit readiness, and reducing unit strain. Most important, better trained aviators will be better leaders. Thus, this proposal will increase the competence and confidence of the branch's leaders. Commissioned officers will gain specialized knowledge and experience necessary to lead aviation units directly and effectively at multiple echelons. Supporting commissioned officer aviation skill and proficiency will also increase the likelihood of officer retention.

Concerns about stacking commissioned officers in schools and associated costs can be mitigated in two ways. First, nearly every commissioned aviator already moves to Fort Novosel as a CPT to attend the career course. Human Resources Command should allow the top 25% of Aviation Captain Career Course graduates to attend advanced track courses. This would eliminate an undesirably long temporary duty trip and loss of a commissioned officer to a division CAB. Rather, this would deliver a trained and proficient leader to their next unit. If only 15–20 commissioned aviators attend track-producing schools following the four annual Captain Career Courses, this effort would produce nearly half the annual warrant IP/MTP gap. Allowing commissioned officers to execute the duties and responsibilities they competed and assessed for will prove to have positive second- and third-order impacts, both short and long term. Remember, increased competency improves leadership capacity, and leveraging assets to increase capabilities supports mission success. Alleviating unit strain with commissioned officer augmentation may show increased retention for both warrant and commissioned officers. Increased leader involvement as subject matter experts will strengthen unit trust and cohesion. More broadly, enabling aviation leaders to train and effectively lead aviation units must become a unit priority rather than an individual responsibility.

Biography:

MAJ Sara Adams is a student at the CGSC, Fort Leavenworth, Kansas, and a UH60M IP.

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AH-64E version 6 Apache helicopters depart the Boeing manufacturing facilities at Mesa, Arizona, bound for Joint Base Lewis-McChord (JBLM), Washington. U.S. Army photo by Paul Stevenson, PEO, Aviation.

Data-Driven Leadership: Empowering Army Aviation for Mission Success

U.S. Army Aviators from the 3D Combat Aviation Brigade, 3D Infantry Division, fly a formation of helicopters in support of Marne Week events on Fort Stewart, Georgia. U.S. Army photo by SGT Savannah Roy.

By COL Ryan P. Sullivan

In today's rapidly evolving military landscape, the ability to effectively harness and leverage data is a game-changer for organizations that must do more with less.[1] Army Aviation is no exception. Operating across complex operational environments, units can significantly benefit from leveraging data in delivering combat aviation brigades that balance capacity and capability to deliver on aviation core competencies to see/sense – strike – move – extend the operational reach of divisions. Embracing the principles of data-driven leadership is crucial for staying competitive and responsive to changing battlefield realities, balancing now vs. the need to preserve combat power for decisive operations. Technological advancements like digital twins;[2] system-level embedded diagnostics (SLED) and smart tool for aviation maintenance picture (STAMP),[3] along with analytic tools in fielding like Griffin Artificial Intelligence (AI); and the Aviation Maintainer Analytics Platform (A-MAP) mark significant progress within our formations, aspiring to create environments characterized by precision and performance akin to Formula 1 (F1) racing.

This article explores the crucial role of data in empowering leaders and emphasizes the significance of data-driven practices in aviation. It draws insights from the Army Data-Driven Leadership [DDL] Certificate Program hosted by Carnegie Mellon University, Heinz College of Information Systems–Public Policy–Management, prioritizes data literacy, and discusses challenges and opportunities present through value extraction models. While it's tempting to present definitive guidelines or a guaranteed roadmap for maximizing the benefits of data utilization within formations, the reality is that this transformation is challenging, and each unit is at a different stage of its journey. Our unit does not have all the answers and is just beginning its own journey. However, initiating discussions, encouraging leaders to ask questions, sharing lessons learned, and committing to fostering a data-driven culture are crucial first steps.

Prioritizing Data Literacy

Prioritizing data literacy is vital for Army Aviation leaders due to its potential to provide invaluable insights essential for decision-making. Data-driven decision-making presents numerous opportunities, from identifying areas for improvement in aircraft maintenance and flight operations, to refining mission planning and execution. Furthermore, leveraging data fosters continuous improvement and encourages innovation. Notably, data collection and analysis meaningfully enhance safety within Army Aviation. By meticulously tracking and examining safety-related data, leaders can proactively identify patterns and trends, thereby preemptively addressing safety hazards and averting adverse outcomes. Prioritizing data collection in areas such as aircraft performance, maintenance records, flight operations, and safety incidents is essential for Army Aviation leaders. This emphasis enables leaders to understand the factors influencing overall performance and safety within their aviation units, empowering them to utilize business intelligence (BI)[4] effectively.

The Army utilizes BI to facilitate informed decision-making and enhance operational efficiency by collecting,

[1] One such example is the Army Force Structure Transformation. Army leaders, who consulted with Congress, will move forward and bring down "authorized" troop levels to "approximately 470,000 Soldiers by FY2029" (U.S. Army Public Affairs, 2024).

[2] "A digital twin is a virtual representation of an object or system that spans its lifecycle, is updated from real-time data, and uses simulation, machine learning and reasoning to help decision-making" (Armstrong, 2020).

[3] "The STAMP dashboard changes to reflect the aircraft's current status so the maintainers can quickly see Warnings, Cautions, Advisories, Faults and Exceedances (WCAFEs) as they occur on an aircraft. It can also distinguish between an aircraft that has landed at home versus an aircraft that has been forced to perform a precautionary landing. From the Dashboard, the maintainer can easily delve deeper into the full SLED report to gain detailed information regarding the WCAFEs" (Herman & Ingraham, n.d.).

[4] "Business Intelligence refers to technologies, applications and practices for the collection, integration, analysis, and presentation of business information" (Creech, 2020).

processing, analyzing, reporting, and strategically planning with data. Leaders must recognize that BI primarily relies on structured data and looks backward, providing historical insights. Leaders should exercise caution in adopting AI if their formation struggles with BI. For instance, the emergence of the natural language processing chatbot, ChatGPT, has made generative AI more accessible, presenting opportunities for exploration across various applications. The Army's Artificial Intelligence Integration Center (AI2C) developed and released CamoGPT specifically for military use.[5] Utilizing CamoGPT to assist in writing this article, a query on the benefits of developing data-driven leaders highlighted several key areas:

1. Leveraging real-time intelligence and operations.

2. Anticipating challenges with predictive analytics.

3. Ensuring personnel readiness through data-driven human resources management.

4. Resource management in a data-driven environment.

5. Utilizing predictive analytics for maintenance operations.

This is not a bad list; however, it is probably incomplete and not something a data scholar would produce. Generative AI is a tool and not the final solution. Data-driven leadership represents a paradigm shift, empowering units to anticipate challenges and make informed decisions against an uncertain future. By understanding the power of data and its potential to revolutionize decision-making processes, leaders can drive their organizations toward better outcomes and greater success. Change will not and cannot come overnight, but there is risk in not improving data literacy, characterized by:

1. Ineffective decision-making.

2. Reduced efficiency and effectiveness.

3. Safety concerns.

4. Missed opportunities for innovation.

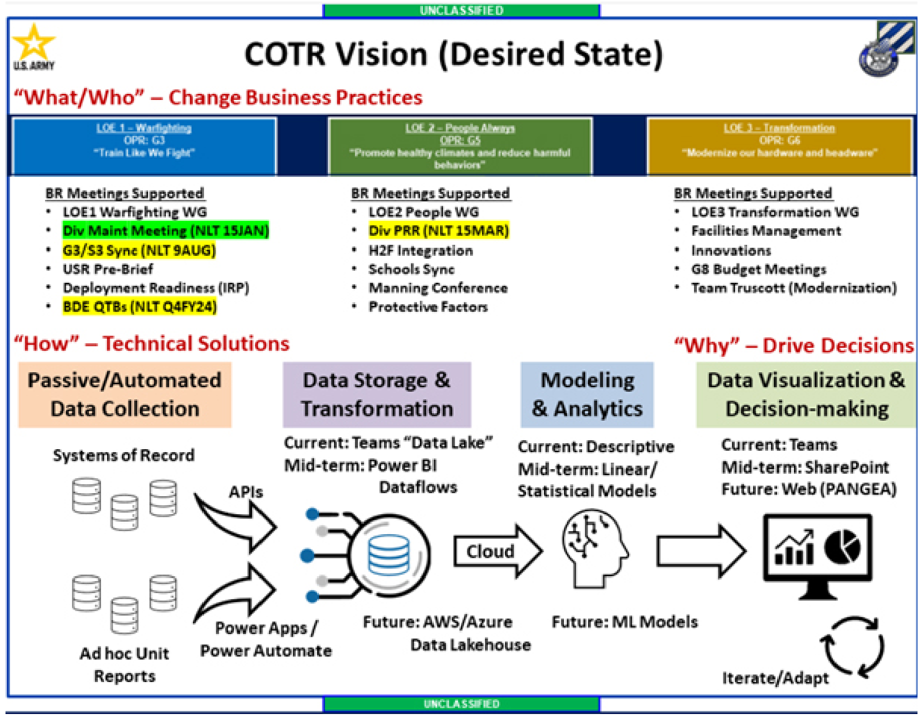

Figure 1. 3D Infantry Division's "COP (Common Operating Picture) of the Rock" (COTR) vision (desired state). Slide used with permission from 3ID, MAJ DaNeve and MAJ Quigley, March 2024.

5. Lack of accountability and transparency.

6. Inability to adapt to evolving threats and challenges.

While some of these risks may seem obvious or intuitive, the ***lack of accountability and transparency*** is particularly noteworthy. The Army increasingly relies on tools like Army Vantage, "the Army's data-driven operations and decision-making platform," (U.S. Army Program Executive Office Enterprise Information Systems, n.d.) and dashboard visualizations such as the 3D Infantry Division's COTR (Figure 1). Without sufficient data literacy, units may be unable to effectively utilize dashboards to accurately assess and communicate their performance, potentially eroding stakeholder accountability and trust. Therefore, Army Aviation leaders must prioritize learning and the importance of becoming data-driven leaders. I used ChatGPT to assist in defining the following essential key terms.

1. **Analytics Continuum:** Refers to the progression of data analysis from basic reporting and descriptive statistics to predictive and prescriptive analytics (Figure 2). LTC Thomas Dirienzo, Senior Data Scientist at AI2C shared that, "the continuum is hard not only because of the complexity of the work, but because it relies on all of the others' steps along the continuum to be in place" (T. Dirienzo, personal communication, March 9, 2024).

2. **Data Warehouse:** A centralized, relational database designed to optimize data querying and reporting across an organization, consolidating data from various sources into one consistent view.

3. **Data Lake:** A large, distributed repository of raw or structured data that can be easily accessed, processed, and analyzed by various tools and services with minimal setup effort.

4. **Data Lake House:** A modern approach to managing data architecture combining the best aspects of data lakes (scalability, flexibility) and data warehouses (structured, consistency).

5. **Data Mesh:** A decentralized, domain-driven approach for managing and processing data across an organization where data ownership lies amongst the business teams.

6. **Data Fabric:** An architecture that inte-

[5]The AI2C announced the early access release (alpha version) of CamoGPT on January 25, 2024. "CamoGPT is designed to be flexible and model agnostic, enabling it to adapt to a wide range of tasks and integrations. This versatility ensures that it remains an indispensable tool for your productivity needs … CamoGPT comes with robust security features. It operates in a closed domain, ensuring your data, prompts, and responses remain secure within the Army's security boundaries … CamoGPT is hosted on NIPR, SIPR, cloud, and, soon to be, edge environments" (LTC Eric Justin Schmitz, CamoGPT Teams post).

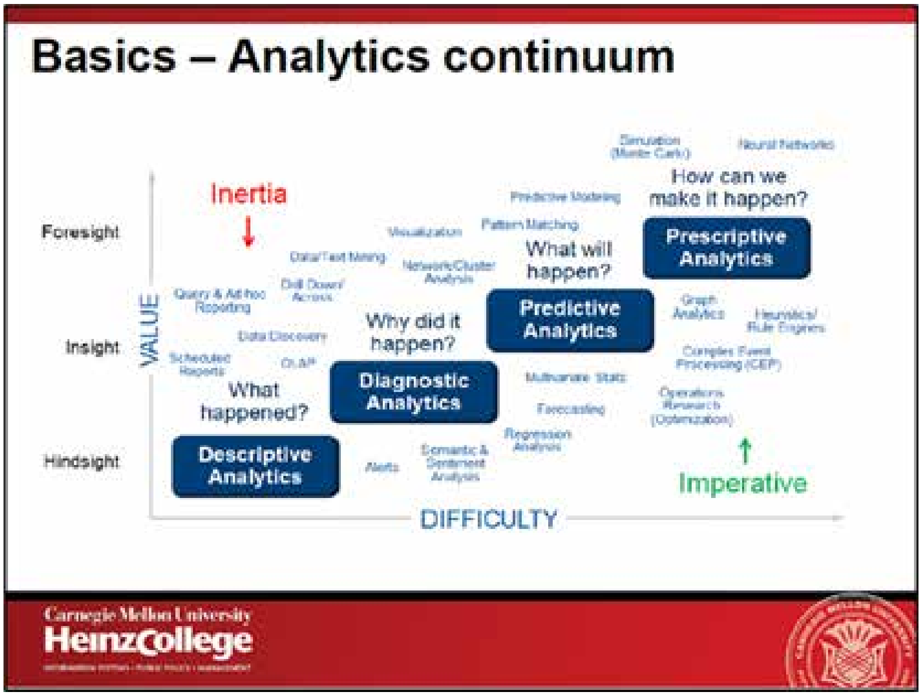

Figure 2. Analytics continuum. Figure provided by Carnegie Mellon University, Heinz College, hosts of the Army DDL certificate program, 2023.

grates various data management components such as data lakes, data warehouses, and other systems into a unified, single pane-of-glass interface for efficient data-driven decision-making (OpenAI, 2024).

Expanding on the definitions, data mesh is an organizational framework rather than a specific product, while data fabric refers to a centralized technical architecture (such as the next-generation data analysis company, Palantir, or Microsoft products). Using Army Vantage doesn't necessarily require coding skills. However, understanding how systems of record feed directly into software applications or into data lakes is essential for informed discussions from senior leaders, especially when discrepancies arise in data accuracy or timeliness for reporting periods. Leaders need to prioritize data literacy to avoid falling behind adjacent or higher commands and missing opportunities for continuous improvement, innovation, and enhanced safety within their units. These opportunities come with challenges, which I will explore in the next section.

Implementing data-driven leadership presents challenges, including managing data volume, velocity, variety, and value. Overcoming these challenges is crucial for maximizing the benefits of data utilization. Investing in modern technologies like cloud computing, big data analytics, AI, and machine learning is essential for enabling data-driven decision-making. However, much of this occurs external to our commands. Understanding the transformations in our operating environments revolves around accepting that data are essential for militaries worldwide. By investing in modern technologies, military organizations can harness data's power to improve mission success, reduce costs, increase efficiency, and enhance situational awareness. LTC Dirienzo provides one such example, "Griffin [AI] is largely possible because the Army invested in a data lake that makes data visible and accessible" (T. Dirienzo, personal communication, March 9, 2024).

However, embracing data-driven leadership involves addressing several challenges highlighted by CamoGPT:

1. **Data Accessibility:** Army Aviation leaders may face challenges accessing reliable and up-to-date data from multiple sources and platforms, essential for informed decision-making.

2. **Data Integration:** Integrating data from various sources, including aircraft systems, maintenance records, mission reports, and external sources, can be complex and time-consuming, making it difficult for leaders to obtain a comprehensive and accurate picture of the situation.

3. **Data Analysis:** Identifying valuable insights and patterns from large volumes of data can be challenging, especially if leaders need more analytical tools and skills to make sense of the information.

4. **Data Security and Privacy:** Protecting sensitive aviation-related data from unauthorized access, misuse, or cyber threats is a critical concern for leaders who must balance the need for transparency and collaboration with safeguarding classified information.

5. **Training and Resources:** Army Aviation leaders may face challenges in providing their personnel with the necessary training and resources to effectively collect, analyze, and interpret data, as well as in implementing the essential technology and infrastructure to support data-driven decision-making.

6. **Cultural Resistance:** Leaders may encounter resistance to incorporating data-driven decision-making within the organization's culture, as some personnel may be more accustomed to relying on experience, intuition, or traditional methods of decision-making.

7. **Change Management:** Incorporating data-driven decision-making into existing processes and workflows can be disruptive and require significant change management efforts to ensure that leaders and their teams embrace the new approach.

While the list appears comprehensive at first glance, the narrative needs additional context that individuals outside of aviation may not grasp. For instance, our current organizational structure lacks designated military occupational specialties for data scientists within our formations, and the capability to organically collect, store, extract, and load data is absent. Further complicating matters is the ownership and access to data stored in numerous black boxes, necessitating our reliance on Field Service Representatives (FSR) who "are embedded with the military to assist Soldier's *[sic]* with technical support, troubleshooting mission commands, and network capabilities" (Colvin, 2019). These challenges make it difficult for Army Aviation leaders to prioritize and analyze data from various sources effectively, requiring them to develop strategies and capabilities to navigate these complexities effectively. The next section will delve into the evolving processes to extract value.

Extracting Value From Data

In today's fast-paced and ever-changing world, data have become an indispensable tool for decision-making and problem-solving, particularly in Army Aviation, where leaders constantly face complex decisions impacting mission success. In framing the problem and to extract value from data, there are three essential questions:

1. What decision is being improved?

2. Who is deciding?

3. What is the value of an improved decision?

These three questions are essential for anyone seeking to frame a problem to extract value from data. Tapping into the value of unstructured data within data lakes is necessary for our formations to move from hindsight to foresight along the analytics continuum. Most units perform above average in descriptive analytics in the form of daily status reports, command and staff slides, and other dashboard visualizations that tell us what happened. Data-enhanced units and leaders may understand how to leverage tools for diagnostic analytics, answering why it happened. However, only some units are data mature and understand how to leverage data and emerging technology to move toward predictive or prescriptive analytics. Those formations would experience a higher likelihood of knowing what will happen and, even more importantly, what leaders should do next.

Without solid data management fundamentals and commitment to BI from leaders to break through silos of excellence within our formations, we cannot expect generative AI or software platforms to solve every problem magically. While this section addresses challenges and risks, it also highlights opportunities. The operation of our airframes relies heavily on data-driven algorithms that enhance flight, improve accuracy, and ensure safety beyond previous generations. Much of these data reside within the black boxes of our aircraft, accessible to original equipment manufacturers through an FSR. Although there may come a time when these data are more accessible to us, it's crucial to build the necessary understanding and organizational structure to extract value from the vast amounts of untapped data. While we may have access to only some of the data, there remains a wealth of untapped semi-structured and unstructured data.

Understanding data lakes and data fabric concepts empowers leaders to ensure that collected data are readily accessible and effectively utilized for decision-making. While insights typically align with descriptive analytics, leaders often rely on visualizations, such as dashboards built from structured data in data warehouses or lakes. For instance, units like the 3D Infantry Division collect massive amounts of data in a central data lake and extract insights through data fabric. This is an iterative process with a tremendous amount of experimentation that continues to evolve and build upon the data lake. Although these tools offer valuable insights, they may need to address the root cause of problems that diagnostic analytics can uncover. The true value of a unit lies in predictive and prescriptive analytics, enabling leaders to anticipate challenges and make informed decisions. By consolidating semi-structured and unstructured data from various sources in a centralized data lake and utilizing a data fabric, organizations can gain deeper insights, conduct complex analyses faster, and deploy machine learning algorithms more effectively to solve problems.

"The challenges that still exist are in delivering data and any associated models back to operational units because they have to make it to the data lake and back in mission relevant time. It is not sufficient to have a data lake that provides what the status of an aircraft was yesterday and so mission relevant time for the Warfighter Mission Area (WMA) is much sooner in most cases than in the Business Mission Area (BMA). Additionally, data lakes require a massive system to manage a lot of data sources that most people will never use. This is why the data mesh and data fabric are vital. For those that need access to data most expediently, they will be able to connect to authoritative data at the nearest point of entry, which provides insight to units in mission relevant time and also prepares the Army for Disconnected, Denied, Intermittent, and/or with Limited bandwidth environments" (T. Dirienzo, personal communication, March 9, 2024).

Data lake houses represent a promising avenue for organizations to consolidate data storage, management, and analysis into a unified platform, offering scalability, flexibility, and analytical capabilities. While still in their early stages, these architectures enable efficient analytics across diverse datasets, integrating with modern data processing and analytics tools like machine learning and big data frameworks. By standardizing extract, transform, and load (ETL) processes, employing tools to handle various data formats, ensuring data quality through pipelines, and implementing efficient ETL solutions, organizations can establish robust data lake houses to support data-driven decision-making.

Conclusion

Culture, leadership, and data literacy are the biggest data and analytics maturity inhibitors. Recognizing the significance of becoming data-driven leaders and embracing data analytics is crucial for the overall effectiveness of Army Aviation operations. Data and analytics maturity doesn't start with technology; it ends there. By investing in data-driven leadership training and education, Army Aviation leaders can equip themselves with the necessary tools and knowledge to lead their organizations to greater success in today's rapidly evolving military landscape. The week-long DDL course is one of the best courses I have participated in throughout my career.

Data-driven leader program goals are to:

• Illustrate the potential of improved data-driven decision-making in various domains, including the Army investing in AI to achieve modernization goals.

• Describe how Enterprise data management (EDM) is essential to increasing the quality and reusability of data across the Army (Figure 3).

• Provide a comprehensive executive level understanding of EDM components and best practices. With a long wait list, most leaders will not have the opportunity to participate, so I hope that this article stirs something within readers, and I offer the following recommendations that anyone can implement:

• Model professional curiosity for your formation. While signing up to learn to code is not required, ask questions to learn more about the technical skills or processes required to execute your vision.

• Use the tools available to you and experiment with emerging technologies such as CamoGPT or Griffin AI. Operationalizing AI applications requires continuous utilization and feedback to scale. Demonstrating commitment at the top will go a long way to drive adaptation and prove value to an organization.

• Measure what matters. Start by saying, "I wish I knew" or "I wish I could," to determine where to start. That will help frame the problem for your team and reinforce a culture of top-down alignment and bottom-up refinement. Only when data are considered true, measurable assets, will necessary investment follow.

• Identify someone in your formation to serve in the Chief Data Officer role, reporting directly to the Commander. This acknowledges the importance of data, but more importantly, recognizes the vital contributions of that one person in your formation, setting the tone and pace for digital transformation. That decision should be based on merit, not position. Then, connect them with appropriate personnel and resources at division and corps.

• Identify talent within your formations and empower them to drive change. Without designated data scientists in our formation or Operations Research/Systems Analysis (Functional Area 49) assigned to a brigade, units must fight with the team we have. Fortunately, the much lamented "experience gap" across aviation does not equate to a "talentgap" –this generation is far more talented and will continue to surprise us if given a chance.

• Enablement of talent to pursue additional certifications in coding, analytics, and data science. Free courses are available to federal employees or the military from online learning platforms such as Udemy, the Federal Virtual Training Environment, and Coursera. Several public offering online learning platforms like Codefinity and EdX courses and programs are also available.

In conclusion, integrating data-driven practices is essential for the success of Army Aviation operations. This can only occur through the emergence of data-

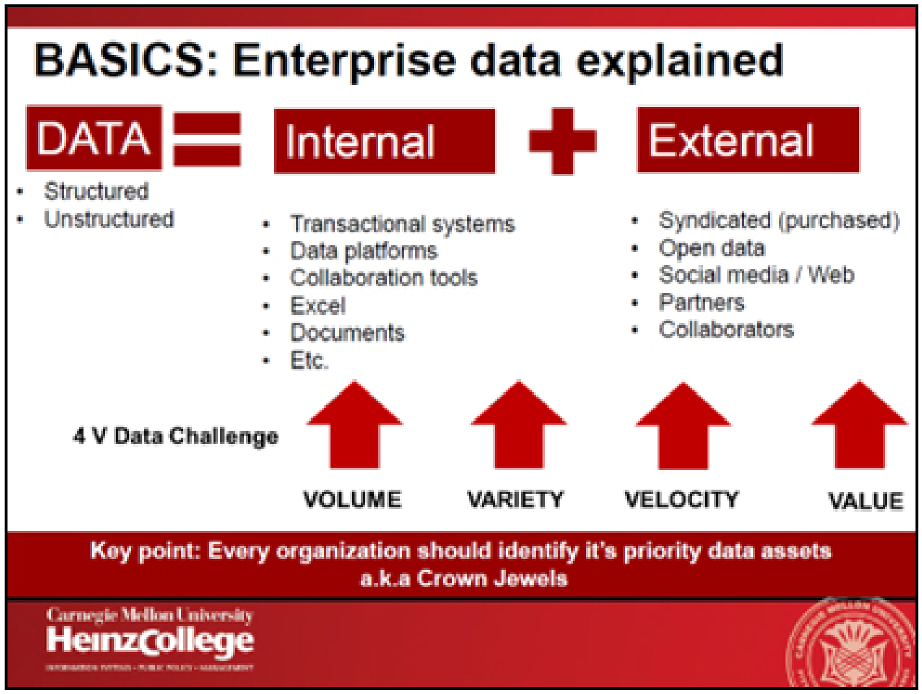

Figure 3. Basics: Enterprise data explained. Figure provided by Carnegie Mellon University, Heinz College, hosts of the Army DDL certificate program, 2023.

Illustration courtesy of Pixabay.com

driven leaders and data-mature formations. Much like the Netflix series *Drive to Survive* (Webb et al., 2019), the digital transformation of our workplace will enable our units to plan, prepare, and execute with F1 precision. Achieving this new reality requires better resource utilization, enhances situational awareness, and improves mission success that ultimately contributes to operational efficiency, safety, and effectiveness in the modern military.

Biography:

COL Ryan Sullivan is Brigade Commander of the 3D Combat Aviation Brigade. An AH-64A/D/E Aviator with multiple combat deployments, he is a former National Defense University (NDU) Scholar, who previously published his research on AI Competition between the U.S. and China for the Joint AI Center.

Illustration courtesy of Pixabay.com

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LOW-ALTITUDE ALGORITHMS:

MOBILE AIR DEFENSE THREATS IN THE AGE OF DEEP LEARNING

By CPT Ezra M. Engel

Introduction.

Modern computer vision (CV) algorithms represent a fundamentally new type of threat characterized by flexibility, autonomy, and accuracy. Electro-optical guidance systems based on modern convolutional neural nets (CNNs) are likely to proliferate widely over the next decade, and due to their relatively low cost and software-based development cycle, can be fielded more rapidly than most previous technologies. These systems, based on the multilayer perceptron (MLP), integrate sophisticated context awareness and complex abstractions of visual data to achieve performance that far outclasses modern systems.

Over the past half century, infrared (IR)-guided missiles have been one of the most persistent and proliferated threats to aviation operations. Their widespread employment throughout both the Vietnam War and Soviet invasion of Afghanistan proved highly consequential throughout those conflicts. Since February 2022, the Ukrainians have effectively used them to deny Russian access in friendly airspace during both offensive and defensive operations.

The most common variant of the IR missile is the man-portable air defense system (MANPADS). Since their development in the 1950s, they have proliferated widely, becoming a fixture of nearly every modern military and many insurgencies (Bevan & Schroeder, 2008, pp. 121-123). They are modular, relatively cheap, and easy to distribute across formations and battle spaces (Freese, 1999). This proliferation and distribution required the development of reliable countermeasures, since high-flying sorties and counterbattery fires could not easily target the infantrymen wielding them. These countermeasures have proven effective against a wide range of common MANPADS and represent crucial security blankets for pilots operating in non-permissive environments.

However, over the past 10 years, rapid development in algorithmic image processing has produced a novel set of guidance systems that are both more robust against countermeasures *and* cheaper (thus, at a higher risk of proliferation) than those in modern IR-based seekers. These new image processing architectures leverage modern deep-learning techniques, an abundance of training data, and powerful graphical processing units, or GPUs, to achieve dazzling precision in real time. This new class of systems is highly accurate, aware of spatial and temporal context, and has flourished within the commercial ecosystem. These CV architectures will almost certainly provide the basis for new area denial weapons platforms, and we are rapidly approaching a future in which they fundamentally change the nature of surface warfare. Without a technical and tactical response, traditional rotary-wing aircraft will be exposed to increasingly unacceptable levels of risk within the low-altitude air domain.

The Spectrum.

The most important sensor in modern warfare is the human eye. Direct visual observation is the primary means of engagement and intelligence collection across all warfighting functions.

Maneuver elements employ direct fire using lines of sight. Most fires require human observers (either on hilltops, in cockpits, or behind drone screens) to communicate target positions. Protective screens require observation and reconnaissance.

The IR missile was one of the first guidance technologies that expanded military sensors beyond this visual range. The introduction of these missiles massively expanded the flexibility and autonomy of guided missile systems.

$$E = \frac{hc}{\lambda}$$

Equation 1. The Planck-Einstein relation (Honsberg & Bowden, 2019).

Almost immediately, however, the IR seeker encountered a fundamental physical constraint. The IR photons have a lower energy than those visible photons. The relationship between wavelength and photon energy is shown by the Planck-Einstein relation (Equation 1) where E is photon energy, h is the Planck constant, c is the speed of light, and λ is wavelength (Honsberg & Bowden, 2019).

Because these photons each carry less energy than their visual counterparts, sensors designed for visual light cannot generally detect IR radiation. Most electronic image sensors use semiconductors for photodetection. These semiconductors contain a valence band (energies at which electrons are still tethered to their parent atoms) and a conduction band (energies at which those electrons can roam freely through the material). Visual photons are energetic enough to knock electrons from the valence band into the conduction band and thus generate a detectable electric current (Klazes et al., 1982, pp. 377-383). Infrared photons are generally *not* energetic enough to trigger this process.

This was problematic in the 1950s and remains problematic today. Photosensors and their composite metal-oxide semiconductors underpin almost every piece of modern technology—from the video camera to the computer. As a result, modern processors and photosensors are both performant and vanishingly inexpensive. The price of intel central processing units has dropped by more than 99.9 percent since 1996 (Flamm, 2021, pp. 403-470), and top-shelf commercial cameras ship with over half a million pixels in their image sensors and cost less than a single blade-hour in a UH-60 helicopter (Best Buy, 2023). Infrared guidance systems can take advantage of neither the metal-oxide semiconductor nor the massive commercial market that continually drives down their cost.

Instead, IR sensors rely on a suite of substantially more niche and expensive technologies with limited commercial uses outside of security and scientific research. Infrared sensors rely on a mix of technologies, to include microbolometers, thermocouples, thermophiles, and pyroelectric crystal arrays (Yadav et al., 2022). Each of these utilizes special substrates that change resistance, polarity, or generate current when they experience changes in temperature. This detection pathway is both more expensive and less performant—especially when the detector is uncooled. For this reason, while digital cameras have been commercially available since the 1970s, most IR missiles did not widely employ imaging arrays until the early 2000s.

The Missile.

Without a multibillion-dollar commercial market driving down costs and faced with a difficult engineering problem, early missileers made some early key design decisions that would inform MANPADS architecture for half a century. The idea to use IR signatures for detection and guidance had been around since the beginning of the early 1900s—and IR detectors had already found use in larger ground-portable detection systems. Miniaturizing the technology to fit on a shoulder-mounted missile, however, proved to be a formidable challenge.

The first generation of MANPADS proliferated in the 1960s. Their sensors were uncooled and thus sensitive only to the exposed pieces of an aircraft's engine (not the plume, as later models would target). This constrained them to "tail-chasing." The seekers utilized a single IR sensor and a rotating reticle in a "spin-seeker" configuration (Figure 1). The rotating reticle on the tip of the spin seeker translated the geometric position of an IR point source into phase information embedded within the single channel detector current. The oscillation phase indicated direction to target track, while the oscillation size indicated the magnitude of divergence from the intended target track (Figures 2 and 3). By design, the reticle was sensitive only to point sources since area sources would produce a constant background signal (Chang & Cooper, 1994, p. 13).

The second generation of MANPADS generally employed a "conical seeker" design and used cooled sensors to improve performance and resistance to countermeasures. Instead of a rotating reticle, conical seekers use a mirror to rotate the observation axis around the central flight axis of the missile. The conical architecture originated in radar systems but quickly improved the performance of IR-guided missiles by simplifying the mechanical complexity of the seeker head and expanding its field of view. These systems still only used a single sensor (1994, p. 15).

While these simple design features allowed early MANPADS to successfully engage aerial targets, they came with serious limitations (Congressional Research Service, 2005, pp. 2-3). First, due to their uncooled sensors, the seekers were highly vulnerable to flares. Second, their narrow field of view resulted in rapid target loss once the missiles erroneously fixated on those same flares. Most air forces quickly fielded countermeasures to mitigate the threats and were able to preserve their freedom of maneuver. Their relatively low cost also led to widespread proliferation with cur-

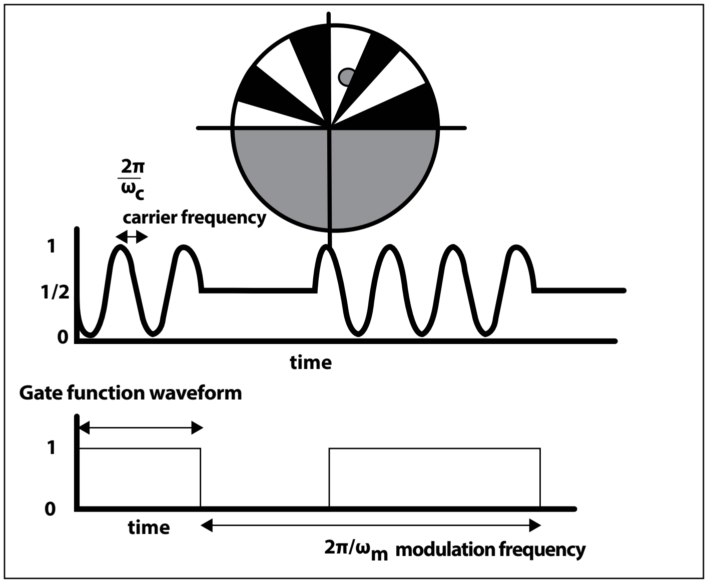

Figure 1. Spin-scan seeker output signal (Chang & Cooper, 1994, p. 14).

rent estimates for international military inventories ranging between 350,000 (Kuhn, 2003, p. 23) and 500,000 (Withington, 2003, pp. 16-17) weapons.

A widespread misunderstanding of MANPADS guidance systems has led to the erroneous belief that *all* or *most* of these systems create IR images of their target and environment as they track and engage aircraft. While this is true of modern systems, these early generations of MANPADS are *non-imaging* seekers. They generate neither an image nor pseudo image of the target. They rely exclusively on the signal's phase information to construct a path to an engaged aircraft. This reliance on phase information is what makes these early systems highly susceptible to active IR jammers (Lewis et al., 2022).

The third generation of MANPADS entered production in the 1980s. These systems employed a second mirror to scan in a rosette pattern (Figure 4) and employed multiband sensors to discriminate between countermeasures and target aircraft (Kumar et al., 2014, pp. 137-150). These improvements led to further increases in field of view, better countermeasure resistance, and improved engagement fidelity (Birchenall et al., 2012, pp. 67-72). "Rosette scanners" are *pseudo imaging* as they retain enough spatial information to roughly reconstruct the spatial elements within their field of view (Congressional Research Service, 2005, p. 3).

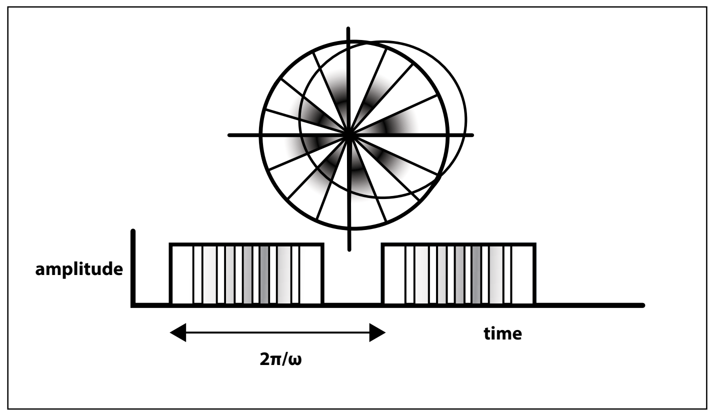

Figure 3. Conical scan seeker under large tracking error (Chang & Cooper, 1994, p. 16).

The fourth and most recent generation of MANPADS rely on full IR focal plane arrays. These are the first generation of seekers to employ multiple diodes to retain raw spatial information about an actual image within the missile's field of view. Focal plane array missiles are the only types of missiles that can generate actual images of the aircraft and its environment, and they use this information to deadly effect. Fourth-generation IR missiles often use rudimentary discrimination algorithms paired with electro-optical information to resist countermeasures and retain target lock while in flight (Pastor, 2020). The full focal plane imaging array also provides resistance to active directed jamming from modern countermeasure kits. These systems represent a serious threat to rotary-wing air assets (Congressional Research Service, 2005, p. 3).

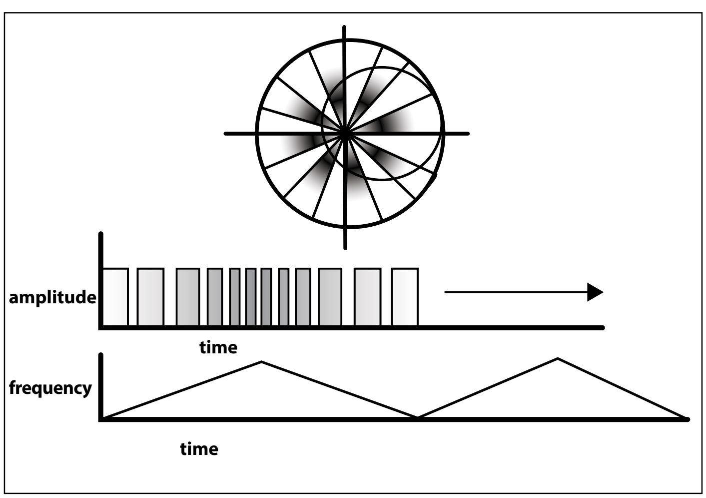

Figure 2. Conical scan seeker under small tracking error (Chang & Cooper, 1994, p. 16).

The complexity and cost of these focal-plane systems constrain their wider proliferation. Modern MANPADS can cost hundreds of thousands of dollars per unit—limiting the pace of their fielding and production (Schroeder, 2007, p. 6). This lack of proliferation is a major protective consideration for aircraft operating in non-permissive environments due to their high resistance against available countermeasures. However, advances in artificial intelligence and CV threaten to fuel new electro-optical architectures that render even these advanced IR-guidance systems irrelevant.

The Algorithm.

Over the past 2 decades, advances in CV have accelerated rapidly. The field includes a broad suite of technologies, algorithms, and architectures that enable computers to process visual information from pictures and video. Many of the underlying principles have percolated through academia since the 1950s, but computers lacked the speed and memory to realize use cases until relatively recently. The modern era of CV research can be divided into two periods: one before the integration of deep learning techniques, and the one that followed (Deng et al., 2020).

Researchers began to make substantive progress on image classification and localization algorithms in the early 2000s. These early algorithms relied heavily on sliding windows and layers of detectors sensitive to Haar-like features in the image. Haar-like features are rudimentary shapes (such as vertical or horizontal lines) that have exceptionally fast computation times.

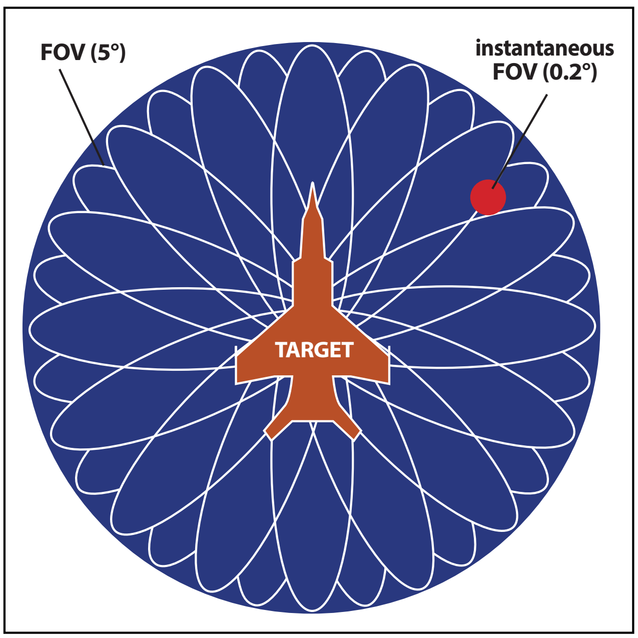

Figure 4. Rosette scanner (Birchenall et al., 2012, pp. 67-72).

These early algorithms would examine large quantities of images, a *training set*, and refine the weight and importance of each Haar-like feature when determining the presence of an object class within a given image (Jones & Viola, 2003). These models might train on tens of thousands of images and refine tens of thousands of parameters over the course of their training iterations.

Though researchers found success with these models, the rigidity and limitations of Haar-like features constrained their overall performance. In 2014, a team at the University of Illinois developed one of the first deep-learning-based CV algorithms (Sadeghi & Forsyth, 2014, pp. 64-79). *Deep learning* quickly proliferated through academia and the commercial sector throughout the 2010s. Its rise to prominence was a direct result of increasing computer speeds and a massive increase in the size of available data sets driven by wide adoption of the internet.

$$y = f\left(\sum_{k=1}^{n} w_k \cdot x_k\right)$$

Equation 2. Single perceptron (Sadeghi & Forsyth, 2014, pp. 64-79).

Deep learning architectures fall into a class of algorithms called **MLPs**. The basic unit for the MLP is the *perceptron*, defined in Equation 2, where w_k is a trainable parameter, x_k is a data point, f is an activation function (sigmoid in a classical case, rectified-linear-unit (ReLU) in the multi-layer use case), and y is the output. In an MLP, tens of thousands of individual perceptrons are stacked in layers to produce highly accurate modeling of non-linear effects and features in a data set (Gallant, 1990, pp. 179-191).

Figure 5 shows a model of a dense, four-layer neural network. The input layer takes pre-processed data from a data set (in a CV model, this data set might be the pixel brightness values in a collection of photographs). These data pass through multiple layers of perceptrons with the output of each layer serving as input for the next. Over the depth of the neural network, the algorithm refines parameters to develop a sophisticated model of non-linear features and characteristics of a data set or image.

The deep convolutional nets that began to dominate the literature after 2014 iterated on the MLP by introducing the concept of a convolutional layer within the neural architecture. These convolutional layers output the convolution of an input layer and convolutional matrix populated by learnable parameters. Using convolutions instead of fully connected layers has three primary advantages. First, it significantly reduces the number of learnable parameters for the algorithm. Modern color images can contain tens of thousands of pixels, and a fully connected layer would consequently contain hundreds of millions of parameters, quickly becoming intractable. Second, convolutions speed up learning by prioritizing the locality of visual information. When processing visual information, pixels that are close together are more informative than pixels that are far away. Convolutions help the architecture to properly emphasize this locality. Finally, convolutions allow the algorithm to learn from repeated patterns in a single image during the training process. At low levels of abstraction, certain features might repeat themselves many times across different localities in an image.

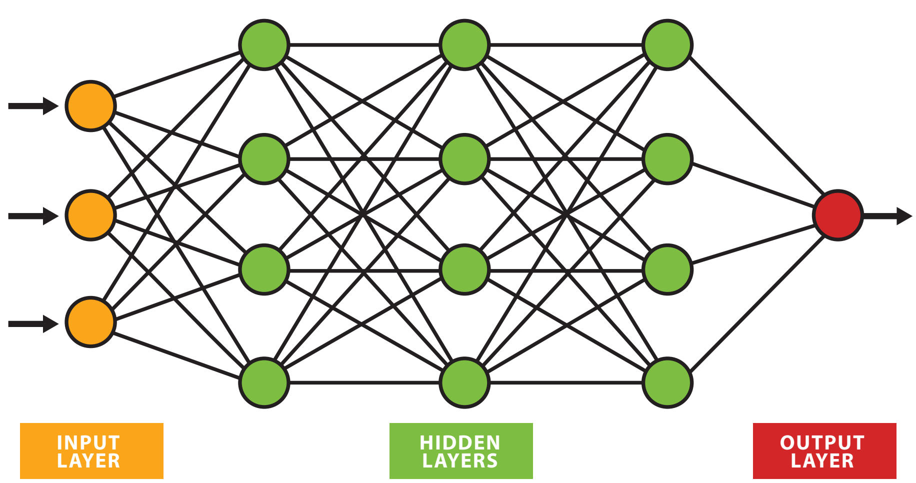

Figure 5. Four-layer dense neural network (TIBCO, 2023).

Convolutions leverage that repetition to accelerate learning (Li et al., 2022).

A simplified model for a convolutional architecture is shown in Figure 6. Modern CNNs use a sequence of convolutional layers to reduce the dimensionality of an image before processing the output with a series of fully connected layers. This allows the algorithm to successfully abstract features and components of object classes within training cases and map these features onto a desired output within the dense multilayer network at the end of the pipeline (Redmon, 2015, pp. 779-788).

Deep learning techniques and CNNs have led to a dramatic improvement in the performance of these algorithms over the past decade (Figure 7). Modern frameworks proliferate widely through both academia and commercial enterprises and their reliability now underpins a variety of new features and technologies—most notably—self driving cars. As economic pressure continues to motivate the further refinement of existing algorithms, they may expand into military technologies as well.

The Threat.

The military proliferation of these algorithms represents a fundamentally new type of threat. Modern CNNs promise to deliver a degree of autonomy, accuracy, and flexibility that will challenge current countermeasures and tactics. Furthermore, adversaries will be able to produce them at a low marginal cost basis and facilitate extensive area denial with wider fielding. Finally, because these weapons primarily consist of software, the technology is likely to follow an iterative and rapid approach for development and updates. An adversary capable of fielding these weapons backed by a modern development operations (DevOps) cycle would gain additional flexibility and speed by updating software to address novel countermeasures and tactics.

Convolutional neural networks offer innovative, highly sophisticated capabilities that far outclass those of current systems. These guidance systems could leverage ultra-wide angle fields of view, large and dense pixel arrays to capture detailed image data, and invulnerability to modern electronic-warfare tactics. A context-aware visual guidance system would be resistant to flares, directed IR countermeasures, and most tactics to break line of sight. Acquisition time would be the length of a single refresh cycle on the image processor (1/30th of a second) (Sadeghi & Forsyth, 2014, pp. 65-79).

These weapons also constitute a unique deviation from the common trajectory of technological development. Usually, when a superior technology begins to replace extant assets, its proliferation is mitigated by prohibitive costs. This holds especially true for military assets, where each new generation of kit almost always comes at a higher cost than the generation it replaces (the F-22 was dearer than the F-15, which was dearer than the F-4) (Hampton, 1998). This pattern holds true for most kit across most domains but it will not hold for CNN-based guidance systems.

Optical detection algorithms are likely to be significantly cheaper than the IR-based systems they replace. They rely on less specialized (and thus far cheaper) hardware for their sensors and processors. With the lion's share of software development costs already borne by industry and academia, potential adversaries are liable only for the cost of fine-tuning extant models (low) and the marginal cost of populating those models onto chips (extremely low). This low cost will massively increase the risk of rapid fielding and wide adoption.

Finally, because these weapons are primarily software packages, the speed of their development will likely deviate sharply from that of extant systems. Software (unlike hardware) follows a DevOps development cycle, emphasizing speed, iterability, and flexibility. Iterated development is impractical with physical hardware due to the high cost of physical transport, but software can be fielded rapidly and improved over time with patches, updates, and new versions without changing the base hardware platform. This could allow for a degree of responsiveness and flexibility that is uncommon in current acquisition processes, further complicating the development of countermeasures and procedures to mitigate these novel threats.

The Future.

The proliferation of these algorithmic systems will require continued refine-

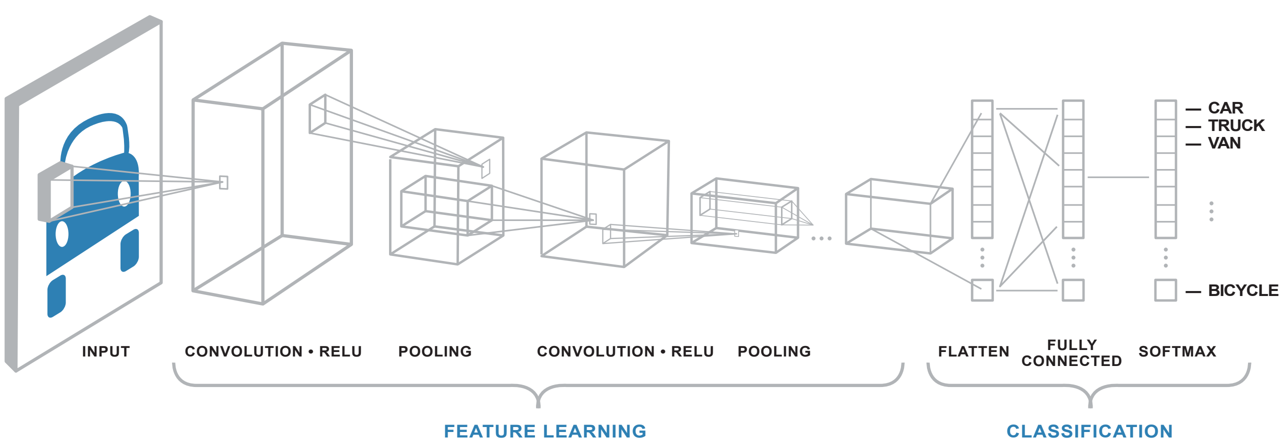

Figure 6. A CNN (Saha, 2018, para. 1).

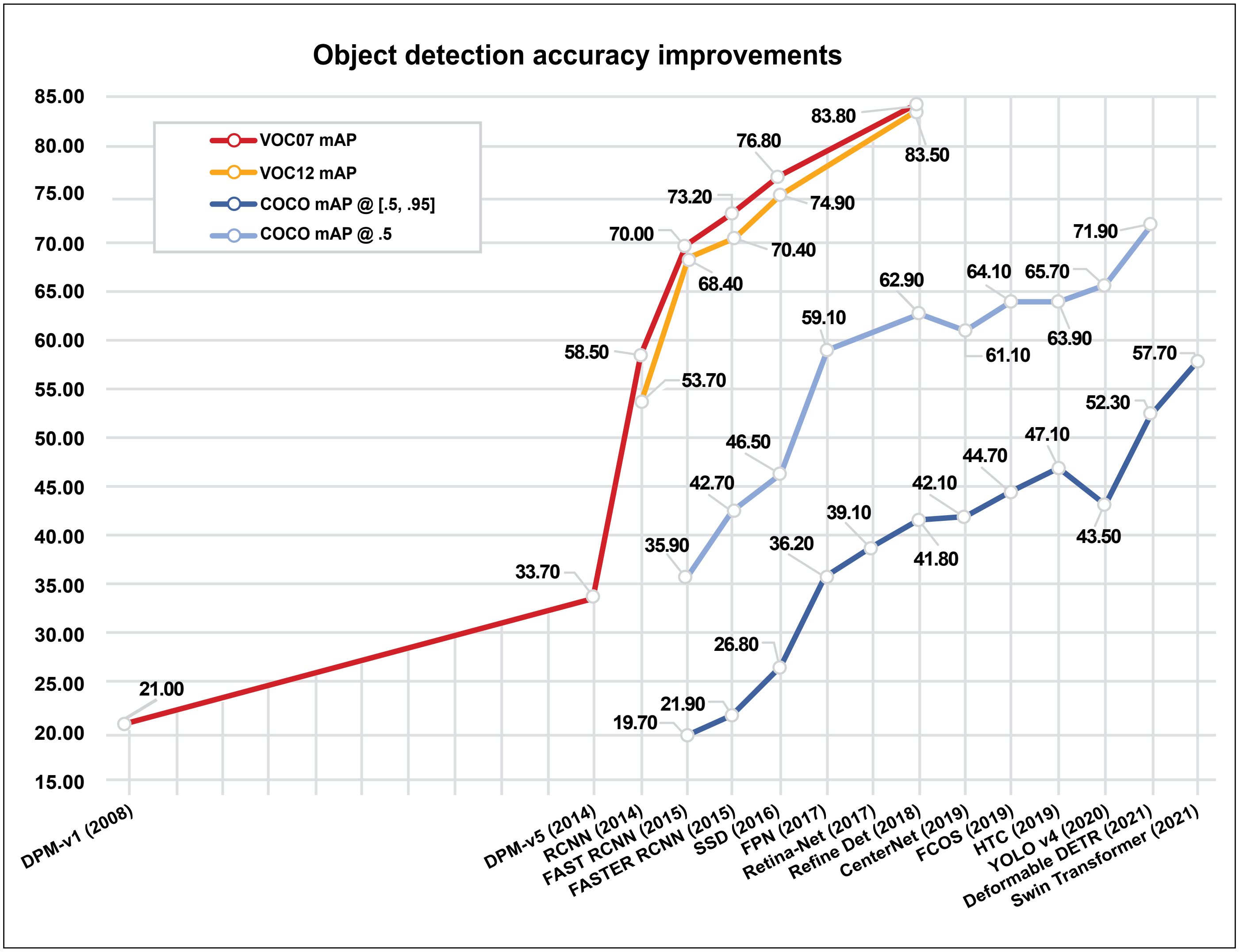

Figure 7. Object detection performance (Zou, 2023, pp. 257-276).

ment, development, and fielding of relevant and modern countercapability systems. The most promising line of current development is the effort to develop countermeasures that pursue hard-kills of incoming missile threats. Because CNN-based missile systems will look nearly identical to legacy systems, it is unlikely that aircraft sensors will be capable of distinguishing between them. This challenge demands the type of threat agnostic countercapability provided by physical kill systems.

These countermeasures generally employ directed energy, direct fire munitions, or smaller guided missiles to intercept incoming threats and ensure a physical kill of the missile before it can damage the aircraft. There is good news for these approaches. Advances in CV enable the development of new threats, but they also enable the development of novel countermeasures at lower cost than was previously possible. Countermeasure systems based on CNNs will have all the same advantages of CNN-based threats: accuracy, flexibility, iterability, speed, and cost. If we are quick to begin integrating these technologies and software design methodologies into our acquisition processes, we can develop effective hard-kill countermeasures before these weapons dominate a future battlespace. If we delay, future non-permissive environments are likely to stymie air maneuver efforts and relegate aviation operations to the support zone.

To remain ahead of this challenge, the Aviation Branch must reassess some of its foundational approaches to survivability, countermeasures, and acquisition. Developing solutions to this future threat should be one of the branch's top priorities if we want to operate as a maneuver force in future conflicts. We have the opportunity and wherewithal to prepare for that conflict by leaning forward on artificial intelligence, autonomy, and software-based countercapabilities. Failure to adapt will allow our adversaries to gain initiative and advantage that may prove catastrophic in future conflicts.

Biography:

CPT Ezra Engel is an aviation officer currently serving with the 10th Combat Aviation Brigade. He first began working with machine learning models at Los Alamos National Laboratory, New Mexico, and further cultivated his interest during graduate study at the Massachusetts Institute of Technology. His previous work has focused on neutron lifetime measurements and epithermal neutron imaging techniques for the verification of nuclear weapon pits. He loves discussing the intersection of defense and technology, and he encourages interested readers to send him an email on the global address list.

A U.S. Army Soldier aims an M-46A2 Redeye missile system intercept aerial trainer during a training exercise. Photo courtesy of the U.S. National Archives.

Soldiers conduct air threat engagement tactics with MANPADs during an exercise at Adazi, Latvia. U.S. Army photo by SSG Cesar Rivas.

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HOW WE FIGHT: MEDICAL EVACUATION SUSTAINMENT IN COMBAT

U.S. Army combat medics conduct hoist extraction training at Katterbach Army Airfield in Ansbach, Germany. U.S. Army photo by Charles Rosemond.

By MSG Evan E. Chaney

Aerial Medical Evacuation (MEDEVAC) is often thought of in one capacity–evacuation of casualties from the battlefield, but the HH-60 Black Hawk and its aircrews could do so much more. Medical Evacuation HH-60s or "HHs" are also capable of moving medical personnel and Class VIII medical supplies and equipment. In a Large-Scale Combat (LSCO) environment, casualty rates will require increased medical sustainment support and MEDEVAC aircraft could and should be utilized to move medical personnel and Class VIII medical materiel (e.g., surgical dressings, medical instruments, controlled/noncontrolled drugs) around the battlefield.

Additionally, MEDEVAC aircrews, in keeping with "Army Health System" (AHS), Field Manual 4-02 (Department of the Army [DA], 2022), should train task number 2048—*Perform external (sling) load operations*[1] —to enable supporting the principles of the AHS (2022, p. 1-8). Sling load operations will prove paramount in fully realizing the robust combat multiplier potential MEDEVAC helicopters and their aircrews bring to the battlefield. External load operations will enable two important lines of effort (LOEs)

1: movement of bulk amounts of Class VIII medical supplies too cumbersome for helicopter internal load, and 2: the self-deployment of the Forward Support MEDEVAC Platoon (FSMP). Through these LOEs, the U.S. Army will maximize the potential of HH aircraft to achieve the ultimate purpose of saving lives and efficiently clearing bed space for the combatant commander.

Movement of Bulk Class VIII

Large-Scale Combat models predict 1,000 casualties per day (Fandre, 2020). Class VIII resupply will be needed at a scale not seen since the Korean War (Sheets, 2021). Class VIII, by volume, will need to move rapidly, and other classes of supply may out-prioritize medical supplies in logistic pushes utilizing other helicopters or ground sustainment assets. Medical evacuation helicopters, utilized in the right time and space to move large amounts of Class VIII slung to a resupply point, could mean the difference between patient life or death. Reliance on the UH-60 and CH-47 community to move Class VIII ties up vital resources or causes competing requirements on those airframes that the medical corps should be able to solve with MEDEVAC helicopters. Internal loads with the HH Basic Medical Interior installed makes bulk movement of materiel complicated and takes longer to load and unload. Medical evacuation, as part of the AHS, should complement the warfighters' medical sustainment rather than being an additional burden to move.

Forward Support MEDEVAC Platoon Self-Deployment

Self-deployment of the FSMP is another opportunity to free up the burden to logistics convoys or UH and CH airframes that have compet-

[1] To learn more about this task, use the common access card-enabled Army Training Network's training and evaluation outline task search function.

“DUSTOFF” Soldiers conduct joint training with Tripler Army Medical Center ICU department and 8th Forward Resuscitative Surgical Team U.S. Army Pacific Soldiers in patient transfers and reporting real-world MEDEVAC training at Tripler Army Medical Center, Hawaii. U.S. Army photo by SGT Sarah Sangster.

ing lift missions. External loads would enable the FSMP to rapidly displace and emplace their command post (CP) without the delay of resourcing external movers. After observations from multiple Combat Training Center rotations as an Observer-Coach/Trainer and from personal experience operating in Afghanistan with a FSMP, the inability to sling needed equipment presents two problems. Organic equipment must be loaded as internal HH loads, turning the HHs into moving vans, and/or the platoon is not capable of conducting sustained MEDEVAC operations until other lift or ground assets arrive with their equipment.

Benefits of External Load Operations

External load operations will enable the FSMP to displace and self-deploy more quickly, enhancing response times to MEDEVAC missions with all three aircraft “lines” of the FSMP. Current execution of CP jumps consists of one HH helicopter that has a reduced amount of CP equipment loaded so they can clear the aircraft to be the “first up” in the event of a mission received. The other two aircraft are loaded to maximum internal capacity with equipment needed for the CP and crew life support. Slings would allow for cabin interiors to be mission ready across all three HHs for MEDEVAC missions, while still allowing for the movement of needed equipment to set up and establish MEDEVAC operations at a new site. In the event of a dynamic retask while conducting a jump, the aircraft could set down its sling, conduct the MEDEVAC mission, and then return to the equipment to complete the sling move to the new operations location.

In addition, there is a tertiary benefit from MEDEVAC crews conducting and remaining current in external load operations. Apart from the medic, the remainder of an aircrew will most likely either have come from or go to a lift unit that requires them to do external sling load operations. By conducting sling operations in the “MED,” the task will not atrophy for those crews while away from the lift community. The “sling” trained MEDEVAC crews enable and enhance the aviation commander’s ability at echelon to rapidly shape battlefield sustainment through the tactical employment of the AHS principles in full.

Conclusion

The recommendation for 'How we Fight in LSCO (MEDEVAC sustainment)' is to train task number 2048, *Perform external (sling) load operations*. If we do this, MEDEVAC will further itself as a combat multiplier and enabler for the warfighter by reducing reliance on external resources and becoming a self-sufficient mover of what the Army needs. Vital repetitions come from training with the ground forces to conduct external loads for movement of bulk Class VIII in the cargo bag or other equipment needed by the medical system. These repetitions and rehearsals validate the capability while concurrently reinforcing task proficiency. Task 2048 drives home the integration of air and ground and creates a shared understanding of the challenges prior to execution in a LSCO environment.

Biography:

MSG Evan Chaney has been a combat medic for 17.5 years and currently serves as Senior MEDEVAC Observer-Coach/Trainer at the Joint Multinational Readiness Center. He has deployed as a FSMP PSG in Afghanistan and MEDEVAC Detachment noncommissioned officer in charge in Grafenwoehr, eastern Bavaria, Germany, and deployed the detachment forward to Poland in response to Russian invasion.

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Ammunition Transfer and Holding Points: Aviation Sustainment Under Fire

By CW4 Michael K. Lima

Introduction

Combat aviation brigades (CABS) provide lift and attack capabilities, allowing maneuver forces to move greater distances flexibly and creating the ability to shape battles early in combat operations. One such case was during the beginning of Operation Iraqi Freedom, as United States Forces conducted airstrikes on military targets around the country. The forward arming and refueling points (FARPs) from the 101st Airborne Division (Air Assault) became iconic, known as Shell and Exxon (a rapid refuel point). These FARPs had the advantage of survivability, staying out of the Iraqi Armed Forces' indirect firing range but far out enough on the battlefield to extend operational reach for coalition forces. The former aviation brigades were supported by a unique formation, ammunition transfer points (Department of the Army, 2001, p. 9-2), a legacy mobile ammunition supply point (ASP) formation dating back to World War II (Lima, 2021). Combat aviation brigades gained organic ammunition transfer and holding points (ATHPs) with the conversion to modular force and counterinsurgency operations (2021). This is a distinctive ordnance-type formation that the Aviation Branch may now lose as the Army shifts to Large-Scale Combat (LSCO) against peer adversaries.

Forward Arming and Refueling Points

The ATHP, located in the aviation support battalion (ASB) distribution company, forms an integrated munitions logistical support system with that of the FARP's. Army Techniques Publication (ATP) 3-04.17, "Techniques for Forward Arming and Refueling Points," provides a definition and purpose as;

"A FARP is a temporary facility organized, equipped, and deployed as far forward, or widely dispersed, as tactically feasible to provide fuel and ammunition necessary for the sustainment of aviation maneuver units in combat. Establishing a FARP allows commanders to extend the range of their aircraft or significantly increase time on station by eliminating the need for aircraft to return to the aviation unit's central base of operations to refuel and rearm" (Department of the Army, Change No.1, 2021).

Commanders and staff plan to use FARPs to sustain the operational reach of friendly forces. Aircraft fuel distribution is accomplished through rapid refuel points, while munitions operations include FARPs to extend operational reach. Rapid refuel points are established for rapidly refueling large numbers of aircraft during surge periods, while FARPs provide for uploading munitions to conduct precision strikes or close air support, such as the initial invasion during Operation Iraqi Freedom. Arming operations, often forgotten, are the last stage of a complex logistical chain that must continue to be resupplied to provide lethal effects.

Arming Operations

In reverse order, the munitions set on armament pads affect load up and turnaround times. Current techniques state that there should be "enough ammunition for at least one arming sequence" (Department of the Army, 2021, p. 2-24) during combat missions before an aircraft arrives. They are laid out in the order of loading and ready to load in heavy conflicts. This directly impacts "the tenets of operations," which are "agility, convergence, endurance, and depth" (Department of the Army, 2022, p. 3-2). What makes aviation unique among other organizations is the ammunition storage areas identified by techniques published for ATP 3-04.17 that support FARP operations and aviation operations (Figure). One step back from the armament pad is the ready ammunition storage area (RASA), which contains ammunition required to resupply the minimum for one load at rearming pads. The RASA provides space for assembling and disassembling of munitions ready to be moved for loading. The next step back is the basic load storage area (BLSA), an area separated from the RASA. The BLSA contains ammunition on hand to support the unit for up to 3 days of combat, including aircraft-specific munitions

Petroleum supply specialists pose for a sunset photo while at a forward arming and refueling point at the 28th Expeditionary Combat Aviation Brigade mobilization station. U.S. Army photo by SPC Kayla Harley.

(Department of the Army, 2021, p. 2-21). This is not to be confused with the organic ATHP under the ASB.

Ammunition Transfer Holding Point

The ATHP is a temporary operation adjacent to the brigade support area to enable the receipt, storage, and issue of ammunition to the supported brigade, including CABs. One of the organizations having the formation since ATP 4-35, "Munitions Operations," unveiled the newest design, the modular ammunition transfer point (MATP). According to ATP 4-35, the MATP provides brigade combat team commanders with "the ability to scale, tailor, and surge munitions capability and capacity" during LSCO across a widely dispersed area of operations (Department of the Army, 2023, p. 2-19). While the MATP may seem to be an improved munitions sustainment organization at face value, it is optimized for brigade combat teams with minimal sustainment support. An ammunition noncommissioned officer section chief leads the MATP section. It is divided into five Soldier teams, an ammunition chief, and handlers with associated equipment designed to conduct split-based munition operations (2023, p. 4-10).

On the other hand, CAB commanders accomplish the same task with the ATHP. The CAB commanders are led by an 890A ammunition WO assigned to the distribution company ammunition section, serving as an accountable officer. The munitions organization is an ammunition support activity designed for the quick transfer of munitions or short storage duration when a mission requires munitions to be held in place. The ATHP ammunition section also consists of an ammunition section chief, ammunition handlers, and ammunition stock control and accounting specialists uniquely designed for area-based munition operations (Table). The organization provides munitions support enabling FARP operations and can independently deploy to support battlefield aviation movements (Department of the Army, 2023, p. 4-9).

Conclusion

Large-Scale Combat in operations is the primary focus of current modernization. Throughout the doctrine, organization, training, materiel, leadership and education, personnel, facilities, and policy, or DOTMLPF–P—which is the "decisionmaking analysis" and "determines/recommends whether a non-material or material approach is required to fill a capability gap"—consider the ATHP (AcqNotes, 2024).

The Aviation Branch creates "force design update (FDU) processes to determine requirements for doctrinally correct organizations" for the Army of 2030 (Department of the Army, 2013, p.1). Consider FDU junior, a faster process than a full FDU, to add capability and improve the current design of the ATHP. The ATHP is an organization created from the modular force and tried-and-true in counterinsurgency, now uniquely serving in aviation. But most of all, keep the ATHP as it can better support aviation operations in LSCO into 2030 and beyond.

Biography:

CW4 Michael Lima currently serves as the training developer with the Ordnance Training Development Division. He is assigned to the Ordnance Corps and Ordnance School under Combined Arms Support Command at Fort Gregg-Adams, Virginia. He was a Training with Industry participant at Raytheon Missile Defense and an accountable officer for the Army ASP at Kadena Air Base, Okinawa, Japan. He holds a doctorate in business administration and a master's degree from Baker College Center for Graduate Studies. CW4 Lima is a former MOS 15R, AH-64 Attack Helicopter Repairer (1999-2005).

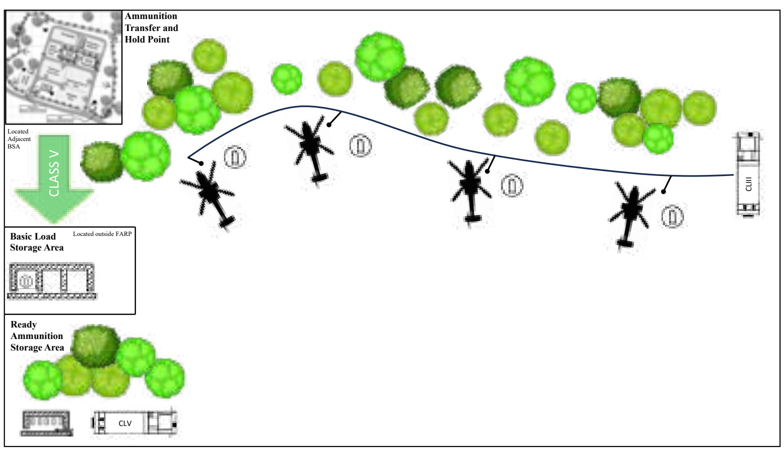

Figure. Class V (ammunition) FARP layout (Department of the Army, 2021).

	Ammunition Transfer Holding Point (ATHP)	Modular Ammunition Transfer Point (MATP)
Units Supported	Other functional and multifunctional brigades (aviation, field artillery)	ABCT, IBCT, SBCT, MDTF
Structure	Ammunition warrant officer Section chief Ammunition section	Section Chief Ammunition Teams: x2 for IBCT and MDTF x3 for SBCT and ABCT (tailored to expected workload)
Mission Focus	Ammunition storage and accountability, ASA area based supply point distribution for customer support. Normally operating in one location adjacent to or nearby the brigade support area.	Primary: Ammunition throughput and visibility, mobile ammunition support operations. Fast moving, often with section performing split operations in two or more locations. Secondary: Ammunition storage and accountability, ASA-type customer support.
Modularity	Not applicable	Ammunition team design matches EAB ammunition unit design facilitating requests for augmented support in standard units (team, section, platoon) when needed.

ABCT armored brigade combat team; ASA ammunition support activity; EAB echelons above brigade; IBCT infantry brigade combat team; MDTF multidomain task force; SBCT Stryker brigade combat team

Table. Key differences between the ATHP and MATP (Department of the Army, 2023, p. 4-8).

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ASSURANCE, CONFLICT, DETERRENCE, AND READINESS DURING COMPETITION

A UH-60L Black Hawk helicopter from Company A, 2D Battalion (Assault), 10th Combat Aviation Brigade, Task Force Phoenix, flies a personnel movement mission over Nangarhar Province, Afghanistan. U.S. Army photo by CPT Peter Smedberg.

By CPT Jordan A. Beagle

Since fall 2023, the 1st Combat Aviation Brigade (1CAB), 1st Infantry Division, Fort Riley, Kansas, has been the Rotational Aviation Force supporting Operation Atlantic Resolve.[1] Since April 2014, the U.S. Army has deployed Soldiers along the Northern Atlantic Treaty Organization's (NATO) eastern flank to support Operation Atlantic Resolve. The 1CAB's mission while forward deployed in Europe is to "Assure and Deter." This means assuring our allies and regional partners that we are committed to supporting NATO and deterring any threat or malign influence. One of the many ways that aviation brigades and Army units deter malign influence and train for the future fight in Large-Scale Combat (LSCO) is through joint multinational readiness exercises and aerial gunneries while deployed.

The 1st Squadron, 6th Cavalry Regiment, 1CAB (Task Force Saber) Squadron Commander, LTC John "Mike" McLean, took time out of his schedule after his Task Force completed singleship aerial gunnery, to talk with me about how his Task Force prepares for a fight in a LSCO environment and how their current deployment prepares them for the fight.

In January 2024, Task Force Saber conducted aerial gunnery in Poland. "Gunnery [in Poland] was an outstanding learning experience with different challenges," said McLean. "However, each challenge was an opportunity for our organization and the Polish on how to prepare ourselves to operate in this theater. A lot of the challenges replicate what we are going to face in a LSCO environment, we will go to an undetermined location, and we will have to adapt," he explained. At home station units such as Fort Riley, Kansas, gunnery ranges have many restrictions built to conduct gunnery tables for both aviation and ground forces. The range in Poland, "has a 360-degree range, so we had free reign to adapt to any enemy situation that is not linear. We could react in any direction. That allowed our aviators to understand that, unlike the traditional safety constraints, there's not just going to be an enemy that is oriented in the direction that you're flying, and you will have to engage it with your weapon systems with very precise limitations" (M. McLean, personal communication, January 2024).

During gunnery, Task Force Saber incorporated Polish Joint Terminal Air Controllers (JTACs) into their training and utilized land on the 56th Air Base (Inowroclaw, Poland) to establish a forward arming and refueling point with the help of the 1st (Polish) Aviation Brigade. Working with the Polish Armed Forces during gunnery is essential to the 1CAB when it comes to conducting realistic training and increasing deterrence across the country. When it comes to fighting in LSCO, interoperability is key, and that is why it is so important to build these relationships now through gunneries, training events, and engagements.

The Apache has served as a critical part of the U.S. Army's attack helicopter for more than 40 years (Interesting Engineering, 2024). In 2–3 years, the Polish Aviation Forces will begin building their

[1] "Atlantic Resolve provides rotational deployments of combat-credible forces to Europe to show our commitment to NATO while building readiness, increasing interoperability and enhancing the bonds between ally and partner militaries" (U.S. Army Europe and Africa, n.d.).

fleet of Apaches (Osborne, 2023). Since arriving in Poland, the Task Force has conducted several scheduled maintenance engagements with the 1st (Polish) Aviation Brigade. "The Polish team has been very excited to work with us operationally to restructure themselves organizationally on how to best employ the Apache," said McLean. "It has also been great to work on how to modernize to prepare themselves to work with advanced modern technology, as opposed to the Soviet-era helicopters that they are currently employing," he stated.

Preparing for a fight in LSCO is something Task Force Saber, primarily an Apache Squadron, continues to prepare for and will be tested on this spring during "Allied Spirit 24." Allied Spirit 24 is an exercise conducted at the 7th Army Training Command in Grafenwoehr and Hohenfels, Germany. Multiple European countries and different U.S. Army forces will participate in this exercise, and it will test the unit's ability to work with different NATO Armed Forces in a LSCO environment. "Allied Spirit forces us to understand that we must fight aggressively to pursue interoperability and a common understanding," stated McLean. "We're very focused on the systems that we have as a U.S. force. It forces us as leaders, staff planners, and subordinate leaders to understand that

Task Force Saber AH-64 being armed and fueled during gunnery. U.S. Army photo by SGT Valesia Gaines.

perfect communications aren't going to exist. Internet availability is not going to exist. Not everyone is 100 percent aligned or aware of U.S. Army doctrine. So, we've got to get rid of those assumptions that our graphics and our terminology are exactly going to match each other at the partner level. It's forcing us to cut through many of the assumed efficiencies. 'Don't go to complex, go to simple,' can be more commonly and easily understood as the pathway toward joint integrated planning, which would be a pathway to success in exploiting initiative through that simplicity that we can achieve by shared understanding" (M. McLean, personal communication, January 2024).

One of the core competencies of U.S. Army Aviation is to "provide accurate and timely information collection" (Department of the Army, 2020, p. 1-3), which is a key purpose of an air cavalry squadron, or a task force organized around an air cavalry squadron. Information collection conducted by manned or unmanned aircraft in LSCO is important so priority intelligence requirements can be answered on the terrain, enemy, and civilian populations. "Accurate and timely information collection is paramount in LSCO," McLean expressed. "We've seen it in digital practice and warfighters, where 'timely' is sometimes more important than being 'accurate.' Sometimes being able to fight for information and send back information to our

Task Force Saber Troopers after conducting a re-enlistment ceremony and scheduled maintenance with the 1st Polish Aviation Brigade at the 56th Airbase, Inowroclaw, Poland. U.S. Army photo taken by CPT Jordan Beagle.

higher headquarters and our supported forces, we were able to establish sensors in various forms of contact to validate that nothing was there. It allows adjacent and higher headquarters to understand that we are validating the S2 (intelligence officer) assumptions and expected courses of action or invalidating them, so the entire formation can pivot the plan together instead of operating in a vacuum. One of the things that we've stressed as a cavalry organization is that we are going to have to utilize the best information available and synchronize our efforts, integrate our concepts, and coordinate our actions. So then, the main effort that will largely come in behind a cavalry security or reconnaissance style mission has its best opportunity for success," he explained.

LTC McLean served as an AH-64D Apache Company Commander during the Army's counterinsurgency (COIN) operations. He also discussed some things he learned as an aviator since the transition from COIN to LSCO. "I feel like in a nutshell, it is quality over quantity in a COIN environment," he said. "It was the smallest feasible element, which is typically a team, operating with very rudimentary information, or sometimes the mission was just to be there 'in case.' There was a lot of focus on the number of aircraft in the air, which minimized the amount of pre-mission planning in a COIN environment because the threat didn't exist to the same degree as in the LSCO environment. From a risk mitigation aspect, there was never an air defense threat. So, we were operating at altitudes that were okay for the [COIN] environment but didn't translate to LSCO, because that's where we go from the quantity of missions to quality missions. There's a greatly increased amount of pre-mission planning and a hugely increased amount

Task Force Saber AH-64 crew after completing a gunnery table. U.S. Army photo by CPT Jordan Beagle.

of fires integration and enemy assessments. The amount of planning per mission and planning per mission hour is, I'd say, 10:1 or higher, but each mission has got to matter because there's an increased risk in the LSCO environment. It's not about being in the air for 8 straight hours. It integrates all the joint forces and enablers required to degrade an enemy force for a very short period to facilitate either a screen line, an attack, or some other type of reconnaissance operation to occur toward a very specified end state. [This is] in support of answering either PIR [priority intelligence requirements] for the supported force or to achieve some type of offensive end state in an attack mission for the supporting force. So to encapsulate all that, the risk goes up in a LSCO environment, and our pre-mission planning has to increase immensely. Our synchronization and coordination have to increase immensely and our overall focus on very low, very high-demand aviation tactics is going to ensure that we maintain our survivability in the lower tier of the air domain, regardless of how many flight hours are occurring. We're still achieving a very decisive end state" (M. McLean, personal communication, January 2024).

The 1CAB's mission to Assure and Deter while forward deployed in Europe is critical when it comes to how we support our NATO allies and partners and how we train and fight in a LSCO environment. The 1st Air Cavalry Squadron, 1st Cavalry Division, Fort Cavazos, Texas, will replace the 1CAB this summer in Europe (U.S. Army Public Affairs, 2024).

Biography:

CPT Jordan Beagle was commissioned as an Infantry Officer from South Carolina State University in 2017. CPT Beagle holds a Bachelor of Arts degree in communication with a focus in broadcasting from South Carolina State University. His military schooling includes Air Assault School, Infantry Basic Officer Leader Course, Bradley Leader Course, Maneuver Captain's Career Course, and the Public Affairs Communication and Strategy Qualification Course. CPT Beagle has served in several leadership capacities from the platoon to brigade level. His most recent assignments were a Mechanized Infantry Platoon Leader while assigned to 2-12 Cavalry Regiment, 1st Cavalry Division, Fort Cavazos, Texas; a Company Executive Officer; and Company Commander of Echo Company, 3-54 Infantry Battalion, Fort Moore, Georgia. CPT Beagle's awards and decorations include the Meritorious Service Medal, Army Commendation Medal, the Army Achievement medal, and the Air Assault Badge.

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A Task Force Saber AH-64 hovers before engaging a target during aerial gunnery. U.S. Army photo by CPT Jordan Beagle.

Platform-Agnostic Aeromedical Evacuation Approaches in Combat

By 2LT Sheldon S. Smith, 2LT Mason H. Remondelli, 2LT Ryan M. Leone, MAJ Brandon J. Moore (Ret.), COL Manuel Menendez, and MAJ Collin G. Hu

Army medical forces [will] employ an all-domain-capable command and control system, and treatment and multimodal evacuation capabilities designed to rapidly stabilize and clear casualties from the battlefield, while maximizing return to duty as far forward as possible to enable cross-domain maneuver."-Army Futures Command Concept for Medical 2028 (Army Futures Command, 2022, p. vi)

Introduction

During the Global War on Terrorism (GWOT), aided by the Department of Defense's Joint Trauma System, or JTS, U.S. Army Aviation expanded the utilization and capabilities of aeromedical evacuation platforms, which enabled the prompt treatment and transportation of critically wounded combat casualties within the "Golden Hour"–the time between injury and life-saving surgical intervention (Rasmussen et al., 2015). While this expansion allowed for en route care advancements and improved return-to-duty rates, Army Aviation in its current setup is insufficient to maintain evacuation capabilities during Large-Scale Combat (LSCO) against peer and near-peer adversaries spanning multiple combat domains. There is a pressing need for continued innovation of aeromedical support and en route casualty care for the future battlefield trauma system. The importance of such innovations is based on the 10 en route care priorities determined by the JTS's Committee on En Route Combat Casualty Care (CoERCCC). These priorities include (1) medical documentation, (2) clinical decision support, (3) patient monitoring, (4) transport physiology, (5) transfer of care, (6) maintaining normothermia, (7) transport timing following damage control resuscitation or surgery, (8) intelligent tasking, (9) commander's risk assessment, and (10) unmanned transport (Hatzfeld et al., 2021).

Similarly, combat operations in Ukraine demonstrate the need for increased focus on prolonged evacuation care and increased "scalability of en route care" for larger volumes of severely injured combat casualties (Davis et al., 2022). Therefore, to meet the priorities established by the CoERCCC, the battlefield environment in Ukraine, and future LSCOs, aeromedical support structures need to shift away from augmenting a linear battlefield trauma system, like the continuum of casualty care with defined roles and capabilities seen during GWOT. Instead, the complexity of LSCO will require layered, redundant, integrated, and networked aeromedical formations that allow for hasty adaptation to rapidly changing, geographically dispersed casualty scenarios. Transport to a higher level of care may not always be feasible; therefore, the need for adaptability is particularly relevant in ensuring fluid movement between Role 1 (point of injury care), Role 2 (more comprehensive care, including advanced trauma management), and Role 3 (hospital care) medical facilities (Department of the Army, 2020, pp. 1-10 to 1-13). Such an adaptable plan for evacuation should not necessarily be dependent upon advances with specific types of rotary-wing or aeromedical platforms; instead, it requires platform-agnostic approaches to evacuation and en route care—ones that alter the organization of transport regardless of whether a UH-60, CH-47, V-22, or any other specific model is used.

This article consequently (1) examines aeromedical evacuation and en route care challenges unique to the environment within LSCO, (2) discusses two platform-agnostic approaches to aeromedical casualty care, including cross-training and adopting a nodes and networks posture, (3) uses the Russo-Ukrainian conflict as a case example for aeromedical support structures, and (4) explores joint force and combatant command-specific considerations.

Aeromedical Care in LSCO: The Urgency for Platform-Agnostic Approaches

Large-Scale Combat settings present numerous challenges in the ability to care for and evacuate combat casualties on the battlefield (Remondelli et al., 2023, p. S183). From a numbers perspective, wargames of an invasion of Taiwan by China suggest that 6,960 casualties would amass during a 3-week conflict, and Russia's invasion of Ukraine has resulted in an estimated 315,000 casualties— almost 90 percent of their initial fighting force (Cancian et al., 2023, p. 141; Remondelli et al., 2023, p. S182). Such quantities of casualties would overwhelm the Army's current structure of medical evacuations on their own, but additional factors further complicate the means of transportation and en route care capabilities in LSCO. More specifically, Army Aviation should not assume air superiority for the duration of the conflict. The challenge of maintaining air superiority coupled with the "tyranny of distance," anti-access/aerial denial (A2AD) surveillance and weapon systems, long-range precision fires, and unmanned combat aerial vehicles will necessitate that effective casualty aeromedical evacuation be completed in the shortest possible time—in which aeromedical evacuation will be that of opportunity within breaks of fighting and not a luxury (Odell, et al., 2022, p. 60).

The en route care from the point of injury or surgical quick reaction forces to advanced care and intra-theater movement between roles of care, therefore, will become critical within LSCO. To counteract the "kill chain" that threatens operational overmatch, a "survival chain" will serve to gain and maintain medical overmatch (Gurney et al., 2024, pp. 94-95). To do this must involve ground evacuation vehicles that can evacuate and disperse en masse to mitigate risk. Similarly, combat casualty care will be conducted by modular and mobile austere surgical teams that converge at the medical decisive point for each operation (Baker et al., 2021; Remick, 2020). These forward medical teams will need to be able to treat and clear an immense number of combat casualties off the battlefield quickly and effectively, without long holding times and diminished capacity. In this same manner, evacuation capabilities must also be able to move and transfer casualties sustained from disease non-battle injuries (DNBI), such as those resulting from endemic diseases and orthopedic injuries. As historical evidence of this, there was a point during the Burma and India campaigns of World War II where medics faced 120 cases of sickness (DNBI) for every battle injury (Slim, 2000). Ultimately, to continue a successful survival chain, Army Aviation and aeromedical evacuation processes must adapt to rapidly clear the battlefield and avoid becoming the weakest link.

Moreover, given the decreased preparedness for mass casualties and the overreliance on aeromedical evacuation, it becomes evident that the U.S. Army's current aeromedical evacuation capabilities, while effective during the GWOT, may not suffice in the geographically dispersed and casualty-intensive scenarios anticipated in LSCO. Experiences during the GWOT, and the advancements of en route care provided a foundation upon which the Army can build. However, the complexity and dynamics of future battlefields necessitate a more integrated and flexible medical evacuation system.

Likewise, the sustainment of adequate medical personnel and supply logistics will again be limiting factors throughout the en route care mission set. During periods of restricted movement, proper sustainment of medical supplies will be necessary to care for patients over a prolonged evacuation route, which requires continuous re-evaluation of patient needs and available resources. The long evacuation times from the point of injury to Role 2 (initial damage control intervention) and between Role 2 and Role 3 (theater hospitalization capabilities) will increase the need for en route care providers with more advanced resuscitation training. Depending on timelines, the ongoing prolonged casualty care concept will need to be continued for evacuations that may not be measured in minutes but potentially in hours or days. Communication techniques and procedures are yet another concern in these contested environments, given that it will be critical to relay patient needs, communicate resupply and fuel requirements, establish drop-off points, and transmit weather concerns, all while emphasizing brevity and adapting to rolling, intentional blackouts.

Compounding these concerns, the indiscriminate warfare in Russia's invasion of Ukraine, including the deliberate targeting of healthcare infrastructure and civilian populations, raises the concern that healthcare capabilities will be targeted in future LSCO environments. According to alarming statistics from the World Health Organization, over the last 3 years, there have been a total of 4,117 attacks on healthcare across 19 different countries and territories. These attacks include 2,441 on medical facilities, 1,153 on transport, and 678 on supplies. (World Health Organization, 2024). The human cost of these attacks is staggering, with 1,312 deaths and 2,206 injuries resulting from these incidents (World Health Organization, 2024). These figures underscore the urgent need for more resilient and adaptable medical evacuation methods and trauma care networks.

Aeromedical evacuation in future LSCO will challenge our battlefield medical capabilities in ways our forces have not experienced during the GWOT era. The joint force can expect that casualties will come both at a faster rate commensurate with the pace of offensive operations and a greater scale as the size of the battlefield and complexity of the threat increases. Therefore, to fight and win in LSCO requires rethinking how Army Aviation evacuates combat casualties on the future battlefield. For Army Aviation to adapt to combat casualty evacuation obstacles in LSCO, platform-agnostic approaches are paramount. Such platform-agnostic approaches must involve (1) education and cross-training, and (2) nodes and web networks.

(1) Education and Cross-Training

The first platform-agnostic approach to preparations for LSCO should be standardized cross-training for medical personnel. Given the inverse relationship between weight and distance and the competition between weight allocations for fuel and personnel, each additional medical provider on a medical evacuation platform—and especially on a casualty evacuation platform—comes with tradeoffs. While Army medical evacuation unit flight medics are tasked as crew chiefs and capable of conducting air surveillance, as well as crew coordination for landings and takeoffs, this is not the case across all platforms or sister services. Applying this cross-training model to teams on all platforms will ensure that medics are value-added crew members even before or after casualties have boarded. Beyond just medics, flight surgeons should similarly be trained to operate and assist with responsibilities that extend beyond what is stated in their Officer Evaluation Reports.

In addition to cross-training, education on aeromedical care protocols and procedures must move toward standardization across platforms. Care handoffs, tactics, techniques, and procedures should be uniform to limit unnecessary risk to patients with multiple potential handovers in contested environments. This will require efficient multiservice working groups that adjust curricula for flight medics and flight surgeons who fly with their patients. Taking it one step further, these efforts should eventually extend toward standardization across our allies and partners, given that future conflicts will not be unilaterally fought by the U.S. Interoperability of care between Americans and partner forces can ensure that British medics on American CH-47s and American medics on British Bell 212s can maintain continuity of care for patients. While singular trips for small numbers of casualties may be manageable without this cross-training, the requirement for constant, multidirectional trips to move patients will require that competence is maximized within smaller flight crews that can minimize aircraft weight to maximize travel distances. Failing to do this has proven consequences historically; a 1998 report on the Army Air Forces Medical Services in World War II states that “poor communications hampered aeromedical planning and patient regulating. Medical crews had trouble returning litters, blankets, and medical equipment to the front. Because litters were not standardized among the Allies, fixed litter mounts were inconvenient or unusable" (Nanney, 1998, p. 15). Such shortcomings can literally be life or death with the number of expected casualties in future wars, so multiservice, multilateral cross-training is a necessary platform-agnostic approach.

(2) Aeromedical Nodes and Care Web Networks

The second platform-agnostic approach describes an aeromedical nodes and network framework for organizing assets, which represents a strategic shift toward a modular, flexible, and resilient medical support system. This involves developing reconfigurable, adaptable medical support nodes—mobile Role 1 or Role 2 capabilities—that can operate effectively across various combat environments and conditions. Such an approach ensures that specific platforms or settings do not bind medical intervention and evacuation, but rather, are versatile and responsive to the dynamic nature of modern combat operations on land, air, and sea.

As seen in the Figure, the nodes represent stopping points for aeromedical evacuation assets at Role 1 or Role 2 care sites, either to retrieve or drop off patients, expanding and contracting with the evolution of battlefield efforts. Role 1 sites and logistical hubs will be dispersed throughout the battlefield with Role 2 capabilities farther out. These nodes are connected with black lines to illustrate potential routes for patient movement that can be followed, with aeromedical platforms of various models being used for each component of the evacuation. In contrast to traditional, linear approaches, this model allows for variability in routes—both maximizing flexibility and minimizing risk to teams that may otherwise consistently return to single bases—making them at higher risk. Such nodes and web networks can be modular to maximize maneuvering where aeromedical capabilities and capacity are most needed.

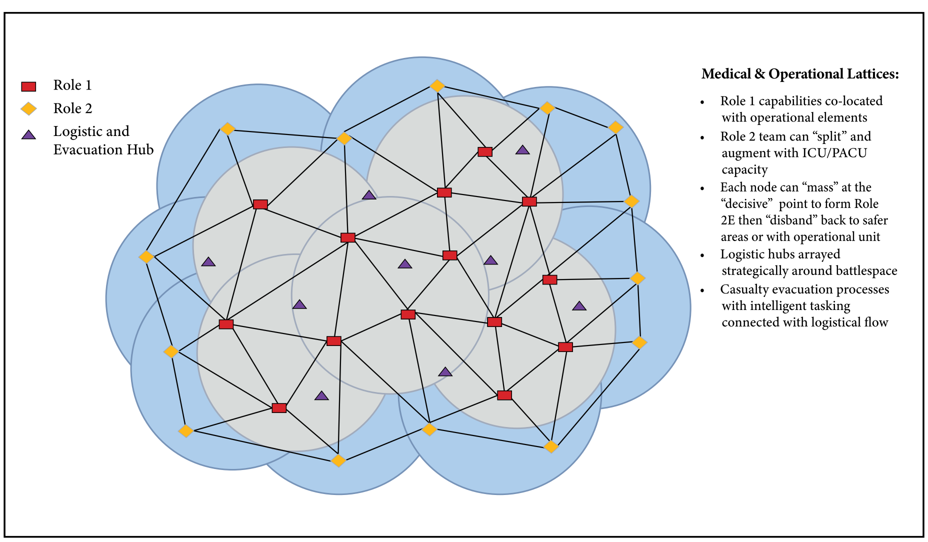

Figure. Medical nodes and casualty web networks (Remondelli, 2024).

The Russo-Ukraine War: A Norwegian Example of Aeromedical Evacuation

In future wars, the concept of platform-agnostic aeromedical approaches becomes not just a strategic advantage but a necessity. In environments where casualty numbers are overwhelming, transportation means are under constant threat and medical facilities are frequently targeted and destroyed, the ability to provide medical care and evacuation transcending reliance on fixed facilities and specific modes of transport is crucial. Norway’s experience evacuating patients from Ukraine offers valuable insights into implementing such a system (Holtan et al., 2023). Their approach demonstrates the effectiveness of integrating various transportation methods, ranging from commercial aircraft to specialized air ambulances, highlighting the essence of a platform-agnostic strategy. This approach ensured that medical aid reached those in need despite the constraints posed by the conflict. Furthermore, the Norwegian model exemplifies how a platform-agnostic system can adapt to the cultural and linguistic challenges inherent in international medical assistance. The Norwegian teams navigated these challenges through intensive collaboration with medical and operational planners (Gurney et al., 2024). Such methods can be adapted by the U.S. and synergized with the international community for effective aeromedical evacuation processes.

Incorporating these strategies and lessons into future medical evacuation efforts in conflict zones can significantly enhance the capacity to provide timely and effective medical care. This is particularly vital in light of the disturbing trend of healthcare attacks, which not only endanger lives but also cripple the medical infrastructure critical for the survival and recovery of affected populations.

The statistics for attacks on healthcare facilities, transport, and supplies are a stark reminder of the challenges faced in delivering medical care in conflict zones. They reinforce the need for platform-agnostic aeromedical approaches—ones that are versatile, scalable, and responsive to the complexities of modern warfare. Such systems would enable rapid and flexible responses to varying medical emergencies, irrespective of geographical location or availability of certain types of transport.

Joint Force and Combatant Command-Specific Considerations

While platform-agnostic approaches to aeromedical evacuation, such as cross-training and adopting a nodes and network framework, can solve some problems faced in LSCO they are by no means holistic solutions. Instead, they must work alongside other joint land and sea evacuation methods to compensate for intrinsic challenges. One such challenge is the baseline assumption that aeromedical evacuation will be possible in a LSCO environment with near-peer adversaries. While China has ostensibly committed to following the Geneva Conventions protocols, which include protections for dedicated medical aircraft in Article 36, Russia's flagrant violations of such rules in Ukraine mean that the U.S. must prepare for such violations in the event of LSCO with a near-peer adversary (International Humanitarian Law, n.d.; Doswald-Beck, 1997; Heisler et al., 2023). An additional limitation of this approach is that it is focused on land-based combat theaters. In the event of combat in the maritime Indo-Pacific theater, such an approach cannot work in isolation, and considerations must be given for transportation over open water onto hospital ships serving as Role 3 facilities, for example. Furthermore, even in land-based theaters, rotary-wing assets must be one of several modalities used in an evacuation.

Moreover, a joint approach to operational planning for aeromedical evacuation is crucial. This requires collaboration among military operational planners, medical planners, and critical care experts. It also involves collaboration with the U.S. Department of State and partners, given the aforementioned shortcomings that can occur when coalition forces are not appropriately aligned. By leveraging resources and expertise, the focus shifts to precision in medical intervention timing and location, aiming to maximize survival rates. Through these collaborative efforts, the operational and medical planning teams can synchronize to pinpoint the decisive points in combat scenarios, ensuring that critical care is delivered within an optimized window for the patient while mitigating risk for the combatant commander. Furthermore, these decisions can be bolstered by technologies like artificial intelligence algorithms that integrate geographic information system data (Donham, 2023). Collectively, a joint approach with new technologies and adaptable platform-agnostic strategies will enable the development of a near real-time medical common operating picture.

As a result, platform-agnostic techniques must be further explored and integrated with alternative air, maritime, and land modalities. One such modality is the ubiquitous use of unmanned aerial vehicles during conflicts. This can be leveraged to supplement the logistical challenges faced by a robust medical force operating in environments removed from the traditional logistical supply network. Beyond the complementary use of medical evacuation and casualty evacuation vehicles, certain theaters—such as U. S. European Command—may also permit the use of trains, which were successfully employed in Ukraine and during World War II (Walravens et al., 2023). Beyond this, the concurrent development of aeromedical, land-based, and maritime evacuation capabilities will further optimize these methods. Programs like the U.S. Army's Future Vertical Lift effort, for example, should charge forward, following leading practices and making modular medical evacuation systems more universal with standardized En Route Care Mission Equipment Packages across platforms that minimize risk and maximize timely utilization in LSCO (Bastian et al., 2012).

Conclusion

With the inevitable transition from counterinsurgency to LSCO battlefield settings, the U.S. military must both revisit lessons learned from past large-scale conflicts and think innovatively about solutions to modern-day problems with aeromedical evacuation. The objective is clear: to enhance survival rates on the battlefield by redefining the parameters and methods of timely medical interventions and evacuations by leveraging a collaborative, flexible approach to combat casualty care. Two such examples are a standardized cross-training model and a nodes and network framework for aeromedical evacuation, which would serve as a departure from the traditional, linear evacuation plan for casualty movement from point of injury to definitive care. These will appropriately account for both the scale of future combat operations, as well as the threat faced by medical facilities that stay in fixed locations for any prolonged period or face limited staff due to weight restrictions. Large-Scale Combat scenarios make a valid assumption that fightingwill be extended in certain phases of combat operations, so platform-agnostic approaches will allow commanders greater operational reach across multiple domains (Townsend, 2017).[1] While these approaches cannot work in isolation and must be integrated alongside other land-based and maritime modalities, they warrant further exploration and will undoubtedly be improved by concurrent advances in engineering lift capabilities and artificial intelligence algorithms that determine optimized evacuation combinations.

Acknowledgments:

The authors would like to thank COL Michael Tarpey, Command Surgeon for U.S. Special Operations Command, and Lt. Col Nicole Pearl, Air Force Special Operations Command, for their feedback and insights as we put this piece together.

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[1] "A geographic information system (GIS) is a computer system for capturing, storing, checking, and displaying data related to positions on Earth's surface" (National Geographic, 2024).

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Medical Evacuation During Peer Conflict: Reality Check

By CPT Rafael F. Barbosa

Imagine that much like Luke Wilson's character in the cult classic movie *Idiocracy* (Judge, 2006), you were a participant in an Army suspended animation experiment that started in 2019 and ended today. In this hypothetical, the world and the Army you would return to would be remarkably different than they were just 4 years ago. Interestingly, minus the science fiction elements, I'm living through this exact scenario.

In October 2019, I was forced to leave my career as an Army Aeromedical Evacuations (MEDEVAC) Officer (67J) due to the symptoms of an undiagnosed case of colon cancer. I was fortunate to continue my MEDEVAC career in the helicopter emergency medical service field in my home state of Minnesota until October 2021, when my stage IV cancer perforated my colon. Fortunately, I responded well to treatment, and through an Army Board for the Correction of Military Records action, I was reinstated to my Army career in October 2023. Many miracles shaped this outcome and influenced some key figures who helped me along the way. Although I can never fully express my gratitude, I try to thank them every chance I get.

My personal journey is not the motivation for this article. I just want to share the reasons behind my current case of ontological shock. Since my return to the Army and my career field, I feel like I've been put through a wringer titled "MEDEVAC during peer conflict: Reality check." The 1 hour standard, or "Golden Hour" that was my north star as a 67J, is now written about as an impossibility and an outdated concept (White, 2023). The Role 2 medical treatment facility, which we used to affectionately call the flyover role during counterinsurgency (COIN) operations, may now be the center of gravity for the whole evacuation structure in LSCO.[1] Rear areas are no longer sanctuaries. Has the world gone mad? Coming to terms with the seismic changes that have occurred during the last 4 years has been extremely challenging. Had I experienced recent history in uniform, I wonder if these changes would appear less shocking today.

Recent History

Interestingly, major events during the past 4 years have provided glimpses of the challenges inherent during LSCO. The COVID-19 pandemic was a significant event across all aspects of the planet. It provided a stress test that pushed healthcare systems to the limit. Personally, it was an honor to be part of the North Memorial Air Care team as a pilot-in-command during the peak of the pandemic back in Minnesota. I can recall a 4-plus hour flight from Grand Marais, near the Canadian border, down to the Minneapolis Department of Veterans Affairs hospital. We transported a nonveteran because that was the only facility in the state with an open bed. The COVID-19 pandemic provided a preview to challenges expected in LSCO, such as managing a medical infrastructure being overwhelmed by large numbers of patients, dwindling medical resources, and requiring the movement of patients across large distances.

At the height of the pandemic in late September 2020, the world saw the "first war in history won primarily by robotic systems" (Antal, 2022, p. 5). During the Second Nagorno-Karabakh War, Azerbaijan achieved a decisive victory through a multidimensional campaign against a nearly equally matched Armenia holding defensive positions in mountainous terrain in only 44 days (Antal, 2022, p. 2). Then, in February 2022, Russia invaded Ukraine employing similar tactics to those seen in the Second Nagorno-Karabakh War; however, it was on a much larger and more destructive scale. Both wars have showcased the transformation of the modern battlefield into a landscape free of sanctuaries where drones enable precision fires resulting in mass casualties (MASCALs) as a norm, and evacuation of casualties is a heavily contested and slow process (Chris0_wiki, 2023, para. 8). These conflicts have unveiled a radical new paradigm in the patient evacuation flow.

So What are we up Against?

Bluntly speaking, I believe every 67J in the Army is feeling a lot like Star Trek's Captain Kirk in the Kobayashi Maru test (Abrams, 2009).[2] Every 9-line[3] is likely to be a MASCAL composed of complex patients, with polytrauma and burns, like the ones being received in a Dnipro hospital East of Ukraine (Smith, 2022). Every evacuation has an extended care under fire window[4] just getting from the point of injury to the Role 1. The closest we can safely hope to reach reliably by air ambulance is the Role 2.

[1]The Role 2 medical treatment facility (MTF) was often bypassed during COIN due to air supremacy between point of injury and definitive care at Role 3. Additionally, "Field Manual 4-02, Army Health System," explains that the Role 2 MTF is meant to hold return-to-duty patients within 72 hours or perform packaging interventions to bridge the evacuation to the Role 3 facility (Department of the Army, 2020, p. 1-12).

[2]"Starfleet's no-win scenario training exercise tests ethical decision-making and leadership. Part of that ethical leadership is recognizing the limits of your powers, and deciding what to do in the face of those limits" (Stemwedel, 2015).

[3]"refers to the information needed to dispatch the medical evacuation crew" (Defense Visual Information Distribution Service, 2022).

[4]"Care Under Fire is medical attention provided by the first responder or combatant to arrive at the scene of injury during an in-progress firefight. Typically, in a Care Under Fire situation, available medical equipment is limited to that carried by the casualty in his or her individual first-aid kit (IFAK) or by the medical provider in his or her aid bag" (UF PRO®, n.d.).

Under special circumstances through temporary air dominance; extensive planning; and application of survivability tactics, techniques, and procedures (TTPs), we can reach the Role 1, but the point of injury is out of the question due to the heavily contested air-land littoral (Rainey & Greer, 2023, p. 14).

Every flight must cover increasingly longer distances because of the enemy fires threat. The patient evacuation architecture must change constantly due to the need for survivability moves. Every electromagnetic (EM) transmission threatens the safety of the requestor and the receiving unit. Casualty estimates far outpace the capacity of expeditionary medical facilities, with numbers as shocking as 50,000 casualties for a 100,000 service-member force (Fandre, 2020, p. 37), all happening under the constant threat of long-range attacks to rear areas, as we tragically experienced in the January 28, 2024, Tower 22 attack in Jordan (Lopez, 2024). The math does not work under the current paradigm. We need new math.

Everything old is new Again

Like most things that stand the test of time, the beauty of Civil War medical innovator, MAJ Jonathan Letterman's, plan for battlefield MEDEVAC was that he built it on a set of principles and not on methods. We've covered a lot of ground since the Letterman Plan[5] was tested through fire on September 17, 1862, during the Battle of Antietam, America's bloodiest day (National Museum of Civil War Medicine, 2024). Yet, the evacuation architecture he envisioned is as valid now as it was then. Large-Scale Combat is going to force us to go back to basics. The casualty estimates presented in current simulations are shocking. The Letterman Plan evacuation architecture provides the best way for patients to flow from the point of injury through the roles of care. It is extremely elegant in the way it regulates patient volume through triage, optimizing the entire medical structure.

The challenge we face lies in the Letterman Plan reaching its full potential when implemented out in the open, with complete freedom of movement, and with medical units operating under a protected status. This is the part where many will raise a skeptical eyebrow. However, I hope this article persuades readers to conclude that MEDEVAC in the hellscape I've described—with nothing but a Red Cross placard for protection—is indeed the best option to minimize deaths from potentially survivable wounds. The future LSCO battlespace must be shaped through all the levers of national power to ensure a robust adherence to the Law of Armed Conflict (LOAC)[6] between belligerents to the greatest extent possible. Otherwise, the casualties will be too numerous, too severely hurt, and too far away to rely on a MEDEVAC architecture built on survivability TTPs alone.

A MEDEVAC architecture with LOAC as a foundation is not without precedent in the modern era. Both belligerents adhered to LOAC provisions during the 1982 Falklands War between Great Britain and Argentina. Of note, both belligerents showed a willingness to respect MEDEVAC assets above and beyond the letter of the law. Hospital ships for both Britain and Argentina were suspected of inappropriate employment during the conflict, yet neither side used this as a pretext to engage them (Freedman, 2005, p. 208; Albon, 2011). At a key point in the war, Britain was concerned that the Argentine hospital ship, *Bahia Paraiso*, could be used to resupply isolated Argentine forces or collect intelligence. The British were keenly aware of the risks involved in attacking a hospital ship without clear evidence of wrongdoing. Through mediation by the International Committee of the Red Cross (ICRC), Argentina agreed for an inspector to travel on board the ship (Freedman, 2005, p. 208). By leaning into adherence with LOAC and engaging with its agents, Britain was able to neutralize a perceived threat, and ensure reciprocity in protection for medical assets from Argentina. "Sixty miles to the north British and Argentine military ships stationed themselves peacefully within view of each other and regularly communicating *[sic]* on good terms" (Albon, 2011). This area was named the Red Cross Box, which "was 20 nautical miles in diameter and within its confines the peace reigned" (Albon, 2011). Coordination for the protection of medical assets was greatly influenced by British forces treating and evacuating the wounded by medical need without regard for nationality, in accordance with LOAC (IHL, 2024). The British medical system treated more Argentines than Britons throughout the war (BBC News, 2012).

"Air-land littoral is the airspace from the ground to a few thousand feet above it. This is where sUAS operate. It is where they engage and are engaged by ground forces. Increasingly, it is where sUAS fight one another" (Rainey & Greer, 2023, p. 14).

Admittedly, a lot has changed in the last 42 years, but the same motivation for reciprocity that steered Great Britain and Argentina toward trusting this paradigm is timeless. Rational belligerents will be invested in preserving the lives of their combat casualties. Respecting LOAC facilitates this goal for all parties. Tactical gains achieved through atrocities are short-lived and counterbalanced through the information war. The chaos and demoralization of fighting forces stemming from indiscriminate attacks on medical personnel and evacuation platforms are detrimental to the military objectives of all belligerents. Allowing for the protected movement of medical personnel and platforms across the battlefield, even when considering fluctuations in ad-

"Battlespace: Term used to depict the multidomain nature of the modern transparent battle areas" (Antal, 2023, p. 358).

[5]The Letterman Plan would, "reorganize the Army's system of trauma care, dedicated to improving the treatment and chance of survival of wounded warriors. These changes, ordered in October 1862, are known as The Letterman Plan" (National Museum of Civil War Medicine, 2020).

[6]LOAC is synonymous with International Humanitarian Law (IHL). "IHL is a set of rules that seeks, for humanitarian reasons, to limit the effects of armed conflict" (International Committee of The Red Cross, 2022).

herence and tragedy, remains the best option for saving the maximum number of lives.

Sadly, the current dynamic in Ukraine is not following this logic. This war is the type of conflict where it would be reasonably expected for both belligerents to respect LOAC in response to the high number of casualties and the information war. Russia is a signatory to the 1977 additional protocols I and II of the Geneva Conventions (ICRC, 2014, pp. 610-611). However, on October 23rd, 2019, the Russian Federation took the controversial and highly unusual step of becoming the only signatory to rescind their commitment to Additional Protocol 1 (IHL, 2019).[7] Notably, the United States is not a signatory to these additional protocols (ICRC, 2014, pp. 610-611). AlthoughRussian adherence to LOAC in Ukraine is currently a matter of great concern (Baker et al, 2023), Russia must be pressured into compliance with previously stated international commitments now, and in a potential future, broader conflict in Europe (Tuzmukhamedov, 2003).

In the Pacific, China is not only a signatory to the 1977 additional protocols, but it is also very public and forward-leaning in its support and contributions to the ICRC (ICRC, 2023, para. 3). Many Americans, especially those in uniform, look at these efforts with suspicion. Military history of 'human wave' (Salmon, 2020) attacks during the Korean War and recent reporting on Chinese respect for the human rights of the Uyghur population (BBC News, 2022), call into question the value placed on human life by the Chinese military. Yet, China's military medical structure and patient flow logic mirror that of the U.S. They have made large investments in medical equipment and in training their personnel, pointing to a real commitment to quality battlefield casualty care. These indicators suggest the Chinese military places a high value on human life, contrary to popular perceptions in the West. This is the type of adversary we would expect to agree to mutual respect for the protected status of medical units. As the saying goes, follow the money. If this is all a ruse, it would be a very elaborate and expensive one. There are cheaper ways to whitewash your military with Red Crosses. "Their efforts appear genuine" (M. Pouncey, personal communication, March 1, 2024). It is also clear through their worldwide engagement, especially in the developing world, that they want to be seen as a legitimate superpower. Maintaining the moral high ground is critical to this status during any future conflict. Chinese identification of medical personnel and equipment may surpass that of the U.S. as a lingering effect of the War on Terror. Their medical architecture can be easily identified from their tactical formations in accordance with the Geneva Conventions' principle of distinction. Of concern at this time, a third party looking at open source images comparing the U.S. Army's and the People's Liberation Army's medical personnel and equipment could reasonably conclude that the U.S. Army is less disciplined in operating under the principle of distinction as defined by Article 42 of the Geneva Conventions (IHL, 2016).

10th FH, 148 bed field hospital training exercise ISO 4th ID, September 2019. Photo courtesy of COL Samuel Fricks, Chief, taken from 2023 Medical Evacuation Concepts and Capabilities Division, Medical Capability Development Integration Directorate.

The Time is now

Admitting and, indeed, acting like things have fundamentally changed between the Global War on Terror, and LSCO is a key first step. The sacrifices and the lessons learned during 20-plus years in the COIN fight will never be forgotten and will remain relevant as part of our institutional knowledge. The goal is not to abruptly switch gears but to adjust our current methodology for the new challenges we face in LSCO.

First and foremost, we need an all-hands-on-deck effort in revitalizing global commitments to LOAC. The U.S. must make deliberate and highly visible efforts to assiduously exemplify adherence to LOAC. Our medical personnel, equipment, facilities, and training events need to be textbook examples of compliance with the Geneva Convention. The U.S. must lead the world in this effort as aggressively as we led the world during the pandemic. Setting the conditions for MEDEVAC to occur under a protected status during LSCO is the greatest force protection investment we can make.

Even if we succeed in making adherence to LOAC the norm between belligerents, we will still need to make a significant investment in hardening our evacuation platforms and continue to train and adhere to survivability TTPs to protect our forces. Current U.S. ground systems lack the resiliency to handle the environmental hazards of a landscape saturated by shrapnel, let alone survive unintended collateral effects. Future systems must be robust enough to operate over long distances, survivable enough to operate in close proximity to weapons effects, and properly equipped to provide care to multiple complex patients. Evacuation operations must also exercise all survivability TTPs that do not jeopardize LOAC-protected status. Ground ambulances must train and execute force protection measures that account for current battlespace trends, specifically, small unmanned aircraft systems. Air ambulances must participate in training events like the integrated air defense system (IADS) threat lanes at California's National Training Center (NTC) China Lake

[7] "Adopted on 8 June 1977, Protocols I and II are international treaties that supplement the Geneva Conventions of 1949. They significantly improve the legal protection covering civilians and the wounded, and - for the first time - lay down detailed humanitarian rules that apply in civil wars" (ICRC, 2009).

R-2508 Complex, led by the current MEDEVAC Observer-Coach and fellow 67J CPT, where rotating MEDEVAC forward support medical platoons (FSMPs) are trained to consistently defeat IADS and safely push as far forward in the battlespace as possible.

The threats posed by EM signature detection, combined with precision fires have become brutally evident in Nagorno-Karabakh and Ukraine. The mission approval process must be re-evaluated in order to reduce radio communications and save precious time. Enemy fires capabilities will push aviation assets miles away from the forward area. The Future Long-Range Assault Aircraft (FLRAA) platform, with its faster cruise speeds and extended range, will counterbalance these greater distances to the forward area but will not be a panacea. The realities of MEDEVAC in LSCO will still demand that we operate with an "every second counts" mindset. A streamlined algorithmic process will be beneficial by reducing EM signature and yielding faster launch approvals. Getting crews in the air as quickly as possible will be critical to compensate for the longer times of flight imposed by the increased standoff from the forward areas. Additionally, our air ambulance FSMPs must be trained and empowered to operate independently across the battlefield. This will optimize patient evacuation flow and increase survivability in LSCO. We must tailor FSMP modified tables of organization and equipment to enable quick repositioning across the battlespace and self-sustained remote operations. These measures will enable forward repositioning, which under the right tactical circumstances, can drastically reduce patient time to higher care.

The battlespace has evolved so rapidly that a significant proportion of FLRAA's impressive capabilities will be immediately counterbalanced by increased enemy capabilities and forcing us to cover greater distances to accomplish our mission. Additionally, we need investments in advanced systems that will expand the aviation operational window in the battlespace. Future pilot augmentation systems will allow us to operate safely and consistently at height-speed combinations on the outer edge of human capability. Combined with visibility augmentation capabilities, these systems could ensure that patient evacuations would occur irrespective of visibility conditions due to weather. We currently own the night. Our next logical evolutionary step is to invest in systems that will enable us to own the weather. In his book, *Seven Seconds to Die*, COL John F. Antal (Ret.) asserts that "Leaders need imagination to inspire foresight to visualize and prepare for the next fight" (2023, p. 20). The Aircrew Labor In-cockpit Automation System optionally piloted vehicle program, a three-stage pilot augmentation system currently being tested under the leadership of the Chief, Medical Evacuations Concepts and Capabilities Division, or MECCD, is a perfect example of the leadership and imagination COL Antal is referring to. We will need renewed investments in imaginative solutions to tackle the upcoming challenges in LSCO. Evacuations will be slow and deliberate affairs near the front line, so we must endeavor to equip air ambulances and their crews with systems that will help safely and reliably make up for lost time on the back end of the evacuation.

10th Combat Support Hospital, Fort Carson, Colorado. Photo taken from 10th Combat Support Hospital Facebook page.

Army flight medics train at the School of Army Aviation Medicine, DUSTOFF training complex, Fort Novosel, Alabama. U.S. Army photo by Joseph Kumzak.

In addition to optimizing technological systems, we need to optimize our people systems. Training events need to mimic conditions as they will exist during LSCO. The time to bring together all the individual pieces in the medical infrastructure and find the friction points is now. Medical assets across the Department of Defense (DoD) need to have enough white space on their calendars to come together, stress test their organic systems, and evaluate their integration into the joint structure. These medical exercises cannot be relegated to value added training within a larger event. They should be deliberate, protected, and prioritized according to the importance of this no-fail mission. We all need to get to know each other throughout the DoD. For an Army MEDEVAC crew, dropping a patient off on a ship should be as mundane as dropping them off at a land-based facility. Every medical asset should be actively engaged in an integrated MEDEVAC structure that will maximize speed and coverage by eliminating redundant lines of effort based solely on branch identification. Much like the Defense Health Agency integrates facilities and staff from all branches to deliver a unified health system to the DoD, we need to train our medical units to seamlessly integrate into a theater structure during LSCO. Once we're playing at the varsity level jointly, we can then start training to fully integrate multinational evacuation plans.

Finally, the perception that MEDEVAC by air ambulance is impossible in LSCO must be corrected. We need units to stop arriving to the NTC declaring there is no air MEDEVAC in LSCO. It will be a heavy lift, but we must adjust to work the margins and make it up on the back end.

We have a wealth of data flowing from recent events to guide our investments in time and treasure toward high-yield initiatives. Future Long-Range Assault Aircraft will allow us to keep up in the modern battlespace. However, we will need additional investments in imaginative solutions to gain a decisive edge in timely casualty evacuation. There is solid proof of concept from the NTC that through survivability TTPs, we can consistently and safely operate in an IADS environment. We have a lot of room for improvement integrating our medical elements into a cohesive battlespace structure. Most importantly, we must lead the world toward a true commitment to conduct war in accordance with LOAC to minimize potentially preventable deaths in the battlespace. Medical evacuation will be forever relevant, regardless of conflict paradigm, because it is an instinct embedded in our humanity to make every effort to care for the wounded without regard to nationality. To paraphrase a far greater man, Dustoff will always be here until we "have your wounded" (Army Aviation Association of America, n.d.)

Acknowledgements:

Thanks to fellow 67Js COL Samuel Fricks, MAJ Suzannah Palmer, CPT Matthew Wright, and Mr. Michael Pouncey for their contributions to this article.

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CPT Rafael Barbosa is a 67J Aeromedical Evacuations Officer currently attending the Aviation Captain's Career Course at Fort Novosel, Alabama. He's a graduate from the University of Minnesota Twin Cities and calls Saint Paul, Minnesota, his home. He is extremely proud of his 14 year old son and his wife, who is a tireless advocate for veterans, and was instrumental in the signing of the Promise to Address Comprehensive Toxics, or PACT, Act into law, August 2022.

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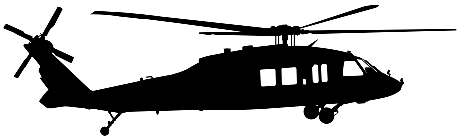

Risk Common Operating Procedure, Version 1.3.1

By MAJ Ashley Hendrickson Howard

By quarter 3 of fiscal year 2023, Army Aviation had five Class A flight related mishaps resulting in 14 fatalities. As a result, the Chief of Staff of the Army ordered an Army-wide Safety Standdown. One of the outcomes identified during the 2023 Vice Chief of the Army Safety Standdown outbrief was the requirement to capture compounding risk while ensuring risk is briefed and approved at the appropriate risk levels. To achieve that, Risk Common Operating Procedure (R-COP), Version 1.3.1, effective 01 March 2024, includes the following changes:

Compounding Risk Thresholds Enforced Manually and Digitally. Thresholds are defined by the number of initial risk levels within each section (See Yourself, See the Mission and Environment, See the Weather) and driven by the highest associated risk level. Thresholds are set by the combat aviation brigade/State and briefed to the division commander. The highest risk still drives the residual risk on the R-COP; however, now the total number of elevated risk values (M=moderate or H=high) will lock that residual risk to no less than a Moderate Non-mitigatable (M*). The intention is to capture the effects of stress, fatigue, and task saturation from our unit trainers getting after proficiency training across the Force. While we may see an uptick of M or H risk missions, the goal here is to ensure the appropriate final mission approval authorities (FMAAs)—in this case, the battalion (BN) and brigade (BDE) commanders—are the ones accepting the risk of developing proficiency at a rate that outpaces our company commanders; the goal is NOT to gerrymander the R-COP to stay an L (low) or avoid quality training.

Experience section is expanded to include discussion of series, not just total hours. Version 1.3.1 now considers each crewmember as their own risk level without increasing risk by adding additional nonrated crewmembers (NRCM); it does this by looking at the highest risk NRCM and "ignoring" the L risk NRCM (e.g., Pilot-in-Command (PC)=L, Pilot (PI)=M, Flight Engineer (FE)=L, Crew Chief (CE)=M; residual risk looks at the M-risk CE, and the FE becomes the risk mitigator). Additionally, the Centralized Aviation Flight Records System will enable ad hoc-series reports by 08 March 2024, to allow a comprehensive understanding of each crewmember's experience breakdown.

Adjusted Initial Risk Values (mandated and recommended) along accident trend data and Directorate of Evaluations and Standardization observations. Recommended elevated risk values include Overwater, Deck Landing, Deck Landing Qualifications ranging from M to M*, driven by area of operations access to applicable training environments (landlocked vs. water-bound). Additionally, mixed mission design series or large-scale multiship operations (particularly AH-64) are recommended M due to the lack of NRCMs and training familiarity. The newly mandated (more to follow in the aviation mission survivability [AMS] standardized communications [STACOM]) elevated risk is AMS or combined maritime forces (CMF) multiship—H for Day, and EH for night vision device (NVD). The intention is to drive this minimally as a BN training program—BDE when choosing to pursue NVD proficiency. This is no longer a task PCs/Unit Trainer Evaluators (UTEs) are to simply go out and train outside of a detailed unit training plan.

Additional Value Mitigation Requirements to be validated by mission briefing officer (MBO)/FMAA. Instructions and R-COP guidance designed to expand the conversation between instructor pilots/UTE/PCs and MBO/FMAA during mission approval process, as well as emphasize the Crawl, Walk, Run methodology, in accordance with the 2021 Field Manual 7-0, "Training." This consideration was driven by the elevation of the AMS/CMF multiship, for which the training methodology will be published in the AMS STACOM later this Spring. However, it is recommended to apply the same considerations to more complex mission sets not already mitigated by training gates outlined in the 2023 Training Circular 3-04.3, "Aviation Gunnery," and the 2022 Training Circular 3-04.11, "Commander's Aviation Training and Standardization Program," (Readiness Level progression).

R-COP Instructions Were Revised to capture compounding risk changes, update specific vs. vague mission planning definition, and streamline information for the end user.

Updated Required Academic Topics for professional military education (Aviation Captain's Career Course, Advanced Warfighting Skills, Aviation Warrant Officer Intermediate Level Education, and Pre-Command course) and annual MBO/FMAA academics. Professional military education academics are tailored to each audience utilizing the same academic slide deck available on the Doctrine Branch SharePoint page at https://armyeitaas.sharepoint-mil.us/sites/TR-ACOE-DOTD/SitePages/Doctrine-Branch.aspx (under the Aviation Branch Standard Operating Procedures, Annex C with all R-COP documents). Units are encouraged to tailor the annual academics for their local requirements.

Biography:

MAJ Ashley Howard is a third generation Senior Army Aviator and graduate of the University of Virginia, where she commissioned in 2014. She completed her command as "Vulture 06" for Company A, 2D Battalion, 227th Aviation Regiment, 1st Air Cavalry Brigade, Fort Hood, Texas. Her additional key assignments include S3-Air, 1st Air Cavalry Brigade; Airframe Repair Platoon Leader, Company D, 3D General Support Aviation Battalion (GSAB), 2D Combat Aviation Brigade, South Korea; and Executive Officer, D/3-2 GSAB. MAJ Howard currently serves as the Doctrine Branch Chief, Doctrine and Tactics Division, Directorate of Training and Doctrine, USAACE, in addition to her duties as a UH-60 L/M Instructor Pilot in support of FS XII. She is accompanied in service by her husband, CW3 George Howard, CH47 SP/IE, and their two Rhodesian Ridgebacks. The Howards welcomed their son, Keith, in February 2023.

Aviation Digest
ATZQ-TDD-T (25)
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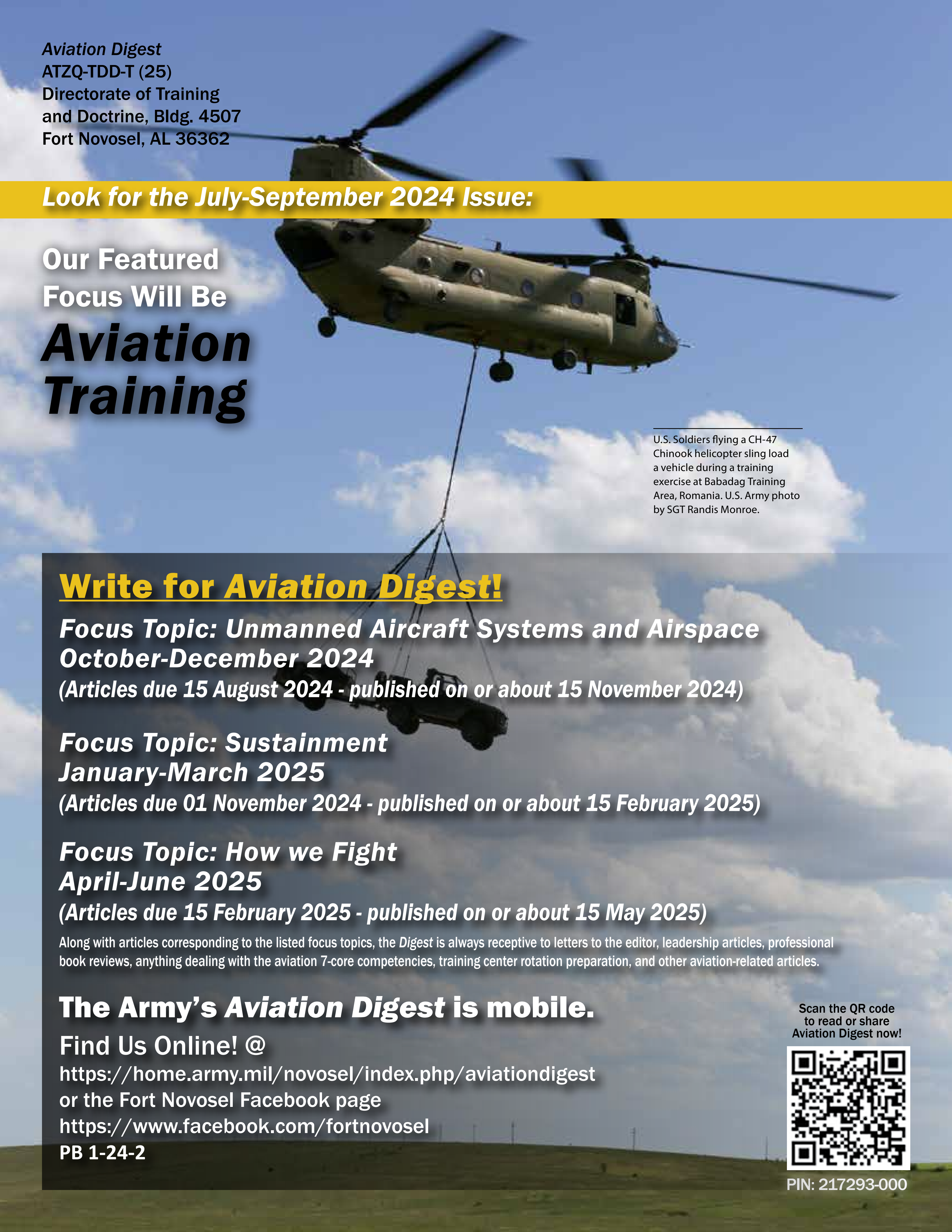

Look for the July-September 2024 Issue:

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U.S. Soldiers flying a CH-47 Chinook helicopter sling load a vehicle during a training exercise at Babadag Training Area, Romania. U.S. Army photo by SGT Randis Monroe.

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(Articles due 15 February 2025 - published on or about 15 May 2025)

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