Transforming Joint Air and Space Power

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Editorial

We are excited to unveil the new and improved JAPCC Journal, offering a transformative reading experience with captivating articles. To begin, it is crucial to highlight that the enduring conflict between tyranny and liberty remains foremost in our minds as Russia continues its reckless actions in Ukraine. However, despite the challenges, the Ukrainian Army demonstrates remarkable courage and skill, effectively countering Russia's delusions of effortless conquest. Furthermore, the Ukrainian Army's capabilities and resources have been significantly strengthened, propelling the nation towards new horizons of possibility. The relentless spread and rapid advancement of today's formidable technologies, be it cyber, hypersonics, or artificial intelligence, cannot be ignored or left unchecked. Predicting future developments in any technology is always a precarious task. However, our authors, relying on expertise and knowledge gained from the emerging technological realities, provide a series of educated guesses on a multitude of relevant topics.

This edition commences with an enlightening article by our Executive Director, Lieutenant General Thorsten Poschwatta, who provides detailed accounts of the largest deployment and live flying exercise of air forces since the inception of NATO, the successful exercise Air Defender 23. Continuing our exploration of the military landscape, the Czech Air Chief, Major General Petr Čepelka, shares invaluable insights into the transformative changes witnessed in recent years and the imminent challenges for a thriving and esteemed Air Force. Further, the Commander of the Italian Navy Fleet, Vice Admiral Aurelio De Carolis, provides a comprehensive overview of the Italian Navy Carrier Strike Group, its composition, current challenges, and prospects, expanding on its vital contribution to maritime air power. Advancing, the journal explores a diverse range of significant and pertinent subjects. These include the inherent implications of hypersonic weapons on deterrence and potential solutions to facilitate the rapid deployment of forces during emergent operations. We continue with the intelligence considerations of fifth-generation aircraft, and advancements in studying pilots' cognitive states to enhance training and performance. We go on with the need for an Agile Combat Employment concept for NATO, considerations on maintaining decision superiority through better situational awareness, a more efficient decision-making process, and greater adaptability. The journal concludes with a preliminary of Electronic Warfare lessons from the Ukraine battlefield, and the effectiveness of synergistic employment of kinetic and non-kinetic operations to optimize outcomes in multi-domain operations.

Thank you for taking the time to explore this newly redesigned edition of our journal. I would like to particularly express my sincerest gratitude to all our contributing authors. We highly value your feedback as it will help us enhance and advance the discussion on the Transformation of Joint Air and Space Power. Please reach out and visit our website at www.japcc.org, follow us on LinkedIn or X, or email us at contact@japcc.org.

Paul Herber
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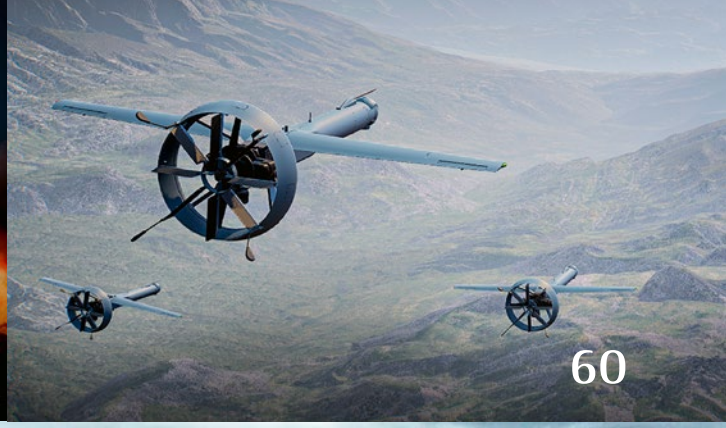

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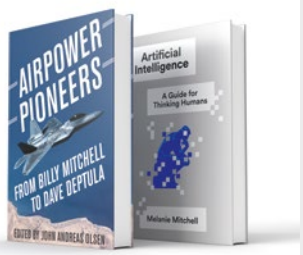

Imprint

Transforming Joint Air & Space Power:
The Journal of the Joint Air Power Competence Centre (JAPCC)

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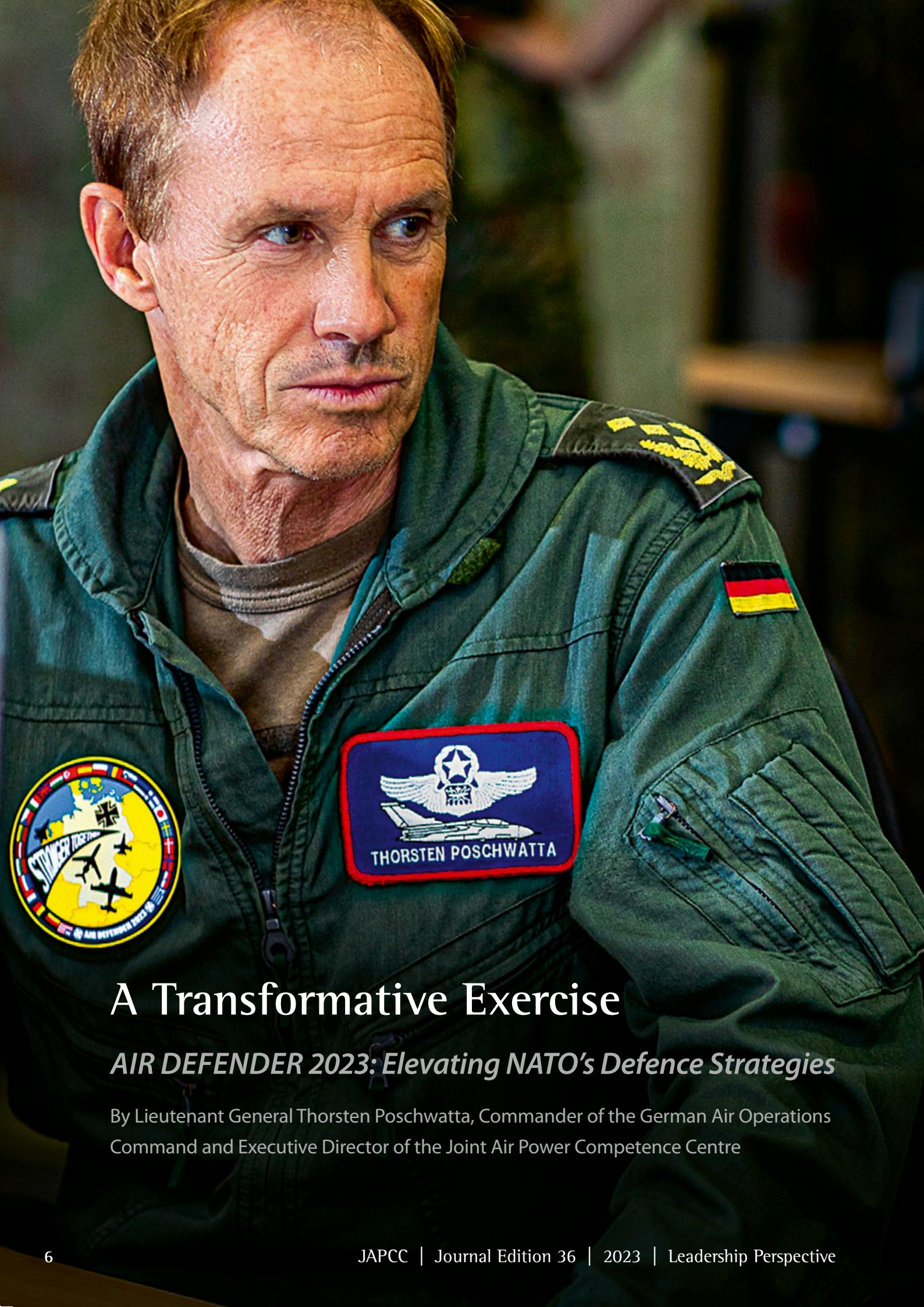
Purpose
The JAPCC Journal aims to serve as a forum for the presentation and stimulation of innovative thinking about strategic, operational and tactical aspects of Joint Air and Space Power. These include capability development, concept and doctrine, techniques and procedures, interoperability, exercise and training, force structure and readiness, etc.

Cover Photo: In the foreground, a Polish MiG-29 from the 23rd Tactical Air Base in Mińsk Mazowiecki with the emblem of the 303rd 'Kościuszko' Fighter Squadron just below the cockpit. On the tail stabilizers is a captivating portrait of Lieutenant Colonel Marian Pisarek, a distinguished WWII Battle of Britain ace from 303rd Squadron. The second aircraft in the formation is a Polish F-16 from the 31st Tactical Air Base in Poznań – Krzesiny, proudly displaying the emblem of the 302nd Poznański Squadron on its cockpit, accompanied by a captivating painting of the Poznań Raven on the upper part of the fuselage.



A Transformative Exercise

AIR DEFENDER 2023: Elevating NATO's Defence Strategies

By Lieutenant General Thorsten Poschwatta, Commander of the German Air Operations Command and Executive Director of the Joint Air Power Competence Centre

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AIR DEFENDER 2023 FACTS

241 Aircraft

54 Different Flying Units

25 Nations

26 Airbases

Decoding the Objectives of AIR DEFENDER 2023

Initiated by Germany in 2018, AIR DEFENDER 2023 (AD23) aimed to be the most extensive deployment and live flying exercise of Air Forces in Europe since the establishment of NATO. Its purpose was to send a strong message of deterrence to potential aggressors and showcase the unity of the alliance. Moreover, it sought to demonstrate Germany's capacity to lead an exercise of such scale and, importantly, to test its logistical and support capabilities. Especially this final challenge could be effectively addressed by hosting and integrating a detachment of the US Air National Guard, deploying from the United States to Germany with over 100 aircraft.

A fictional NATO Article 5 scenario was selected to provide a realistic backdrop for the exercise, ensuring that it encompassed the full range of air power: command, control, and execution.

AD23 was a dynamic flying exercise conducted over Germany and neighbouring countries from 12 June to 23 June, 2023. The exercise involved a total of 241 aircraft from 54 different flying units, with personnel representing 25 nations, deployed across 26 airbases. The primary objective was to conduct three Composite Air Operations (COMAOs) per day, along with up to 50 additional Continuation Training missions, resulting in a maximum of 240 planned sorties daily. The Joint Force Air Component Headquarters (DEU) served as the exercise's Air Command and Control (AirC2) agency, responsible for tasking and monitoring all operations.

Reflecting on the exercise, it is impressive that out of the initially planned 2036 sorties, a remarkable 1808, or 90 % of the planned sorties, were successfully executed without any significant impact on flight safety. The few cancellations were primarily due to operational or weather-related factors.

From the perspective of AirC2, what insights were gained from AIR DEFENDER 2023?

Every exercise teaches lessons, and the larger the exercise, the more lessons you can identify. Numerous participants have submitted valuable observations to enhance exercises like AD23, making them even more seamless in the future. I sincerely appreciate your help and extend my thanks! However, today, I would like to focus on three significant observations.

In general, NATO was long overdue for an exercise like AD23. Most exercises typically focus on a single level, such as AirC2 or flying units. While these exercises are necessary for familiarizing oneself with tactics, techniques, and procedures, AD23 took it a step further.

AD23 required the coordination of flying operations from 54 units across 26 Airbases, spanning multiple countries including Germany, Poland, the Czech Republic, Denmark, Romania, and the three Baltic States. This complex task also had to take into account civilian air traffic. To tackle these challenges, a modified JFAC HQ (DEU) (Joint Force Air Component Headquarters) was established to provide centralized AirC2 planning and execution.

The additional integration of specialists from flying units, known as 'Airbosses', into the JFAC was crucial in capturing unit-level training requirements and objectives. They also played a key role in developing COMAO vignettes for the exercise. During the execution phase, the Airbosses were instrumental in refining and leading the vignettes.

Despite numerous meetings during exercise preparation, AD23 revealed differing perspectives and perceptions of the AirC2 process. This occasionally led to friction and misunderstandings between the Airbosses and the JFAC, resulting in incomplete information flow. As a result, the reporting process was affected, with minimal reporting taking place at the beginning of the exercise.

It became evident that reporting is essential for a JFAC HQ to effectively execute Command and Control in an

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operation. However, it was challenging to emphasize the importance of reporting, as subordinate units were no longer accustomed to fulfilling basic reporting requirements to their headquarters. This lack of training in reporting to multinational (NATO) Headquarters from their home stations had become the norm over the past few decades.

The primary focus of the flying portion was on COMAOs, which required detailed mission planning, briefing, debriefing, and reporting. To ensure the security of classified information, various systems, including VTCs (Video Teleconferencing), were utilized. It is crucial to have the capability to communicate and coordinate using a classified IT structure, as it is essential for the NATO alliance to fulfill its primary commitment of defending all partner nations in an Article 5 scenario against a peer enemy.

During this exercise, Germany faced the challenge of relying on two separate classified networks. This was due to the absence of a consolidated system that could connect the headquarters with the individual units and squadrons. The NSWAN (NATO SECRET Wide Area Network) was employed for original AirC2 (Air Command and Control) matters, while an additional national classified system was primarily used for briefing and debriefing purposes. Furthermore, there were connectivity issues with other nations, which Germany managed

well by deploying additional manpower. However, it is crucial to address this issue for future exercises and, more importantly, in the event of an actual operation.

Conclusion

In conclusion, the AIR DEFENDER exercise highlighted the importance of several key factors. Firstly, it emphasized the need for a single, reliable, resilient, robust, and interoperable classified IT system. This system should include features such as J-Chat (NATO Chat tool) and VTC capability to facilitate effective communication between higher HQs and the corresponding units.

Additionally, the exercise revealed the necessity for a revision of the Airboss integration and a refinement of the exercise planning organization, particularly in terms of scenario and vignette preparation. These improvements would contribute to a more streamlined and efficient training experience.

Furthermore, the analysis conducted during the exercise shed light on the potential areas for enhancing training in terms of collaboration between the JFAC HQ and unit level. This could involve implementing academic programs prior to the exercise and increasing the involvement of the JFAC HQ in Live Flying Exercises.

To summarize, AD23 provided a unique opportunity for the JFAC HQ (DEU) to engage in tactical level operations with multiple affiliated entities. The diverse range of participating nations, units, and assets created an environment that closely resembled a real air operation. In my opinion, AD23 was an outstanding success. Let us continue to work together in the light of the AD23 slogan 'Stronger together'. ●

ABOUT THE AUTHOR

Lieutenant General Thorsten Poschwatta

Commander, German Air Operations Command
Executive Director, Joint Air Power Competence Centre

Lieutenant General Poschwatta is the Commander of the German Air Operations Command and the Executive Director of the Joint Air Power Competence Centre, both located in Kalkar, Germany. He is a Weapon Systems Officer of the TORNADO fighter bomber aircraft and held command positions at both, Group and Wing levels. Additionally, he served in various national and international staff positions in air as well as joint staffs, and in the German Ministry of Defence. These appointments included operational assignments in Afghanistan and Bosnia-Herzegovina. At flag officer rank, he was the Deputy Chief of Staff Operations at German Air Force HQ Gatow, the Deputy Commander of the Bundeswehr Joint Operations Command Potsdam, followed by an operational deployment as Chief of Staff HQ Resolute Support in Kabul.

Charting a New Course

The Czech Air Force Transition to an Exciting New Era

Major General Petr Čepelka, Commander of the Czech Air Force

Today, the Czech Armed Forces (CAF) and its Air Force are at a historical and conceptual turning point. This year, it celebrates 30 years since establishing a separate Czech Armed Forces after the dissolution of Czechoslovakia in 1993. Next year, it will commemorate 25 years since joining NATO. Both significant milestones have positively shaped the condition of the Czech Air Force (CZAF) 30 years long quantitative and qualitative transformation: the introduction of new weaponry, modernization of equipment, and implementation of complex new TTPs. These changes might give the feeling that the transformation from the former Warsaw Pact Air Force to a NATO-compatible Air Force is complete. While the CZAF has evolved into a highly professional and confident air force, earning its rightful place as a distinguished member of NATO, it must not rest on its laurels and must continue the successful transformation.

Three Decades of Czech Air Force Transformation

From a conceptual point of view, in the 25 years since joining NATO, the CZAF has experienced a substantial reduction in size and undergone a profound transformation. The primary goal of this transformation was to establish a compact, yet highly efficient professional air force, modelled after Western standards. It aimed at moving away from merely replicating the former Czechoslovak Air Force, which operated hundreds of aircraft from multiple airbases. Today, the CZAF operates a small quantity of sophisticated and modernized aircraft and systems allocated to four primary bases. These bases are actively involved in national and foreign operations, international exercises, and are preparing for tasks that differ significantly from those of previous years. Our commitments encompass a wide range of operations, including the 24/7 allocation of two-ship JAS-39 Gripen to NATO Integrated Air and Missile Defence. Simultaneously, until Slovakia completes training on their new F-16, we diligently safeguard the sovereignty of their air space. For numerous years, our C-295 CASA transport aircraft have been actively engaged in fulfilling crucial tasks as part of the Multinational Force and Observers mission in the Sinai. Additionally, we biennially undertake the responsibility of leading the Baltic Air Policing mission, while simultaneously training for the NATO Readiness Initiative. Our highly skilled JTACs seamlessly integrate land and air forces, working in close coordination with L-159 and Mi-24 squadrons, thereby ensuring effective operational outcomes.

Furthermore, the mind-set of our soldiers has undergone a significant transformation since joining NATO. A considerable number of them have successfully completed their education at renowned foreign war schools, equipping themselves with invaluable experience through operational deployments in Kosovo, Afghanistan, and Iraq.

However, lessons learned from deployments to combat missions and the current change in the security environment are significantly altering previously known rules. For a long time, we thought that the war did not concern us and that our possible deployment would be focused only on the fulfilment of tasks within peace operations. The recent rise of the geopolitical trend of great power competition with the development of emerging and disruptive technologies, the conflict on NATO's eastern flank, and the Alliance's new concept of future warfare – NATO Warfare Capstone Concept (NWCC) – are becoming prevailing factors influencing the development of future capabilities. Without the integration of new technologies

such as AI, Machine Learning, digitized virtual environments, or concepts such as Loyal Wingman, we cannot succeed in the future theatre of war.

Over the past three decades, we have been fortunate to witness a period of freedom, and security that is unparalleled in our modern history. However, Russia's recent aggression unequivocally demonstrates that a long period of peace is the exception rather than the rule. The Czech Republic is taking a responsible approach towards these changes and is actively adjusting its geopolitical perspective. In 2023, it will join twenty-four other Alliance members with a defence treaty with a strong strategic partner, thus deepening transatlantic cooperation. At the same time, the present Government has passed a defence financing law that anchors spending 2% of GDP on the military budget, which will significantly stabilize planning and facilitate financing military modernization projects.

The current crisis evokes new challenges for the Armed Forces and its air power. Accordingly, the highest priority is accelerating modernization and urgently increasing combat capability and readiness. However, this will only be possible by addressing the most pressing issues.

Confronting the Challenges

Experienced and motivated personnel, who often go above and beyond the call of duty, are crucial for an effective and ongoing transformation. Thanks to the interconnectedness with NATO structures and Centres of Excellence, European and US defence organizations,

'Increasing combat readiness and developing operational capabilities is a priority; digitalization of the battlefield is inevitable.'

Major General: © Czech Air Force; JAS 39 Gripen: © Czech Air Force; F-35: © TSgt Brandon Shapiro US Air Force

and the ability to cooperate and share experiences from international exercises and operational deployments, the CZAF employs motivated and experienced personnel. Nevertheless, the decreased manpower from previous years and the diminished motivation to join the Air Force have recently been a significant problem. In addition to that, demographic trends, expectations of 'Generation Z' and higher cognitive demands driven by advanced technological development have led to recruiting and retention challenges. To define the conditions to motivate recruitment and to develop an effective education and training system that corresponds to the pace of anticipated technical modernization and combat readiness, the Chief of the General Staff initiated a comprehensive analysis in which the Air Force participated too. Moreover, we have modernized the military aviation training centre including the introduction of Western training helicopters and advanced jets. Nevertheless, an opportunity to participate in international advanced standardized training activities will be of increased importance in the near future.

The state of the Air Force is very closely linked to the availability of sufficient and sophisticated weaponry. Despite extensive westernization and modernization which primarily involved the Tactical Air Force, other helicopter and transport units and the long-neglected ground-based air defence units remain equipped with equipment of Russian origin. The apparent advantage of this solution, when in the past the CZAF could train the Afghan Air Force armed with Mi-24, becomes a significant disadvantage in the current context of disturbed relations with the Russian Federation. Therefore, the priority is to expedite the westernization of mentioned units.

Unremitting Changes – Audacious Plans

Continuous transformation of the Air Force and its capabilities within the structure of the CAF is the joint responsibility of the Capabilities Planning Division and the Air Force Development Department of the Ministry of Defence, which in close cooperation with the Component command of the Air Force deal with technological and conceptual development, analysis and lessons learned. A top-down approach ensures streamlined implementation of capabilities, with the main influencing factor being the fulfilment of NATO commitments set out in Capability Targets and interoperability with other Alliance partners. Following the identified capability shortfalls and reflecting on the deteriorating security situation, the Czech Republic intensively reconsidered its Strategic Development concepts and established new enhanced modernization milestones and programmes.

In the context of diminishing dependence on the Russian Federation for armaments, the transition from Mi-24/35 helicopters to the United States made H-1 system (AH-1Z Viper/UH-1Y Venom) is underway these days, which will provide the helicopter forces with a significant qualitative capability increase in both accuracy and effectiveness of fire support and the range of effects critical to supporting ground troops. Strategically, the H-1 system provides a necessary advance in NATO interoperability and the opportunity for deeper involvement in Alliance exercises and operations. Concurrent with the ongoing upgrade of the Mobile Air Defence Radars (MADR) 3D surveillance radar backbone network, the generationally obsolete SA-6 KUB system will be replaced by the Israeli SPYDER SHORAD system beginning in 2024. This will place the CZAF among the countries with technologically advanced ground-based air defence systems and envisages integration into NATO's broader Integrated Air and Missile Defence. However, Air Defence modernization does not end there, and the Air Force, in cooperation with the University of Defence, is intensively analysing implementation of capabilities such as C-UAS and ballistic missile defence.

The subject of extensive modernization also includes increasing and supplementing the capabilities of the drone fleet. However, the intent to acquire medium tactical drones has been postponed based on lessons learned from the current Ukrainian battlefield; the CZAF has decided to prioritize the purchase of a larger fleet of smaller drones. It is also apparent that the future focus should be on sophisticated jamming-resistant drones incorporating advanced features such as AI, and Manned-Unmanned Teaming.

M Helicopter: © Bell Textron; Sky: © jamesteohart – stock.adobe.com

© SPYDER System, Czech Air Force/Rafael

H1 and SPYDER – newly introduced systems in the Czech Air Force.

Despite the indisputable effectiveness of multinational solutions, the Czech Republic's conceptual plans address the increase of strategic transport capabilities by purchasing its own medium transport aircraft. Moreover, it was decided to accelerate the acquisition process which will ensure the ability to react quickly to the development of crisis situations in the world. Therefore, market research is already underway targeting the C-390 Embraer, A-400M Atlas, and C-130 Hercules aircraft.

Although the CZAF will go through another critical stage of modernization in the following years and thus achieve a significant increase in capabilities both for its operations and for NATO's Collective Defence, it will be necessary to continue to discuss the factors shaping future battlefields and consequently the missions in which the Czech Republic could eventually operate. The threat posed by the A2/AD systems, which are also increasingly implementing ballistic and hypersonic missiles, covers an ever larger NATO territory, including the Czech Republic. This creates an additional requirement for tactical assets to be able to operate in contested and degraded opponent environment. The CZAF will therefore have to include counter-A2/AD capability in considerations for the successor to the 4th generation aircraft fleet, which will ensure the integrity of the Czech Republic airspace beyond 2030.

However, a significant increase in combat effectiveness cannot be achieved only by introducing modern technology and recruiting motivated personnel. Hence, we have been meticulously studying the Multi-Domain Operations (MDO) whose conceptual and operational frameworks have been provided in NWCC and DDA. Moreover, the Air Force, by principle, has significant potential to take a leading role in the introduction of this concept into the entire CAF. Speed of relevance, agility, distributed C2, unity of command and decentralized execution, advanced technology and the use of information sharing, the ability to orchestrate and provide kinetic and non-kinetic effects across physical domains, and the ability to integrate and exploit Space and Cyber capabilities are factors that play a significant role in the initiation and integration of MDO into national capabilities.

Elevating Ambitions

The CZAF has been intensively preparing to substitute its fleet of fourteen JAS-39 Gripen, which the Czech Republic leases from Sweden until 2027. An expert team across all decision-making components of the Air Force, the General Staff and the Ministry of Defence has been created and tasked to conduct a thorough analysis, assess and determine the requirements for the future capabilities of the tactical air force. The resulting analysis, taking into account the independent expertise provided by the Joint Air Power Competence Centre and NATO's upcoming development concepts, provided the basis for a military recommendation to the Czech Government, which concluded

that an effective solution for the comprehensive future development of the CZAF beyond 2030 is to implement the 5th generation aircraft supplemented with advanced drone capabilities.

Nowadays the only conceivable system, the F-35, with its unique sensor suite and low observability, possesses the potential to dramatically enhance the Czech Republic's defence capabilities by being able to provide one layer of integrated airspace protection effectively enough to maintain and establish flexible air superiority over its territory and, where appropriate, provide support and conduct operations as required by the Alliance. In addition, by increasing the presence of 5th generation assets in the middle European region, the Czech Republic will further strengthen deterrence and defence of the Alliance.

NATO's strategic documents formulate the space for the emergence of an adaptive protective wall based on 21st-century technologies. The prerequisite is digitally and technologically interconnected elements that can react quickly and act adaptively across all domains. The primary purpose is information dominance and accelerated decision-making, an essential components of modern warfare and premise for dominance in future conflicts. The 5th generation capabilities, which are Data-Driven by design, can potentially create a foundation of the information backbone network that will subsequently connect other domains to create and enable MDO C2. Moreover, the crucial 5th generation capabilities cannot be fully exploited without thorough and consistent integration into both national, and subsequently NATO federated mission networks. Thus, for the CAF, the 5th generation system could be the gateway for introducing MDO capabilities and forming the framework for the inevitable digitalization.

The CAF have been actively raising their ambitions in the space domain as well. Although the Czech Republic does not currently possess its own space assets, apart from the experimental satellite VZLUSAT2, its military puts great importance on utilizing space products to enhance operational capabilities. A new Space Capabilities Planning Section was therefore created within the Capabilities Planning Division. Its initial task is to implement space capabilities into strategic and doctrinal documents and to work closely together with the already functioning Military Intelligence Satellite Center. To maintain an appropriate level of integrity and interoperability with NATO, Czech representatives are deployed at the Space Operations Center in Germany and the newly established Space Center of Excellence in France.

For small militaries, it is believed that combining joint capabilities to create kinetic and non-kinetic effects is a significant boost in combat effectiveness. Understanding the basic principles is fundamental to introducing the MDO into the CAF. Therefore, the CAF Operations Command, while utilizing capabilities of the Simulation and Training Technology Center, has started a series of both virtual and live computer-assisted exercises called Odolné Česko (Resilient Czechia). Through the principle of *learning by doing,* the CAF are verifying their operational and tactical readiness to plan and command all its components together for the first time in modern history. In this way, it already collects the necessary knowledge for future advanced digitization, requirements for innovative C2, and the possible integration of 5th generation aircraft and thus creates a basic prerequisite for adoption of the MDO concept.

Need for Continual Modernization, Standardization, and Enhanced Collaboration

In order for the Czech Air Force to thrive on the future battlefield and solidify its position as a dependable NATO partner, it is imperative that we continue to modernize and enhance our combat readiness. We must invest in professional personnel and further adapt our training system, focusing on introducing advanced weapon systems based on innovative technologies. Newly rearmed units and the upgraded C2 system should be built from the outset as interoperable with NATO by design.

The ever-increasing technological sophistication of weapon systems and the complexity of planning processes and TTPs will increasingly require unified and

standardized training within NATO. The Czech Republic is well on its way to introducing 5th generation aircraft resulting in an unprecedented increase of operational capabilities. In this respect, there will be a need for multinational cooperation in all areas of training, from maintenance personnel and cyber specialists to operational pilot training. In the realm of European F-35 users, fostering collaboration is of utmost importance. This can be achieved by actively initiating or joining programs that facilitate the exchange of operational experiences. Additionally, close cooperation in cross-servicing initiatives will prove instrumental in strengthening our collective capabilities. Furthermore, it is crucial to allocate adequate training facilities to ensure the continuous development of our forces. An important chapter will then be forming protected airbases for both own operations and Host Nation Support, but also building the enablers for the eventual execution of coordinated airfield maneuver to ensure the resiliency and survivability of High Value Assets. However, a potential NATO air maneuver will not be possible without a joint discussion and resolution of the ability to share and flexibly adapt airspace, provide spare parts and maintenance capability, and build and share prepositioned ammunition stocks.

Since its inception, air power, and its ability to gain air superiority and support the operations of ground and other forces has been an essential and an integral element of conducting effective combat operations. The contemporary security situation in the world not only reaffirms this fact, but it also increasingly emphasizes the need for the interdependence of the air domain with other fighting domains. The ability to operate in a coordinated manner across all domains will form the fundamental premise of future warfare concepts. Utilizing these principles, it will be possible, for example, to operate in an adversary's A2/AD environment. Capability advancement and mutual coordination must therefore continue across all types of forces, not just the Air Force, which has the potential to lead the introduction of MDO capabilities into the CAF. ●

ABOUT THE AUTHOR

Major General Petr Čepelka

Commander of the Czech Air Force

Major General Petr Čepelka graduated from a Military Aviation College Košice in Czechoslovakia with a Master's degree in Aircraft and Missile Technology in 1991. He began his flying career as a helicopter pilot at the 11th Helicopter Regiment in Pilsen. He then worked his way up in ranks through several tactical, operation and strategic assignments and concluded his flying career as the 22nd Wing Commander followed by the 22nd Helicopter Air Force Base Commander. Operationally he completed two deployments to Afghanistan culminating with his deployment as the Czech Air Mentoring Team Kabul Deputy Commander in 2010–2011. His staff appointments include, among others, Head of the Helicopter and Transport Aviation Section, MoD Force Development – Operations Division and Director of the MoD Force Development Division. Major General Čepelka is a graduate of the Air War College, Maxwell AFB, Alabama and Royal College of Defence Studies London and completed courses at NATO Defence College Rome and Defence Academy Sandhurst. On 1 November 2022, he was appointed commander of the Czech Air Force and promoted to the rank of Major General on 8 May 2023. He became the twelfth Air Chief in the modern history of the Czech Air Force and only the second helicopter pilot to assume such a position.

© Italian Navy

'The Italian Navy Fleet is undergoing a thorough process of preparation and training to guarantee the readiness of its forces and to ensure the maritime defence and security of our country, protecting national interests and preserving stability in the Wider Mediterranean and beyond. IT CSG is one of the highest forms in which our maritime component can contribute to multi-domain operations in a joint military campaign.'

The Italian Navy Carrier Strike Group

Vanguard for the Nation

An Interview with Vice Admiral Aurelio De Carolis, Commander in Chief of the Italian Navy Fleet

Sir, thank you for taking the time to address the following questions and for providing insight into the Italian Navy Fleet. Could you first outline the role of Maritime Power in this age of global competition?

The highest expression of Maritime Power sits in the concepts of projecting high-end capabilities at sea and from the sea and ensuring the sustainability of maritime forces in time and space to accomplish assigned missions, guarantee prolonged presence in the areas of operation, and quickly adapt to any possible situational change.

In the case of Italy, as in most other Western countries with similar economic strength and global interests, the joint military enterprise acknowledges the maritime component's role of force multiplier for expanding the spectrum of potential intervention options at

both national and international levels. Thus, in the possible employment scenarios of the Italian military, regardless of the theatre's type and geography, the effective prepositioning and deployment of high-readiness maritime forces is a precondition for follow-on operations. Such deployments happened in the mid-1990s in both Somalia and the Balkans, in the early 2000s with Operation Enduring Freedom in the Indian Ocean, in 2006 in Lebanon and five years later in Libya, and are currently ongoing in the Mediterranean region for deterrence purposes. All these engagements find their epitomization in the Wider Mediterranean, which represents Italy's primary area of strategic interest stretching from the Atlantic Ocean, including the Artic, to the Persian Gulf and the Indian Ocean. In this complex geopolitical and geostrategic system, centre to multiple heterogeneous and conflicting dynamics, three continents merge, each with its respective economic, commercial, and social centres of gravity. This makes the Wider Mediterranean a multidimensional area shaken by deep historical faults that translate into geopolitical impulses continuously fuelled by tensions of social, commercial, and climatic nature. In such strategic quadrants, potential threats to national interests may originate, requiring adequate means to monitor and, if necessary, counter them or at least intervene to contain their effects and mitigate the associated risks through stabilizing actions.

Italy, a medium regional maritime power with global interests, has its peninsula stretching through the centre of this multifaceted, unstable, and dynamically evolving context where every actor – whether state or non-state – moves in an arena of ongoing competition for the exploitation of limited resources. This generates critical processes concerning the territorialization of the Mediterranean, leading to the generation of 'anti-access' and 'area denial' bubbles, currently located at specific strategic locations. In turn, this threatens the historical principle of freedom of the seas and the legitimate use of Sea Lines of Communication (SLOC), including the five strategic choke-points of Gibraltar, Sicily strait, Otranto channel, Turkish straits, and Suez Canal.

In this demanding context, the Italian maritime instrument, which includes the Naval Aviation, rests its effectiveness on what the Italian Navy has defined as the 'Expeditionary Trident', articulated into three fundamental pillars, able to expand and operate in Multi-Domain Operations (MDO). First, the Carrier Strike Group (CSG) with 5th generation fighters acting as a self-contained force expandable with the Italian Air Force's F-35B squadron; second, the Amphibious Task Group (ATG) with a landing force that can reach brigade size with the addition of Army units; third, the sub-surface component including submarines and special forces for underwater operations. These pillars are enhanced by operational enablers, such as integrated air defence, access to satellite services from naval terminals, integrated air and ballistic missile defence, naval fire support with extended engagement range, uncrewed platforms, next-generation weapons, and additional capabilities for cyber defence and space operations.

The current global context is shaped by the will of the most industrialized coastal countries to augment their strengths in the maritime environment. Here comes into play the generation and deployment of CSGs, whose intrinsic persistence and self-sustainability create the conditions to influence an area of operations and, consequently, by their mere presence, protect national, allied, and collective interests. CSGs are strategic military capabilities that allow nations to pursue a wide range of operational and tactical objectives with greater flexibility and autonomy. At the same time, CSGs boost the relevance of ATGs, whose role is strongly growing in the multi-dimension operational arena, especially when the deterrence is aimed at the littorals where most Anti-Access/Area Denial (A2/AD) platforms are based. Finally, for their own protection, ATGs would not be deployed to a crisis area where adequate CSG support is not available.

In relation to the Maritime Power, what is the concept of employment of the Italian Carrier Strike Group (IT CSG)?

Protecting national interests and preserving international stability in the Wider Mediterranean imply investigating the dynamics of such an important geopolitical and geostrategic concept that underlies the Italian national interests. Similarly, it is necessary to

June 2012, Ionian Sea, CVH Cavour in operation achieving FOC.

intervene in the right time and manner – wherever and whenever is required – to support the Alliance's defence, deter adversaries, prevent and contain crises, and stabilize contested areas. The Italian Navy, after more than thirty years of experience in blue water and carrier operations conducted in *expeditionary sea-based* contexts, is currently transitioning to 5th generation aircraft with the F-35B.

Considering the foregoing, the IT CSG concept of operations aims to protect, promote, and sustain the nation's maritime power status and to consolidate the full strategic potential of the entire Italian Navy Fleet.

Multinational and modular by design, the IT CSG is able to sustain an Air Campaign with tenable number of sorties to generate effective Air Power. Moreover, it offers unique versatility and flexibility to ensure the defence of national borders and territory, as well as the Euro-Atlantic and coalition areas of responsibility, including the ability to support the national and international community for humanitarian and disaster relief operations. In the current geostrategic scenario, the operational use of the aircraft carrier Cavour and its escort group has found its maximum expression in the context of training and real-world activities promoted by NATO. In this respect, the IT CSG is a crucial enabler of collective defence and supports the effectiveness of the Alliance Comprehensive Defence and Shared Response concept.

Concerning the Diplomatic, Information, Military, and Economic (DIME) model and the objective value of defending the nation's sovereignty and territory, the Italian CSG represents a powerful diplomatic tool for deterrence, which contextualizes and even expands the concept of Naval Diplomacy. Fielding a CSG elevates a nation's rank and the influence it can exert at the regional and global levels. The economic pillar of any society is also strengthened by the intrinsic ability of CSGs to act as instruments for guaranteeing a nation's vital and strategic interests. Moreover, CSGs represent an effective potential deterrent towards anyone harbouring expansionist ambitions to the detriment of

other countries' territorial integrity, as well of their economic stability and ability to access vital resources. From a military perspective, CSGs represent an enabling tool for conducting scalable operations, from reinforced vigilance to extended power projection, even at broad distances from the motherland and for prolonged periods.

Moreover, CSGs' dual capabilities, with organic health and logistics facilities, can provide considerable relief in severe natural disasters. The IT CSG, in particular, hosts an advanced hospital area, with diagnostic and intensive care units, up to NATO Role 2 Enhanced level, which expands the range of missions to combat, maritime security, cooperation, and peace support operations.

Through the embedded capabilities of multidimensional surveillance and telecommunications, CSGs contribute decisively to the compilation and distribution of Maritime Situational Awareness and Joint Intelligence Surveillance and Reconnaissance (JISR). Similarly, CSGs can embark dedicated systems and platforms to build and maintain situational awareness in non-permissive theatres far from the motherland.

Additionally, CSGs can project power from nearby areas to remote crisis theatres and from blue waters over to the land, exploiting their strategic versatility, operational autonomy, and tactical flexibility, operating as a self-contained force that can work independently or as part of a broader operation. Aircraft carriers, by themselves, represent true hubs for command and control, able to even host a Maritime Component Commander or the entire High Readiness Force Maritime Headquarters staff, with its Maritime Air Operation Centre (MAOC) as sortie generator and with the required other agencies, to exert operational and tactical control of functional organizations, including air and sub-surface control agencies. The presence of an embedded MAOC on board the carrier would allow to either autonomously generate Air Tasking Orders (ATO) – in case of maritime operations outside the area of responsibility of an Allied CAOC – or to provide the pertinent CAOC with the Maritime ATO (M-ATO) that would then feed the consolidated ATO.

Furthermore, in an MDO environment, CSGs will contribute to local naval and air superiority by generating strategic effects and creating operational 'dilemmas' for adversaries.

The intrinsic 'binding' value of the CSG formula complements these aspects when adopted in the Alliance framework whereby, through a federated approach, different Navies – even with limited blue water capabilities – can enhance the resilience and sustainability of a CSG by contributing with escort assets.

What makes up the Italian Carrier Strike Group?

The composition of the IT CSG is tailored to the mission and centred on the aircraft carrier and the embarked air component. The CSG is completed by a modular package of escort units for its defence and by an ensemble of supporting assets that provide the required logistic sustainability.

October 2021, CentMED, IT Navy and IT Air Force F-35B performing 'Carrier Qualifications' on CVH Cavour.

a. The Aircraft Carrier with the Embarked Air Component

The primary role of the aircraft carrier is to project air power from the sea and over the sea without reliance on land bases and airports. Moreover, the aircraft carrier ensures surveillance and control of large maritime areas and SLOCs and protects military contingents and civilian populations on land.

The embarked air component, with its organic fixed and rotary wing aircraft, is an integral part of the unit's main combat system that ensures the integrated defence of the CSG and represents the highest expression of surveillance and power projection. The air assets also contribute decisively to other strategic activities, such as maritime security, infiltration/exfiltration of special and underwater forces, search and rescue, personnel recovery, humanitarian assistance, and support to governmental and non-governmental entities in the event of natural disasters. The aircraft carrier's new 5th generation weapon system ensures more effective employment of Air Power as a functional and integral element of the broader Maritime Power concept.

ITS Cavour was upgraded to F-35B standards in 2020 and completed the certification process at the beginning of 2021, undergoing carrier qualification and training with allied aircraft carriers. During ITS Cavour's unavailability, e.g. maintenance cycles, the Italian Navy plans to adapt the ITS Trieste, an amphibious assault ship that will be delivered in 2024, to the carrier functions, yet with obvious limitations.

The F-35B represents the enabling element that guarantees remote engagement of air and surface threats to sustain an Air Campaign, Air Power projection deep into the opponent's territory, and support of the landing force in amphibious operations.

b. The Group of Escort Units

CSG's escort units are self-protection first-line warships in all the main maritime warfare areas, i.e. anti-air, anti-submarine, and anti-surface. These combatants usually are cruisers, destroyers, and frigates. Given that the Italian Navy no longer has cruisers in its inventory, depending on the availability and threat assessment, the CSG's escort may be composed of:

1. One to three anti-air warfare destroyers to ensure airspace surveillance, air and missile protection, and ballistic missile defence that are capable of integrating within the national Air Defence system and with the allied data and information sharing systems supporting, for instance, the development of the recognized air picture.
2. One to four anti-submarine warfare frigates to ensure detection, deterrence and, if necessary, to counter the threat posed by enemy submarines.

c. The Set of Support Elements

The support elements are naval platforms providing either logistic sustainability or additional defensive/offensive capabilities. In the IT CSG, these elements include:

1. A logistic support ship to provide fuel, food, water, materials, spares, and supplies, as well as to ensure the availability at sea of ad-hoc teams to conduct maintenance and technical interventions and provide additional NATO Role 2 medical facilities.
2. One or two hybrid propulsion submarines to covertly conduct deterrence, surveillance, and intelligence activities, increase the surface and subsurface protection of the CSG, and support special operations forces.
3. One intelligence-gathering ship.
4. One to two mine countermeasures vessels, essential for the CSG's protection when transiting through shallow waters, including approaching/departing from ports and harbours.
5. One to two maritime patrol aircraft dedicated to increasing the long-range surveillance capability of the CSG.

When deployed in selected carrier vessel operations area (CVOA), the IT CSG is able to generate pre-planned and on-call fixed-wing offensive and defensive sorties (OCA, DCA, maritime/land strike, RECCE, CAS) in support of air, naval, and amphibious operations, also as

May 2023, Tyrrhenian Sea, IT CSG underway during exercise MARE APERTO 23-1.

part of a joint campaign, which are planned and tasked through the M-ATO issued by the MCC in accordance with the NATO air tasking cycle.

The streamlined, dynamic, and modular configuration of the IT CSG represents a key contribution of the Italian Navy to the Joint General Staff force planning process development of the entire military instrument, in line with the prescriptions and requirements brought forward by the Alliance through the NATO Defence Planning Process.

What are the Italian Navy Fleet's contributions to Alliance Maritime Air Power?

The Italian Navy is actively contributing to international stability, as witnessed early in 2022 when combined activities between the IT CSG and homologues groups centred on the USS Harry S. Truman and the FS Charles de Gaulle occurred. The three NATO CSGs carried out coordinated drills aimed at consolidating interoperability between their embarked aero-tactical components, as well as between the escort and support groups. These training activities followed the November 2021 interaction when the IT CSG cooperated with the British CSG centred on the HMS Queen Elizabeth. On every occasion, these collaborations underlined the firm will of the participating countries and, in general, of the Alliance to cooperate and implement every action aimed at guaranteeing a prompt and credible deterrent to support and preserve international peace and security. Under the umbrella of the 'Neptune Strike' exercise, similar activities were performed with the USS George HW Bush between 2022 and the first months of 2023, with the participation of the Spanish ESG centred on the ESPS Juan Carlos I. An additional boost to the effectiveness of collaboration came during the exercise with the transfer of authority of the IT CSG under STRIKFORNATO's Operational Control through SACEUR. Similarly, interactions are planned

March 2022, Ionian Sea, US-FR-IT CSGs in Multi Carrier Operations.

during 2023, with the European Carrier Group Interoperability Initiative that, in June 2023, transferred its chairmanship from Italy to the United Kingdom (UK).

The Italian Navy also provides escort units to allied CSGs, mainly when they operate in the Mediterranean. To this extent, several Italian Navy frigates and destroyers have already been attached, mostly over the last three quarters of 2022, to French, UK, and US CSGs, for anti-air and anti-submarine protection. In this view, the Italian Navy is intensifying its contacts with the mentioned navies to deepen the achievable degree of interoperability to the point at which we may reach a certain level of 'interchangeability', to adopt an expression recently used by the US Navy's NATO top leaders at both JFC Naples and STRIKFORNATO.

This last aspect allows me to highlight another relevant feature connected with the defence of the CSG and the ongoing evolution of the missile threat. The Italian Navy's escort destroyers and frigates regularly participate in the Formidable Shield exercises, which the US Navy and UK Royal Navy conduct every other year. Given the onset of hypersonic threats, these engagements allow for constant improvement of our anti-air and anti-missile capabilities, which are particularly critical today. CSGs are military strategic capabilities revolving around capital ships – the aircraft carriers – that will always be easier to protect and defend than an airport or a land forward operating base.

How does the future look for the IT Navy CSG?

The national Expeditionary Sea-based concept, centred on the experience gathered by the Italian Navy in thirty years of aircraft carrier operations, is going through a profound renewal phase. The main element of this evolution is the stand-up of the 5th generation air power, which is to achieve IOC at the end of 2024 and FOC in 2030. This represents the very essence of the future of the IT CSG. The Italian Navy Air Power, to sustain an Air Campaign, relies on a combination of 5th generation aircraft and AV-8Bs. In this light, developing CSG's tactical potential goes through several stages, structured around two major national maritime training exercises per year codenamed Mare Aperto, which are live opportunities for the entire CSG to operate at sea with all escort and support groups. Before each session, the aircraft carrier conducts separate training with the embarked air component whilst escort ships and support elements train separately. In particular, the training of the IT CSG is achieved in the context of national and international exercises, as well as through standardization agreements and multinational frameworks.

Prior to any deployment, the IT CSG undergoes an adequate integration phase among the units constituting the group. The capacitive development path of the IT CSG must be oriented to support, adapt, and expand its potential according to the contextual development of the maritime and strategic scenarios.

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For continuous availability of this strategic tool, to which the nation can entrust specific tasks, it is necessary to act in the medium and long term. This will foster a balanced upsizing of the fleet, combat progressive obsolescence, and enable gradual upgrades for each component of the CSG.

The process of developing the IT CSG to its full potential requires acquiring enabling capabilities that include maritime uncrewed systems, standoff weapon systems, satellite-based early warning, advanced ISR, long-range transport for carrier-on-board deliveries, air-to-air refuelling assets, and improved cyber defence capabilities.

The development of the CSG focuses on achieving full interoperability with allied systems and assets and seamless integration with homologous forces belonging to NATO allies and partners and European Union (EU) member nations.

The Italian Navy Fleet is undergoing a thorough process of preparation and training to maintain all assets at high readiness, ensure the maritime defence and security of our nation, and support the strategic roles and lines of defence outlined in the national defence strategy. Moreover, its contribution is essential – within the framework of international alliances and agreements – to the regional stabilization processes and the protection of legitimate interests. Finally, establishing the IT CSG is the essential step to the path to achieving the 5th generation aircraft carrier capability and the concomitant development of the maritime instrument.

As a last note, I wish to highlight that a CSG is one of the highest forms in which the maritime component can contribute to the overall effort in a joint military campaign while providing the air component with a valuable set of capabilities. This consideration provides a recommendation for NATO and EU countries operating aircraft carriers to synchronize the availability periods of these 'capital ships' and thus maximize the overall CSG coverage, in the end, to ensure that CSGs will continuously play their crucial deterrence and defence role for the Alliance.

Sir, thank you for your time and your comments. ●

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Vice Admiral Aurelio De Carolis

Commander in Chief of the Italian Navy Fleet

Vice Admiral Aurelio De Carolis graduated from the Italian Naval Academy in 1986. He is the Commander in Chief of the Italian Fleet (CINCNAV) since 17 December 2021 and previously served for two years as the Deputy Chief of Staff of the Italian Navy. As a surface warfare officer, he was embarked on board cruisers and frigates, deploying in NATO, EU and coalition operations. He commanded the patrol vessel SPICA, the frigate ESPERO, the aircraft carrier CAVOUR, the Italian Amphibious Force and the Second Naval Division. In this last position, from 2017 to 2019, he was dual hatted as Commander Italian Maritime Force (COMITMARFOR) for the NATO Response Forces and Commander of the Italian Carrier Strike Group. His primary shore duties include naval military assistant to the President of the Italian Republic, Chief Communications Officer at the Italian Defence General Staff, Head of the Amphibious Department and Head of the Plans and Policy Department at the Italian Navy General Staff. He holds a Master's in Physics and International Studies, a BS in Maritime and Naval Sciences and a full-time MBA from the London Business School (class of 2000).

Hypersonic Weapons on the Front Line

Deterrent or Detractor?

Mig-31s are launching the hypersonic 'Kinzhal' into Ukraine.

By Commander Aaron Shiffer,
US Navy, JAPCC

Introduction

Some regard hypersonic weapons as a niche capability that offers a new first-strike capability for a small set of high-value targets, while others argue they have little real impact beyond strategic messaging of national prestige – a national prestige that NATO nations do not currently possess. The United States (US) and France have tested early versions with limited success, whereas Russia has fielded Avangard via land-based missile forces, Zircon in its Navy, and the Kinzhal from its Air Force. The Kinzhal (Kh-41), currently deployed for combat in the Russo-Ukrainian war, has received significant media attention despite its limited accuracy and effect.

Hypersonic technology presents new opportunities for adversaries to enhance national pride and introduce greater ambiguity during crises. It also has the potential to level the playing field by shifting the strategic balance of power away from those with a previous defensive advantage and towards a new offensive capability. By utilizing hypersonic capabilities, adversaries can introduce a higher degree of uncertainty and complexity, making it more difficult for defensive systems like NATO's Ballistic Missile Defence (BMD) to counter these threats effectively. BMD's success at deterring attacks highlights the evolving nature of strategic deterrence, and this success must be considered in the face of hypersonic advancements. NATO must prioritize the ability to defend against

hypersonic weapons over the development of our own national pride to return the strategic balance in our favour.

Hypersonic weapons travel at speeds greater than Mach 5 without following a standard ballistic missile profile. Hypersonic weapons achieve their immense speed in one of two ways: using advanced engines as the high-altitude cruise missiles or as glide vehicles flying a depressed trajectory using the potential energy available to ballistic missiles. This combination of speed and altitude leads to significantly less reaction time compared to ordinary cruise or ballistic missiles. Both China and Russia have fielded hypersonic weapons, whereas India, the United Kingdom (UK), the US, and France are in various stages of development. This article briefly overviews the applicable history, ongoing developments, and possible impacts to strategic deterrence of hypersonic weapons.

History

The US has been developing hypersonic vehicles since the 1950s but paused at the end of the 1980s. By contrast, 'Russia and China made the opposite decision. Instead of mimicking our restraint as we hoped, they developed and deployed increasingly sophisticated and numerous hypersonic capabilities of various types – including nuclear-capable and orbital hypersonic weapons'.[1] Instead of developing a hypersonic offence, President Ronald Reagan initiated the Strategic Defense Initiative (SDI), an anti-ballistic missile programme designed to shoot down nuclear missiles in space. Otherwise known as 'Star Wars', SDI sought to create a space-based shield that would render nuclear missiles obsolete.[2] Reagan, known as the US president who ended the Cold War, knew that having the ability to defend was far more important than increasing stockpiles of ballistic missiles.

The advent and successful fielding of BMD via the US Navy's Aegis weapon system and the Army's Terminal High Altitude Area Defense (THAAD) system meant that NATO's adversaries could no longer be confident that their strategic nuclear weapons would reach their targets. In March 2018, Putin addressed the Russian Federal Assembly and proclaimed that 'the US is permitting constant, uncontrolled growth of the number of anti-ballistic missiles, improving their quality, and creating new missile launching areas. If we do not do something, eventually this will result in the complete devaluation of Russia's nuclear potential. Meaning that all of our missiles could simply be intercepted'.[3] That same year US Missile Defense Agency (MDA) published test results from the THAAD, Aegis, and ground-based midcourse defense (GMD) systems revealing 100 %, 77 %, and 57 % success rates, respectively. 'Testing to date has given us confidence in the basic design, effectiveness, and operational capability

Notional scramjet powered hypersonic missile.

for short-, medium-, and long-range ballistic missile defense'.[4] While not precisely as Putin feared, the fact sheet did show an incrementally growing capability with a success rate that continues to improve. Russia later claimed that President Obama's European Phased Adaptive Approach (EPAA) initiated by President Obama, which brought US BMD capabilities to Europe to defend against Iran, was 'fuelling a new arms race' and that is constructed 'on ridiculous fabricated pretexts'. Dmitry Rogozin, the Deputy Prime Minister of Russia, further elaborated: 'Russia vehemently opposes the plan, claiming that its own ballistic missiles would also be covered by the US shield, disrupting the nuclear parity between the countries'.[5]

At the 2016 Warsaw Summit, NATO leadership declared the Initial Operational Capability (IOC) of NATO BMD, and individual nations committed to developing or acquiring their own BMD contributions for the defence of the Euro-Atlantic area. A European consortium consisting of Airbus, BAE, Leonardo, and Thales developed and successfully tested ASTER-30 missiles in a BMD role in the Sol-Air Moyenne-Portée/Terrestre (SAMP/T) system against Short-Range Ballistic Missiles (SRBM). Fielded in land-based batteries, destroyers, and frigates, ASTER-30 can provide terminal defence and promises expanded capabilities in 2025 against medium-range ballistic missiles.[6] The combination of US and European efforts are slowly degrading Russia's confidence in the credibility of their offensive weapons.

Ongoing Developments

The Council of the European Union (EU) TWISTER (Timely Warning and Interception with Space-based TheatER surveillance) project was approved on 12 November 2019 to provide a 'new endo-atmospheric interceptor [that] will address a wide range of threats including manoeuvring intermediate ranges ballistic missiles, hypersonic or high-supersonic missiles'.[7] Led by MBDA (Matra, BAe Dynamics, and Alenia), the new missile system has an expected in-service date of 2030 with a range of 3,000 km, providing coverage for both hypersonic weapons and Intermediate-Range Ballistic Missiles (IRBM).

The US continues to develop its Aegis combat system by expanding its NIFC-CA (Naval Integrated Fire Control-Counter Air) programme to include F-35s, which

enables Aegis BMD ships to shoot beyond line of sight using radar data from NATO's newest aircraft.[8] Several nations have bought Aegis or the ASTER-30, showing that Putin's fears could be fully realized in the next few years as those systems are fielded in larger numbers throughout multiple NATO nations. For example, the US Navy will have 53 BMD-capable ships by the end of 2024.[9] However, we must consider how hypersonic weapons are different from the ballistic missiles that have underpinned nuclear deterrence for more than 70 years.

'The NATO nuclear arsenal is significantly larger than the Chinese arsenal and more survivable than the Russian and Chinese nuclear triads.'

Hypersonic weapons combine the speed of ballistic missiles with the accuracy of cruise missiles, travelling in a rarely used portion of the air domain and exploiting an untested vulnerability in NATO Air Defence systems. Hypersonic weapons' speed and ability to manoeuvre means they will hit their targets within minutes of launch and do not necessarily follow a predictable flight path. In contrast, a ballistic missile's high-parabolic path allows surface-based systems to detect them early and predict their likely trajectories. Our current standalone systems have a mere three minutes to run the full Find, Fix, Track, Target, Engage, and Assess (F2T2EA) kill-chain against a hypersonic weapon. Networking sensors together, as TWISTER and NIFC-CA envision, will enable earlier detection, tracking, and engagement using assets such as the F-35, Northrop Grumman E-2D Hawkeye, and future Alliance Airborne Early Warning Capability such as Boeing E-7 Wedgetail or Airbus Modular Multi-Mission Aircraft (A320M3A). Better networking of our terrestrial, air, and space sensors will ensure terminal success and enable earlier engagements.

The US MDA and TWISTER are both working towards creating a persistent and resilient space-based tracking layer enabling earlier detection and engagement of ballistic and hypersonic threats. MDA and the US Space Force partnered with SpaceX to launch the

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A missile defence system intercepts and destroys attacking missiles.

first batch of a new tracking and communications constellation as the first step towards creating a space-based tracking layer.[10] Connecting via the US Naval Research Laboratory, these new satellites will demonstrate 'multi-phenomenology ground-based sensor fusion' expanding Aegis BMD's ability to engage advanced missile threats at the edges of current missile capabilities.[11]

The Impact on Deterrence

Hypersonic weapons' speed and ability to manoeuvre complicate target engagement as well as decision-making at the political and strategic levels. China and

'NATO does not need hypersonic weapons to assure its strategic security, and their use would probably be limited to countering adversary A2/AD capabilities.'

Russia's intentions to equip hypersonic missiles with nuclear warheads create strategic ambiguity when determining how to respond to a hypersonic weapon attack. Their speed shortens the Observe, Orient, Decide, and Act (OODA) loop, increasing the risk for a nation to assume the worst possible outcome; 'the consequences of which will not only alter military balances but also have a psychological impact on decision-makers during crisis'.[12] At the extreme, political leadership may assume an inbound hypersonic weapon as a 'first strike' intended to destroy their nuclear arsenal and retaliate in accordance with strategic doctrine by launching their own nuclear weapons.

For example, hypersonic weapons undermine how No First Use (NFU) countries, such as China and India, view nuclear deterrence. A nation's nuclear arsenal sits at risk of quick destruction through the advent of global hypersonic strikes with conventional warheads. China, having a comparably smaller and less survivable nuclear triad, believes they will need to 'use asymmetric retaliation to dissolve the enemy's determination to conduct further hypersonic strikes'.[13] Chinese think tanks argue this implies that China may launch nuclear retaliation against a conventional hypersonic strike. Similarly, in response to the perceived Conventional Prompt Global Strike (CPGS) threat from the US, experts believe China will adjust its long-standing unconditional NFU policy to a conditional one, i.e. China is willing to launch nuclear retaliation once its nuclear weapons are struck by conventional weapons.[14]

On the flip side, Forbes magazine argues 'hypersonic weapons – with their combination of assured penetration, tailored effects and credible utility – have the potential to make a significant contribution to strategic deterrence. They will never replace nuclear weapons in the deterrence calculus, but they can make the use of America's most fearsome warfighting systems less necessary even in extreme circumstances'.[15] Hypersonics do offer the ability to take an adversary by surprise as well as nullify many air defence systems currently in use, however maturing the technology remains elusive.

Despite years of early research, the US lags behind Russia and China in fielding hypersonic weapons. The US Congress has enacted an accelerated profile to develop and test hypersonic weapons adding 0.9 Billion Dollar to the Department of Defense's FY23 funding request, bringing the total to 4.7 Billion Dollar.[16] By comparison, the UK's hypersonic weapon development budget is roughly 13 % of the US budget for FY23 with a total of 2.5 Billion Dollar budgeted from FY22-26. A significant disparity exists between the investments in hypersonic defence and offence in the US budgets. In FY22, 255 Million Dollar was allocated for defence against hypersonic weapons, while offensive hypersonic development received approximately sixteen times that amount. Meanwhile, the EU budgeted 100 Million Dollar in FY22 for the Hypersonic Defence Interceptor Study (HYDIS), which concludes in three years, whereas the UK and France have budgeted significantly more for the development of their own hypersonic weapons. 'Effective deterrence leverages both the threat of punishment and a credible capability to deny an attack' and, similarly to BMD, the results from the ongoing hypersonic defence investment will show our adversaries a credible defence.[17] The current budget profiles do not support fielding of a credible defence

until the mid-2030s whereas a US hypersonic weapon may finish testing in 2028.

While the US's surging offensive hypersonic budget is quickly catching up with Russia and China, the US policy for hypersonic weapons use is not public, leaving think tanks to debate likely policy options. Policy experts profess mixed opinions on hypersonics and their usefulness in war. In one perspective, 'hypersonic effects will most likely be felt on the sub-strategic level. This may include the ability to frustrate local defences and to provide rapid strike capabilities against locally deployed armed forces, especially in naval warfare, and high-value, time-sensitive, and hardened targets'.[18] Conversely as a first strike weapon hypersonics offer the ability to take an opponent by surprise, striking high-value assets, such as aircraft carriers, land-based headquarters, or high-end air defence systems, allowing for follow-up strikes with cheaper cruise or ballistic missiles in large volleys. Hypersonic weapons could also be a solution to counter adversaries' modern long-range Anti-Access/Area Denial (A2/AD) systems.[19]

Russia and China are developing their hypersonic weapons to be both conventional and nuclear-capable, increasing the survivability and diversity of their nuclear triads in response to NATO's capability to defend against ballistic missiles. NATO nations (US, UK, and France) have publicly stated that their hypersonic weapons will not be nuclear-capable, in an effort to de-escalate the perceived threat hypersonics place on our adversaries' deterrence calculus.

The intended target of ballistic missiles can be determined from their initial trajectory.

[...] *'…as a first strike weapon hypersonics offer the ability to take an opponent by surprise, striking high-value assets,…'*

Conclusion

'Deterrence is most likely to be successful when a prospective attacker believes that the probability of success is low and the costs of attack are high'.[20] The NATO nuclear arsenal is significantly larger than the Chinese arsenal and more survivable than the Russian and Chinese nuclear triads. NATO does not need hypersonic weapons to assure its strategic security, and their use would probably be limited to countering adversary A2/AD capabilities. Negatively, 'hypersonic weapons can increase pre-emption fears and dangerously alter crisis escalation scenarios' further destabilizing deterrence, whereas investing in a larger arsenal of cruise missiles is significantly cheaper.[21] Considering the potential savings and hypersonic weapons' negative impact on strategic deterrence it would be prudent for NATO nations to prioritize funding for defence against hypersonic weapons thus decreasing the probability of an adversary's successful attack and returning the strategic balance once again in our favour. ●

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Commissioned into the United States Navy in 2000. Initial pilot training was in the P-3C Orion serving two US operational tours and a third with the Royal Australian Air Force.

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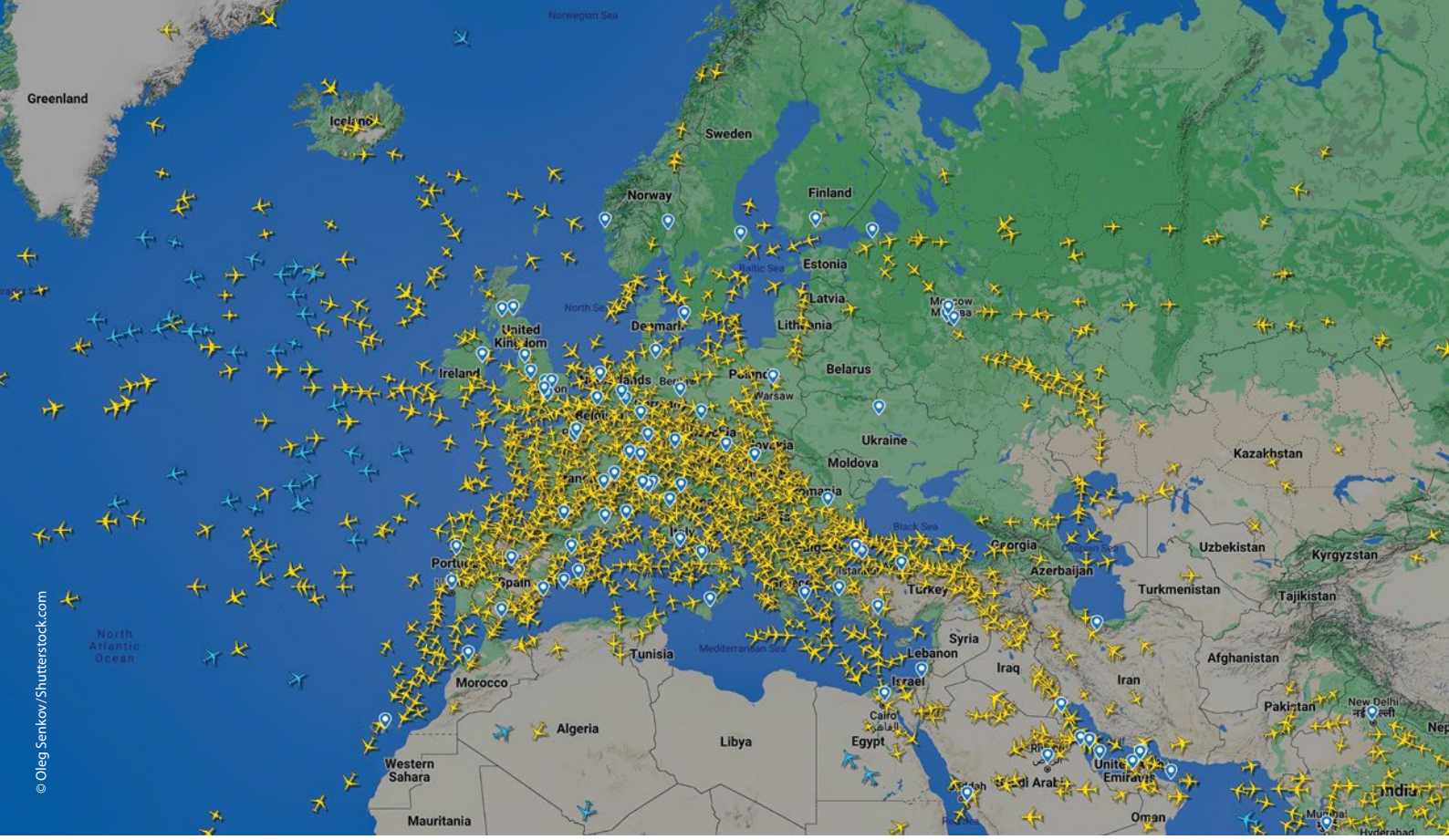


Air traffic density over Europe.

NATO Rapid Air Mobility

Bringing the 'Rapid' into NATO Air Transport

By Major Massimo Di Milia, IT Air Force, JAPCC

> *'Obtaining additional air transport mobility – and obtaining it now – will better assure the ability of our conventional forces to respond, with discrimination and speed, to any problem at any spot on the globe at a moment's notice.'*
>
> President John F. Kennedy[1]

Introduction

NATO's Rapid Air Mobility (RAM) initiative enables state aircraft to support the rapid deployment of forces during emergent operations. Executing the mobility mission faster, with little or no notice, leads to a more efficient Alliance. NATO Assistant Secretary General for Defence Investment, Mr Camille Grand, stated that 'by facilitating quicker air movements across the Alliance, we can be more effective in preventing crises, more efficient in deploying our forces, and quicker in reacting when unforeseen situations arise'.[2] In addition to contributing to NATO nations' global reach, RAM is a key enabler for air and space superiority, precision engagement, and agile combat support.

A Royal Air Force Chinook helicopter is being carefully loaded into a C-17 Globemaster aircraft, preparing for its extensive journey back to the United Kingdom from Afghanistan.

The RAM initiative fills a critical need by supporting the Alliance's deterrence and warfighting capabilities that rely on quick strategic movement. RAM is not just an Air Component force multiplier but also a crucial enabler of joint and multi-domain operations. This article provides background on the origins of RAM, explains its workings and technical requirements, evaluates the importance and deficiencies of RAM, and provides some recommendations for improvement.

The Origins of RAM

The NATO RAM concept began to take shape in the late 1990s and early 2000s, as NATO members recognized the need for a more flexible and responsive air mobility capability. In 2003, NATO established the Strategic Airlift Interim Solution (SALIS), which provided participating countries access to a fleet of C-17 transport aircraft. This was a significant step towards the development of the RAM capability. In 2004, NATO established the NATO Response Force (NRF), which included a RAM component responsible for providing rapid air transportation of personnel and equipment to crisis areas.

RAM allows NATO aircraft to deploy quickly and with little notice across the Alliance. Activating RAM assigns a distinctive and recognized priority to designated aircraft, facilitating fast routing compared to a standard mobility mission. This allows for swift and efficient movement of personnel and cargo across NATO's borders and through international and partner airspace. Moreover, it provides Alliance leaders the capability to project hard and soft power at any moment at any location. RAM mission areas include inter and intra-theatre airlift, air-to-air refuelling, aeromedical evacuation, and operational/executive support. RAM has gained importance for many reasons, and allies have quickly realized its significance.

The initial operational capability of NATO's RAM initiative was declared shortly after the 2018 NATO Brussels Summit.

Operational control of RAM resides with Supreme Headquarters Allied Powers Europe (SHAPE). It can be activated in support of crisis management or whenever designated in other situations that require intervention. The Joint Support and Enabling Command (JSEC), directly subordinated to SHAPE, oversees and plans the manoeuvres of the allies.[3] Once RAM is activated, dedicated aircraft are assigned the 'OAN' call sign, which also includes expedited diplomatic clearances. The European Air Traffic system recognizes the OAN call sign as a priority aircraft, lifting military airspace restrictions and ensuring a quicker execution through coordination with the relevant air traffic controllers along the flight path. NATO has worked closely with all allies and the European Organization for the Safety of Air Navigation, commonly known as EUROCONTROL, to ensure the procedure is secure and efficient. To summarize, OAN-designated aircraft get preferred access over all other traffic in European airspace. Besides procedural provisions, RAM must also account for a series of technical requirements.

Technical Requirements

Many nations within the Alliance place greater emphasis on technology while paying reduced attention to the other two aspects of the military employment revolution: operational and organizational changes. The correct use of technology to enhance a force's capabilities and the fact that it takes time to adapt are two important lessons learned from military history. This is also true for the implementation of RAM: it requires operational and organizational changes together with technological advancement.

In order to have a substantial impact, technological advancements typically necessitate concurrent modifications in doctrine, equipment, force composition, tactics, organization, and command and control. In

Air traffic controllers depend on cutting-edge commercial off-the-shelf technology to efficiently manage and ensure the safety of air traffic.

other words, if organizational and operational changes are not made, technology on its own will have limited, if any, positive effects. This also has implications for the introduction and use of RAM.

Global Air Traffic Management (GATM), which includes communications, navigation, surveillance, and air traffic management, gives EUROCONTROL sufficient surveillance and control of air traffic to safely and efficiently prioritize military aircraft, which was not previously possible. A number of systems are required to facilitate GATM. Communications are accomplished mostly via datalink, enabling aircrew to request and approve non-verbal clearances and Air Traffic Control (ATC) instructions, gather weather information, and furnish automated position reports. GATM also includes advanced Global Positioning System (GPS) capability for flight navigation in all oceanic airspace thus increasing the accuracy of position data reported to ATC and enabling closer sequencing of aircraft. An active surveillance capability transmits and receives aircraft position and intent data by means of Mode-S transponders and the Traffic Collision Avoidance System (TCAS). Finally, enhanced air traffic management enables Reduced Vertical Separation Minimum (RVSM), which reduces aircraft separation from 2,000 to 1,000 ft vertically.

Compliance with these technical requirements enables aircraft to use the most direct air routes between destinations without incurring time and fuel-consuming deviations around restricted airspace. To guarantee access to optimal European airspace for all air mobility aircraft, it is fundamental to comply with RAM requirements as soon as possible, either by investing in new technology or by making the most of the existing platform by carrying out operational and organizational changes. Without RVSM and TCAS, an aircraft cannot participate in RAM operations.

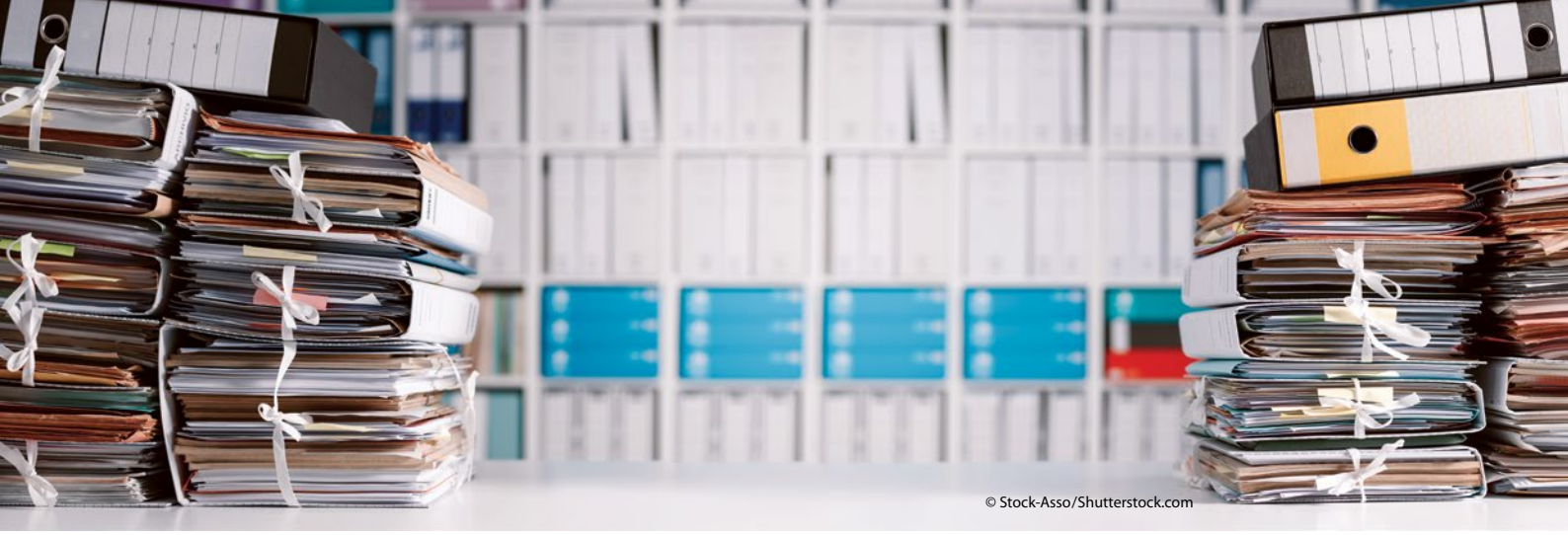
The Growing Importance of RAM

We are witnessing a profound and constant information evolution, which accelerates conflict escalation, driving the requirement for military forces to respond extremely quickly.[4] Furthermore, the constant evolution brought by globalization and changing supply chains requires extra effort from military logistics.

Air Mobility is an essential component of all three elements of NATO's capacity to enhance security abroad: shaping the international environment, responding to crises, and preparing for an uncertain future.[5] Deployments and exercises both require air mobility, in the form of airlift, to transport the required personnel and equipment, and air refuelling. Other activities, such as aeromedical evacuation, are vital in responding to threats and emergencies by strengthening the warfighting capability. Coalition members may need to deploy forces into a theatre of operations quickly or move forces closer to a crisis area.

Both foreign or forward presence and involvement during times of tension need the delivery of supplies and equipment to happen in hours or days as opposed to weeks, a mission particularly well suited for air mobility. At the onset of a crisis, forces may deploy at a smaller scale to accomplish humanitarian

The C-17 is executing rigorous flight manouevres.



The progress of Rapid Air Mobility is being impeded by outdated bureaucratic processes.

assistance, enforcement of no-fly zones, non-combatants evacuations, allies' reinforcement, limited strikes, and military interventions.

Some nations have pursued a version of lean logistics, typically referred to as 'just-in-time logistics'. This was evident during Operations Desert Express, European Express, and Bosnia Shuttle when the aim was to minimize inventory and reduce costs. The closure of depots resulted in an increased reliance on air mobility forces, primarily on airlifters and, to some extent, tankers, to support forward deployed forces and deliver essential and frequently life-sustaining services.

In 2020, allied nations used the RAM initiative to support relief planes transporting critical supplies for the pandemic fighting effort. Another example of RAM activation took place in August 2021 as part of Operation Allied Solace, at the conclusion of NATO's Resolute Support Mission in Afghanistan, facilitating the emergency relocation of NATO-affiliated Afghans and their families.[6] Over the last four years NATO RAM has advanced rapidly but is there room for improvement?

Weaknesses and Obstacles

Several reasons have prevented the use of this key enabler, and one is timing. To be efficient and effective, the RAM process needs to run smoother, more specifically the time from the initial RAM request through SHAPE to execution sometimes takes too long compared with the existing procedures, and thus is unable to meet the delivery date. Additionally, some nations have already signed bilateral agreements with most of the NATO countries or have ad-hoc procedures in place. This ensures that diplomatic clearances are received quickly, often in less than 72 hours, which is less or similar to the RAM process.

For some countries, RAM does not provide much benefit because the standing national system is incompatible with the RAM system used to produce diplomatic clearances and cargo loads. However, more importantly, RAM flights can only be used for narrowly defined purposes, such as missions in direct support of the Very High Readiness Joint Task Force (VJTF).[7]

To summarize, the benefits of using RAM have to increase. Regulations should be more permissive regarding the type of cargo allowed to transport. Furthermore, the SHAPE activation process must be more expeditious to make RAM more relevant.

Conclusions and Recommendations

The air mobility enterprise must increase its responsiveness and flexibility to further integrate into NATO's future operations. Moreover, the air mobility operating environment is dynamic: airspace and airfield access can be restricted by continuously changing factors such as weather conditions, airspace closures, or threats. RAM helps break through those barriers by prioritizing NATO air missions and enabling aircraft to accept rapid re-tasking and even mid-mission replanning. It can also receive new diplomatic clearances while en-route to include alternate destinations. The future air mobility fleet should be prepared to operate in the full spectrum of future environments to

avail of the speed and agility air mobility currently provides to the joint warfighter.

When assessing the current RAM situation, there is evident room for improvement. It would be ideal for RAM to see support in a top-down approach to create a common and broad understanding and ensure implementation. Unfortunately, RAM is not yet matched by operational confidence and efficiency. Too often national processes and procedures are preferred, even by nations that clearly understand RAM's benefits. The following recommendations should be considered to improve and further the adoption of RAM:

- Streamline the staffing process at SHAPE in order to make air mobility truly more rapid.
- Re-evaluate cargo restrictions. Nations should be allowed some flexibility in planning their limited air transport assets.
- Incorporate the technical requirements needed for RAM in all NATO air transport aircraft.
- Encourage and advocate the activation of RAM as a key tool to provide political value by showing the Alliance Unity of Effort.
- Promote RAM at national and international levels, to reach all civil and military stakeholders.
- Ensure the required exercising and training opportunities are available through continued consideration and representation in the NATO Education, Training, Exercises, and Evaluation process.

In order to satisfy the demands of present and future missions, the Alliance needs mobility forces that are ready and capable of operating in the future environment. In a world running fast, NATO has to run faster to be on top. ●

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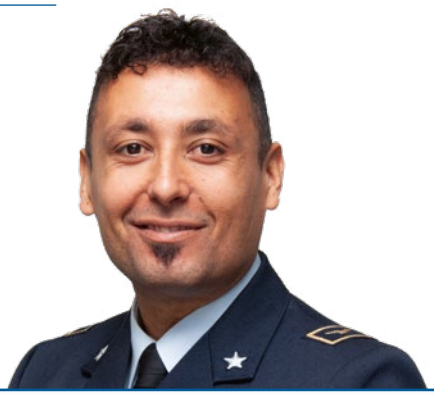

Major Massimo Di Milia

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Major Di Milia joined the Italian Air Force Academy in August 2004, where he obtained a degree in Political Science. In 2009, he started military pilot training at the Specialized Undergraduate Pilot Training School in Vance AFB (US). He later obtained 'Combat Readiness' on the C130 aircraft at the Air Transport Squadron of 46th Air Brigade in Pisa. From 2011, he complemented his training with special skills, e.g. airdrop, air-to-air refuelling, night-vision goggle flight, and assault operations. As a pilot, he was extensively involved in air support missions abroad in Afghanistan 2011–2015, Kosovo 2012, Lebanon 2013, Libya 2014, and Iraq 2014. Furthermore, he participated in a plethora of multinational joint exercises. Since September 2019, he has served in the JAPCC as the Subject Matter Expert for Air Transport.

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Fifth-Generation Intelligence Considerations

Cannot Be Afterthoughts

By Major Joy Lomheim, US Air Force, 613 Air Operations Center ISR Division

Introduction

To unleash the full reconnaissance capabilities of fifth (and future) generation platforms, we need to prioritize and enable their potential for Non-Traditional Intelligence Surveillance and Reconnaissance (NTISR), wherein non-ISR (albeit ISR-capable) platforms are tasked with ISR roles or contribute to ISR concurrently with primary missions. Given NATO's limited ISR coverage, these platforms could provide an invaluable contribution by filling voids in the sensor grid if the fifth-generation community leaders properly prioritize, resource, support, and train NTISR-specific mission-type sets to address other sensor shortfalls. The substantial technological leap of fifth-generation assets brings along a tremendous value for intelligence collection.[1]

To vastly enhance the operational sensor grid demands optimizing such platforms' ISR capabilities. This holds particularly true for NATO and its strained ISR inventory, which only comprises the Alliance Ground Surveillance (AGS) programme's RQ-4D and E-3 Airborne Warning and Control System (AWACS).[2]

The resultant void in NATO's sensor coverage is particularly alarming in today's increasingly contested world, which demands that the Alliance's limited fleet of dedicated ISR assets must expand, namely to include the F-35 Lightning II. Purportedly the 'backbone of NATO', the F-35's enhanced survivability and lethality, even in contested or hostile airspace, will assuredly yield formidable strategic allied advantage, especially if its NTISR capabilities are fully exploited.[3] To mitigate

Maintaining the exclusive focus on primary mission sets, such as Suppression of Enemy Air Defence (SEAD) or strategic attack, overlooks the opportunity for NTISR as a concurrent or dedicated mission.

NATO's ISR shortfalls, F-35 nations must address three issues in parallel: NTISR must be prioritized, intelligence sharing must be expanded, and requisite intelligence training should be offered to all F-35 nations. Without these approaches, such formidable capability is benched, impacting NATO's effectiveness in an increasingly turbulent and hostile world where every advantage counts. Accordingly, NTISR is one compelling option to augment and assure sensor coverage of the vast area that NATO must maintain and defend.[4]

Proposed Solution to the ISR Gap

Prioritizing and utilizing fifth-generation assets (particularly the F-35) in NTISR roles, increasing intelligence sharing, and furthering international training will significantly address current intelligence shortfalls. This is particularly vital for NATO, given its low density of ISR assets and high demand for ISR. The F-35 community, and in particular Joint Strike Fighter (JSF) programme leads, must first demand and prioritize NTISR to becoming a stated mission. Since NTISR is not part of the normal downloading and Processing, Exploitation, and Dissemination (PED) process, incorporating download and PED must be accomplished next. If enabled, NTISR capabilities could help address respective national and NATO intelligence priorities and questions, collection requirements, and gaps. In turn, this would bolster NATO as well as JSF allies' national ISR capabilities and battlespace understanding. The F-35's unparalleled collection and fusion capabilities can amplify the overall ISR effort, especially due to its extended ability to penetrate contested or enemy territory with its low-observable design.[5] Its sensors' extended detection range and infiltrating reach can fill intelligence gaps by delivering an enhanced intelligence picture, including a greater fidelity order of battle and even indications and warnings of pending or forthcoming enemy action.

When embedded into the overall Alliance effort, the F-35 in an NTISR role will substantively bolster NATO's sensor grid and subsequently lead to a more accurate recognized threat picture. However, multiple obstacles persist as the F-35's sensors and ability to fuse a complicated battlespace picture place a new requirement for intelligence, operations, training, and

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systems to synthesize any F-35 collection into useable intelligence. This requirement comes from the F-35's array of complex sensors and fusion that ostensibly produce vast volumes of information. Thus, understanding and truly harnessing the full scope of this capability levies new requirements on the Command and Control ISR community to optimally inform and expedite decision-making. Such requirements include information passage, policy, and architecture to ensure pertinent NTISR collection arrives at the necessary end-users, such as NATO and respective national intelligence organizations.

Obstacles to Implement NTISR as a Solution

Many obstacles continue to impact implementing an NTISR role for fifth-generation assets, as the F-35 was not designed as an ISR platform. Nonetheless, its ISR potential remains substantial, especially for countries who prioritize their ISR capabilities and rely on the F-35 to serve as their (sometimes singular airborne) national ISR platform. Leveraging NTISR could provide a new and supplemental intelligence source to address national and NATO intelligence collection requirements and gaps. Having this additional intelligence contribution could serve several purposes, such as validating the battlespace picture and even producing new collection that addresses intelligence gaps or provides new indications and warning that help deliver strategic advantage. Alternatively, maintaining the exclusive focus on primary mission sets, such as Suppression of Enemy Air Defence (SEAD) or strategic attack, overlooks the opportunity for NTISR as a concurrent or dedicated mission. Despite the selling point of the F-35 as internationally interoperable, which has been achieved in several areas such as aircraft cross servicing, the F-35's potential intelligence role – namely NTISR as a gateway to greater intelligence collection and sharing – remains largely unaddressed.[6]

Dismissing NTISR out of hand as a valuable mission further contributes to overlooking and ignoring NTISR's potential for a more holistic understanding of the battlespace, especially in increasingly contested environments. Consequently, the necessary resourcing and data architecture, to include tasking and processing

frameworks, the right amount of certified analysts, and the requisite systems to store and disseminate finished, shareable intelligence products, etc., remain largely absent. Developing the requisite enterprise to handle these outputs includes funding, resourcing, and establishing procedures to effectively exploit NTISR, especially F-35 ISR capabilities, to provide meaningful novel intelligence to end-users.

However, even if the enablers for the NTISR mission are reached, it does not matter if the collected intelligence is not shared. Another obvious obstacle is the current mentality that favours restricting intelligence sharing and training. NATO nations and partners must therefore adjust governing policies and directives in favour of F-35 intelligence sharing to ensure resilience, achieve day-zero readiness, and enhance allied interoperability. Various efforts and short-term solutions are underway to address some of these shortfalls, but failure to seriously consider and fully address these issues puts NATO and F-35 nations at an exploitable disadvantage. Failure to effectively collect, process, and share operational data that could reveal new intelligence, coupled with the inability to share such intelligence, means that even within NATO, individual F-35 nations will operate on incomplete or different pictures of the operating area. The lack of a comprehensive common intelligence picture must be rectified lest conflicting assessments dangerously confuse, restrict, and even impede executing effective operations. The urgency is indisputable, particularly for the NATO F-35 nations who must already be prepared to operate seamlessly together, especially since full-scale war returned to the European continent early last year.

For NATO and global F-35 users, this broadened intelligence sharing should apply internally across the F-35 community and, when and where appropriate, externally to the entire Alliance. Although allied integration remains a stated priority, current policies and a reigning anti-sharing mentality continue to impede effective integration, leading to lower intelligence understanding of a potential battlespace. The main barrier to lift is a shift in the sharing mentality, to further strengthen the trust in coalition and allied partners. Accomplishing this shift will require supporting national policies to increase pertinent intelligence sharing amongst F-35 nations and within coalitions. Without the right sharing mentality and policies in place, the collected intelligence will not bring the utmost benefit to the coalition or allied forces.

Recommendations

The following recommendations will help to address the identified shortfalls. Firstly, the F-35's NTISR capabilities must be prioritized, operationalized, and enabled. Governing policies and required resourcing must be implemented to establish the necessary PCPAD (planning and direction, collection, processing and exploitation, analysis, and dissemination) requirements as well as architecture to make NTISR collection useful and available to the end-user. Traditional ISR assets, such as the U-2 and MQ-9 Reaper, provide an insightful precedent for executing PCPAD within the Air Force Distributed Common Ground System enterprise.[7]

This model, in terms of framework, operating procedures, and organizational structure, could be leveraged to establish NTISR PCPAD for F-35 collection. Certainly, it should also evolve to assure discoverability, as well as account for discrepancies and unique considerations pertaining to non-traditional versus traditional ISR assets. Moreover, the necessary technical solutions (possibly including infrastructure or networks), applicable intelligence policies, as well as appropriate manning and training must exist to properly handle the significant requirements for exploiting such collection. Addressing this will facilitate PCPAD to ensure integrated vital F-35-sourced intelligence achieves data discoverability within the expanded ISR constellation of today.

Secondly, countries and their respective intelligence services must increase sharing of pertinent intelligence to integrate effectively as allies. To accomplish this, an institutionalized need-to-share approach and corresponding policies must enable the transfer of shareable NTISR products. The F-35's ISR potential provides a compelling argument to reconsider a deeply entrenched anti-sharing philosophy. The NATO Joint ISR community echoes this objective and promotes a

'need-to-share' mentality.[8] The Pacific region, which presently hosts four F-35 nations, also demonstrates this important perspective and asserts the necessity to expand information sharing whereby analysts 'write-for-release' by default.[9] Therefore, in parallel to prioritizing and realizing the F-35's full NTISR potential, intelligence sharing must expand in kind. The global nature of the JSF programme and the increasing number of F-35 nations, particularly NATO nations, require broader intelligence sharing. This need-to-share transition proves exceptionally important for NATO and should be extended across other fifth-generation capabilities, such as the Joint Air-to-Surface Standoff Missiles (JASSM).

To achieve a more open and integrated sharing approach, appropriate policies and information-sharing frameworks must exist or be established. Specifically, changes to governing guidance, networks, systems, and dissemination mechanisms must address existing barriers to ensure the required data arrives at the desired end-user. This can be achieved by addressing several overarching obstacles. First, adjust the current anti-sharing mentality by directing intelligence personnel to more readily share pertinent intelligence with other F-35 and allied nations through more permissive policies. This change should ultimately expedite intelligence sharing. Moreover, enabling systems and network architectures must be established to ensure discoverability of NTISR data or NTISR-derived intelligence and enable dissemination of shareable intelligence to the designated end-users.

Lastly, the necessity of expanded sharing also extends to intelligence training. Until 2022, not even an introductory level F-35 intelligence training existed for non-US F-35 intelligence personnel. Although the USAF F-35 Intelligence Formal Training Unit (IFTU), operating since 2015, asserted that such intelligence training and knowledge has immediate mission impact critical to success, no other F-35 nation, other than the US, had such vital training opportunities

The U-2 and MQ-9 Reaper, which are conventional ISR assets, serve as significant examples of effectively implementing the PCPAD framework within the Air Force Distributed Common Ground System enterprise.

Heightened intelligence sharing and training among NATO nations may lead to achieving true allied interoperability through a shareable NTISR-augmented operating picture.

available.[10,11] Given the indispensability of such training for US military intelligence personnel serving at F-35 units, the recently established F-35 Partner IFTU (PIFTU) at Luke AFB graduated its first F-35 international intelligence students in November 2022.[12] Although this successful effort was the first to internationalize F-35 intelligence training, continued internationalization of pertinent training must continue, enabled by continuous intelligence sharing efforts. The PIFTU provides a common training foundation for F-35 intelligence personnel. However, no basic, intermediate, or advanced international targeting training exists, which also must be rectified. Of note, though NATO offers targeting training, advanced F-35 targeting training – tailored to the platform's low-observable capabilities – is not addressed.[13]

PIFTU illustrates the success of reversing this anti-sharing mentality. Similar fifth-generation intelligence training efforts are ongoing and continue to evolve. This approach toward greater intelligence sharing must happen now to enable vital day-zero interoperability. Therefore, international intelligence training must be holistically incorporated at all echelons into the multinational F-35 programmes from the earliest stages of development. PIFTU is a model helping to shape and ensure that continued efforts endure to provide further follow-on and requisite advanced training opportunities for all F-35 intelligence personnel.

Conclusion

Intelligence considerations, especially fifth-generation platforms' NTISR potential, cannot be an afterthought. Failure to capitalize on their intelligence value prevents NATO from filling crucial sensor gaps. Heightened intelligence sharing and training among NATO nations may lead to achieving true allied interoperability through a shareable NTISR-augmented operating picture. This is particularly true for NATO's most advanced air asset, the F-35. To exploit its full potential, the JSF nations must champion, prioritize, and unleash its NTISR capabilities. Additionally, to ensure NTISR data discoverability JSF leaders must advocate for and facilitate pertinent intelligence sharing, as well as expand international F-35 intelligence training opportunities.

Given that the vast majority of F-35 nations are NATO members, the importance of these intelligence considerations cannot be overstated. Capitalizing on NTISR's unrealized potential requires expanding the F-35's narrow mission focus by including NTISR tasks and shifting the current mentality and policy from a need-to-know to a more inclusive need-to-share approach. Furthermore, it remains of utmost importance that NTISR, increased intelligence sharing, and expanded training are established well in advance of conflict to guarantee day-zero interoperability. Neglecting to properly consider and address the vital role of intelligence, especially for NATO and the F-35 community, foregoes an opportunity to enhance Allied decision advantage and lethality – particularly in today's increasingly opaque and contested world of near-peer competitors capable of jeopardizing freedom and security worldwide. ●

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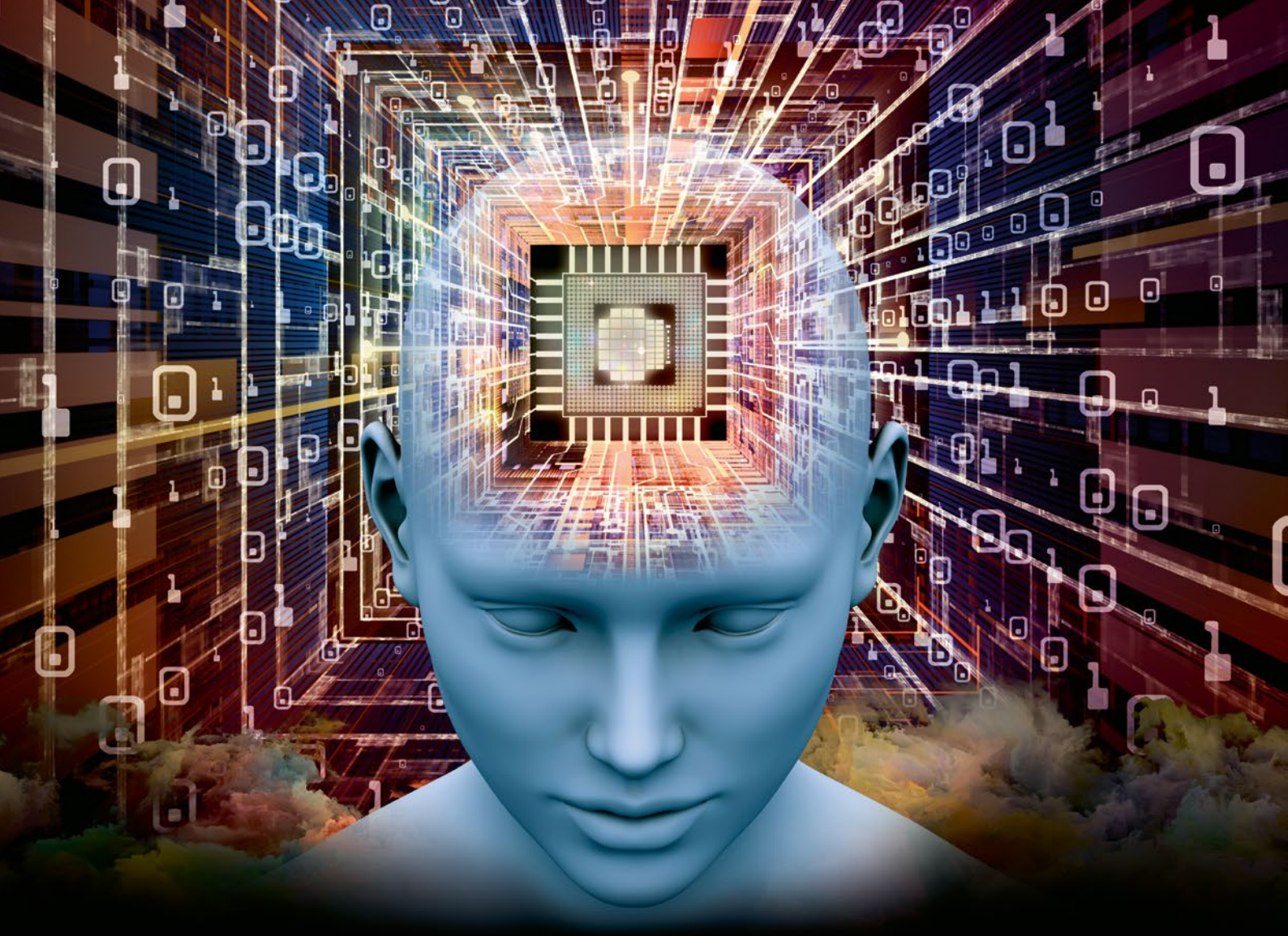


Towards Intelligent Flight Simulator Training

A Multimodal Cognitive Approach

By Assoc. Prof Dr Murat Perit Çakır, METU TAF Modelling and Simulation Centre
By Colonel Gökhan Gürakar, TÜ Air Force

Introduction

Recent developments in neurophysiological sensor technologies have enabled the development of wearable and portable devices, leading to new research areas such as neuroergonomics.[1] Prior work in this field foreshadowed great promise for decoding the mental states of pilots/operators, including changes in mental workload, vigilance, and drowsiness.[2] In particular, studies utilizing brain imaging sensors, such as electroencephalography and functional Near-Infrared Spectroscopy (fNIRS), have demonstrated that

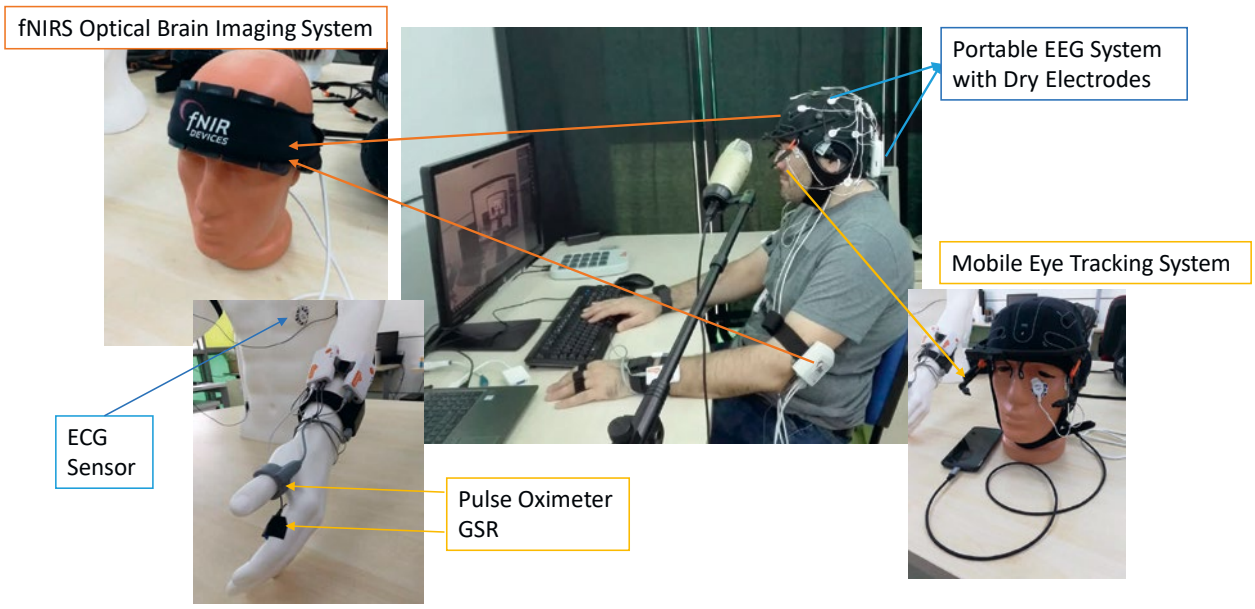


Figure 1: The placement of the sensors used in the Genius pBCI system.

certain measurements enable objective assessment of key cognitive states underlying pilot's performance. The changes observed in neurophysiological signals during stressful or cognitively demanding phases of flight give further insight into pilots' performance.[3] Such findings have opened up the possibility of developing passive Brain-Computer Interface (pBCI) applications that can infer and adaptively respond to the cognitive status of pilots by monitoring their neurophysiological signals in relation to performance indicators logged in a simulation system.[4] Such pBCI systems have the potential to enable the development of personalized training simulators for optimized learning and improved man-machine interaction via adaptive interfaces that can help pilots prioritize tasks and manage information complexity.

There are multiple technical and methodological challenges to monitoring pilots' physical and cognitive states in real-time conditions, as well as in simulator training situations, via pBCI applications. Firstly, to aid interpretation of the neurophysiological signals and facilitate performance assessment, appropriate task scenarios and task performance models need to be developed. Secondly, the technical infrastructure must synchronize heterogeneous data streams, develop methods for processing and cross-checking signals originating from different body parts at various spatial and temporal scales, and ensure good data quality without sacrificing operators' comfort. Finally, finding appropriate ways to fuse neurophysiological data with machine learning and artificial intelligence techniques, devising measures for real-time assessment of pilots' cognitive states, and translating pBCI-enhanced training into the real world are considered higher-level challenges.

In an ongoing research project, we have been integrating several neurophysiological sensors with a high-fidelity flight simulator to develop a pBCI system that optimizes flight simulator training for fighter pilots. In this paper, we provide an overview of related efforts in utilizing neurophysiological measures in aviation and summarize our preliminary findings and observations regarding the technical and organizational challenges involved in the design, development, and deployment of such a pBCI system. We

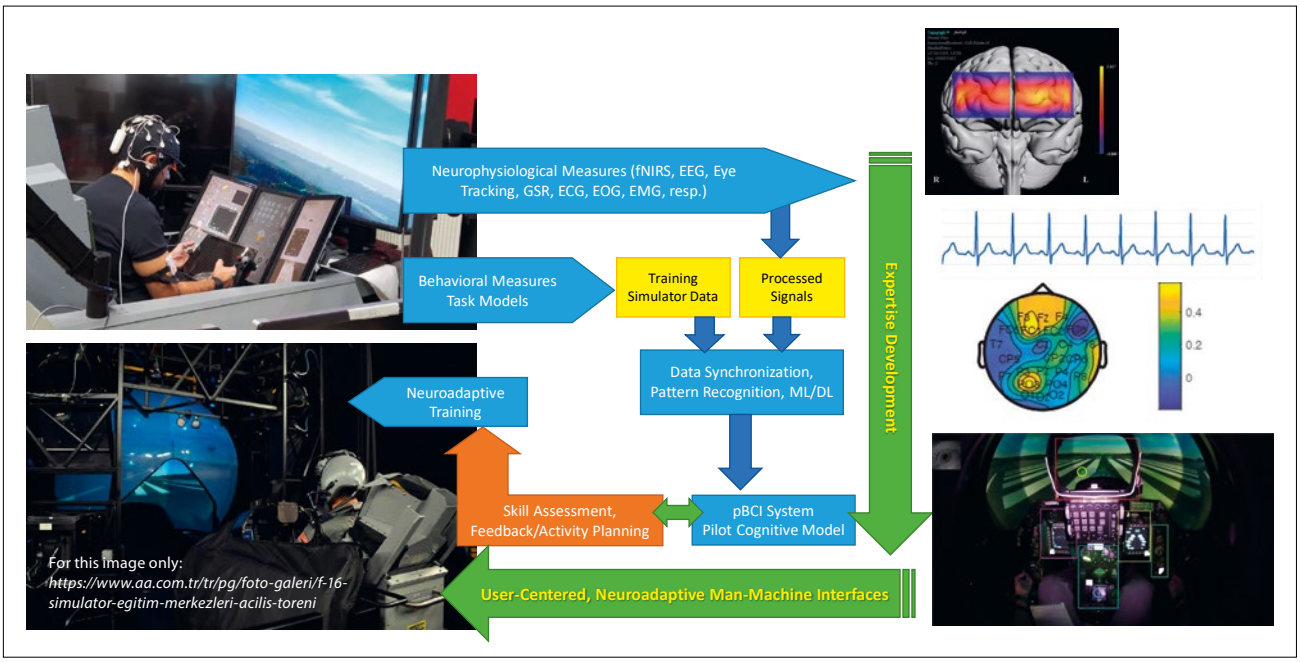


Figure 2: Overview of the GENIUS pBCI flight simulator training system.

further discuss potential ways of contributing to next-generation training concepts for the Turkish Air Force or other Air Forces.

Pilot Cognitive State Assessment

Human factors such as cognitive workload, situational awareness, stress, divided attention, vigilance, mental fatigue, drowsiness, and incapacitation are generally listed among the fundamental cognitive processes and states that play a decisive role in pilots' performance.[5] Although modern avionics systems assist pilots by reducing the cognitive and physical loads, piloting is still a cognitively demanding task. In particular, piloting tasks significantly burden attentional and working memory resources, especially in mission-critical phases of flight such as take-off, landing, or target engagement, as well as in unexpected events such as emergencies or instrument failures. Such an increase in mental workload may lead to the loss of situational awareness and, eventually, mishaps when tasks consume the available cognitive resources. According to ICAO (2022) safety reports, high-risk categories of incidents (including loss of control in flight, runway incursions/excursions, and mid-air collisions), which are closely associated with cognitive factors, constituted 10.4 % of all incidents and 100 % of the fatal accidents in 2021.[6,7]

Flight simulators play a critical role in modern aviation training as they allow pilots to master flight procedures, controls, and avionics interfaces in a realistic but safe environment. In addition, flight simulators provide a safe environment for training on emergency procedures that can be extremely dangerous to attempt during actual flight. Pilots are expected to develop the much-needed skills for mastering interfaces and appropriate task prioritization to handle mentally demanding situations and use their cognitive resources effectively. Simulators also provide a controlled environment where progressive task sequences can be repeated, thus creating opportunities for devising measures to monitor and assess learning.

Although studies on simulator training suggest that the skills acquired in these environments have positive implications on real task performance, innovative approaches are needed to increase effectiveness.[8] In the aviation domain, the mental workload is typically studied with behavioural methods. The NASA Task

Load Index[9] is a popular instrument to develop a subjective measure of pilots' workload by asking the pilots to rate their experience along specific constructs. Such ratings are often associated with other performance measures, like the level of mental workload elicited by a given task.

Another common subjective method of assessing pilots' workload is through the deliberate assignment of secondary tasks, such as mental arithmetic exercises or initiating additional air traffic control queries while the pilot is engaged in his primary piloting task. Under such settings, some pilots' primary task performance may decrease significantly, indicating their lack of cognitive resources to spare for the extra task. This suggests that some pilots must allocate most of their cognitive resources to the main piloting task, with little cognitive reserves for reacting to unexpected events or emergencies. It has been observed that as pilots gain experience they tend to perform better in

multitasking scenarios, which is often attributed to their improved cognitive capacities.[10] However, the difficulties arising from the objective characterization of cognitive states and capacities solely from behavioural data, and the questionable validity of some of the secondary tasks imposed relative to the aviation domain, have spurred research for alternative methods based on the neurophysiological underpinnings of the related cognitive processes.

Neurophysiological Underpinnings

The need for more objective measures to monitor cognitive states has motivated the use of various neurophysiological sensors. Existing studies have utilized electrocardiogram, electromyogram, Galvanic Skin-Conductance Response (GSR), electrooculogram, eye tracking, electroencephalography, and fNIRS to measure parameters such as heart rate variability, muscle contractions, electrodermal activity, eye movements, brain oscillations, and cerebral oxygenation changes.[11] These studies focused predominantly on a single or a small number of sensors to explore neurophysiological correlates. For instance, increased heart rate variability, rate of respiration, GSR amplitude, lateral prefrontal cortex oxygenation, and power in specific electroencephalography bands are associated with increased mental workload. Eye movements also provide important information regarding changes in attentiveness and mental workload levels. Observed findings suggest that an increase in mental workload

is associated with a decrease in the rate and duration of eye blinks and an increase in gaze durations. Altogether, these sensors offer different perspectives on pilots' mental workloads.

Comparing the neurophysiological responses of different pilots to changing task conditions can bring further insights into the level of experienced cognitive load. This can help us better identify why some pilots' performance dramatically degrades when introducing a secondary task. For instance, oxygen consumption in the prefrontal cortex of the brain, as measured by fNIRS, can be an indicator. Two pilots performing at the same level during the single-task scenario may have significantly different prefrontal oxygenation trends. The pilot consuming more prefrontal oxygen will be more likely to have difficulty coping with the secondary task than the other pilot who can perform the task with less oxygenation. Moreover, the struggling pilot's eventual disengagement from the task can be observed as a sudden drop in prefrontal oxygenation.[12] In addition, after repeated exposure to the tasks through training, systematic decreases in prefrontal oxygenation are also observed along with improved performance.[13] Therefore, such measurements have the potential to improve secondary task-based subjective evaluations by providing objective indicators for cognitive workload and learning assessments.

Prior work in neuroergonomics has demonstrated neurophysiological sensors' potential for measuring pilots' cognitive states in simulated and live flight settings. There are many challenges to collecting objective data, such as differences in individual ability and experience, and contextual factors that heavily influence the interpretation of mental workload-related measurements.

Unimodal measures such as changes in heart rate, respiration rate, pupillometry, and prefrontal oxygenation can be equally influenced by physical load, muscle fatigue, ambient light conditions, motion, or noise. Some of these challenges can be addressed with offline signal processing techniques. Still, such techniques may not be suitable for real-time application. The sensors also measure at different temporal and spatial resolutions, requiring additional data normalization and fusion procedures to enable real-time cognitive state monitoring. Finally, prior studies have also demonstrated that the neurophysiological responses to different workload levels might change with practice.[13] This opens the possibility of utilizing such measures to monitor expertise development. Still, it also complicates identification of thresholds defining mental workload levels.

A Multimodal Approach

The challenges mentioned above highlight the need to integrate neurophysiological sensing modalities to improve the robustness and accuracy of pBCI applications and, ultimately, aid flight simulator training. To enrich flight simulator training with multimodal neurophysiological data, we have conducted a research project titled 'Cognitive Workload Monitoring for the Personalization of Flight Simulator Training (GENIUS)', supported by the Presidency of Defence Industries and the Turkish Air Force. The goal is to build a multimodal cognitive state-monitoring application that provides a scientific basis for assessing expertise development during simulation training and developing intelligent, personalized training systems. For this purpose, we developed a system that collects data wirelessly from several wearable sensors in tandem with ambient sensors and streaming flight data from the simulator. The sensors are synchronized and integrated with the flight simulator data.

A total of 42 F-16 pilots were recruited during the data collection stage; they were split into three groups (i.e. beginner, intermediate, and advanced) based on their flight hours. After installing the sensors, the pilots had to perform a full-flight F-16 simulator mission, which included basic flight manoeuvres, air-to-air, air-to-ground strike tasks, and a return-to-base episode under zero visibility and light turbulence conditions. Also, they had to engage an enemy aircraft at the beginning of the session under poor visibility conditions.

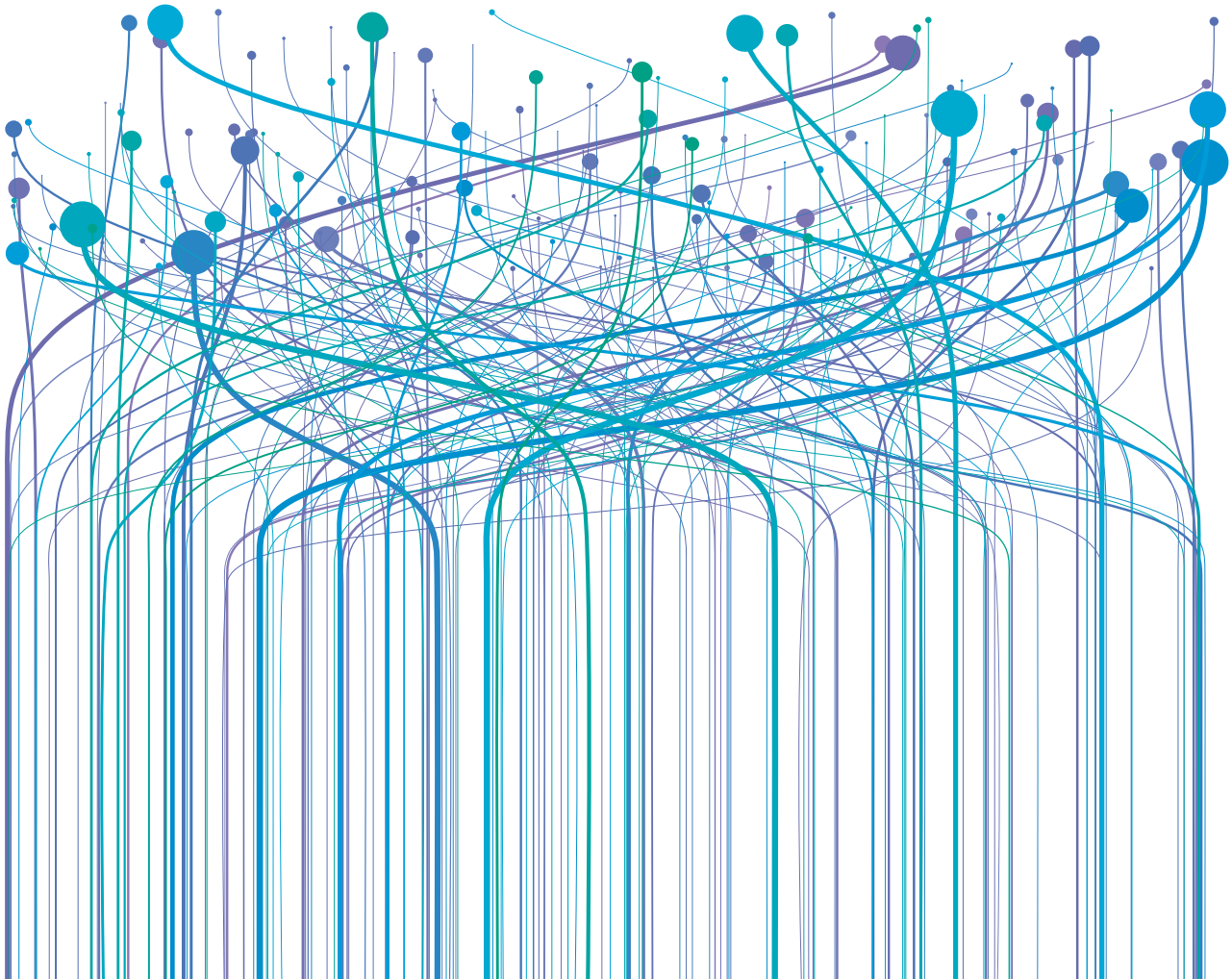
Our initial data analysis included a multistage feature extraction process where each sensor's output is

screened and pre-processed for possible artefacts. The raw signals are then converted into higher-level measures such as cortical oxygenation changes, alpha/beta/theta frequency power, eye dispersion, phasic/tonic responses, blink rate, pupil diameter changes, heart rate variability, respiration rate, head movements, and muscle activity on the arms, around the neck, and eyes. Further, the signals were resampled for multimodal analysis in sliding time windows and labelled based on the scenario episodes and events observed in the flight recordings. Finally, machine-learning techniques were employed to detect changes in the mental workload, physical workload, disengagement, and stress levels.

Significant insights were gained from our initial results. We observed that having multiple modalities allows fast crosschecks across sensors and optimizes the required number and type of sensors. By integrating such measures with training tasks and clear performance goals, we aim to develop an intelligent flight simulator that can guide the trainees based on a multimodal assessment of their behavioural and neurophysiological responses and, consequently, to personalize pilots' training regimen according to the deficiencies identified by the pBCI system. We expect multimodal analysis of mental workload changes to be a vital component of a system of this type due to its relevance in assessing pilots' performance. We also plan to expand our dataset by covering the development of the same group of pilots over time and by involving pilots from different platforms to better account for expertise and platform dependency.

Way Ahead

Based on our initial findings, we expect the wealth of information on pilots' cognitive states that can be obtained from neurophysiological sensors to significantly impact fighter pilot training and, potentially, selection practices in the near future. The possibility of integrating such measures into existing Augmented Reality/Virtual Reality (AR/VR) sets can bring personalized and effective training opportunities in a variety of live and simulated contexts. Moreover, recent developments in flexible electronics and advanced sensing materials increase the probability of integrating neurophysiological sensors into the real cockpit, in



the near future, with minimal discomfort for the pilot, to enable monitoring health and cognitive states during live flight.

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In 2021 he returned to TÜ AF HQ as Chief of the Air and Space Power Development Centre.

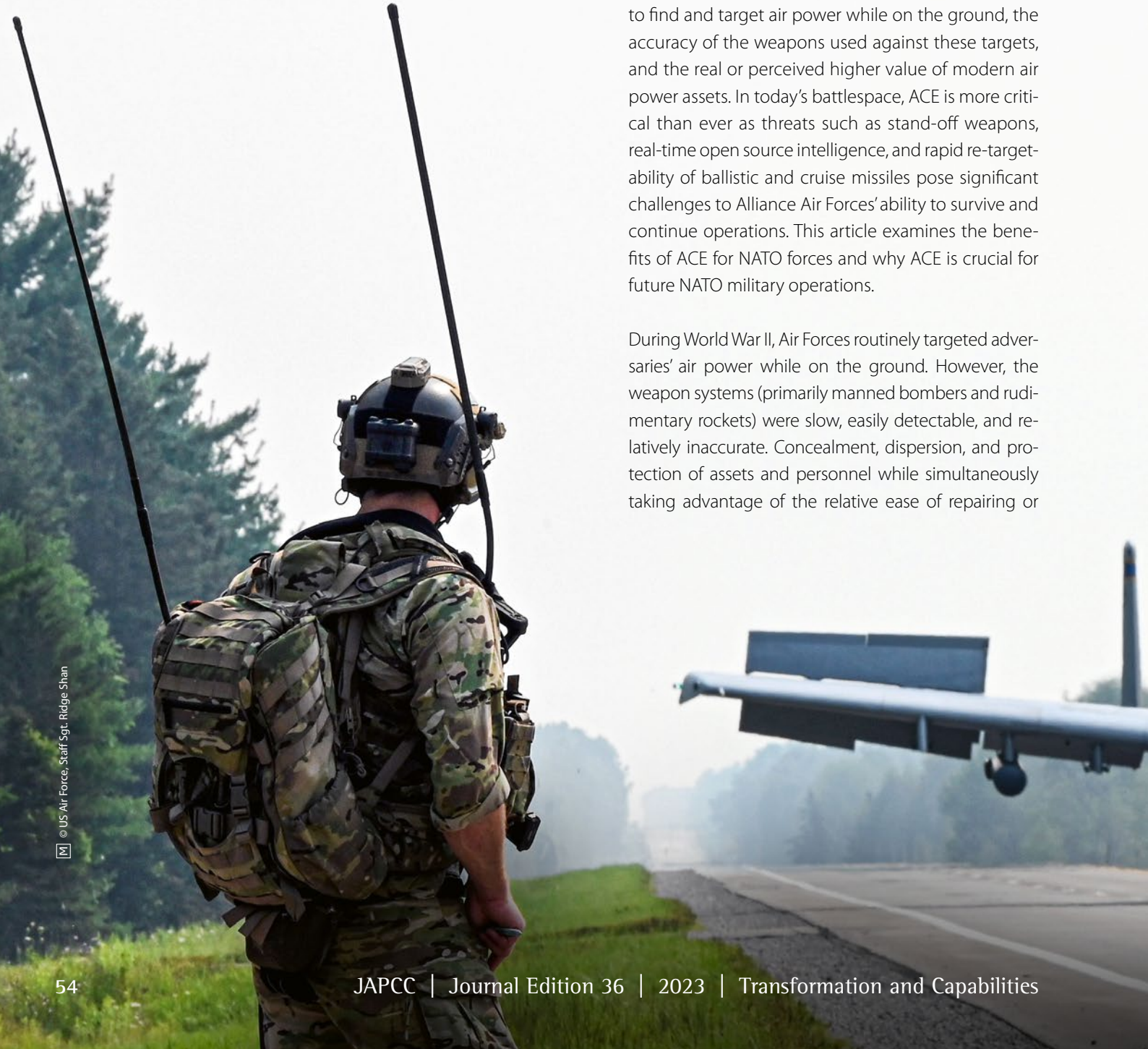
Agile Combat Employment

The Next Big Thing for NATO Air Power

By Lieutenant Colonel Isaiah Oppelaar, US Air Force, JAPCC

The concept of Agile Combat Employment (ACE) may not be entirely new nor radical, but the complexities of modern warfare necessitate a number of modifications resulting in a more nuanced and innovative approach. Defined by the USAF's Doctrine Note 1-21 as a 'proactive and reactive operational scheme of manoeuvre executed within threat timelines to increase survivability while generating combat power'; the core tenets of ACE have always been a requirement for both US and NATO forces.[1] However, the differences now are the reduced time for adversaries to find and target air power while on the ground, the accuracy of the weapons used against these targets, and the real or perceived higher value of modern air power assets. In today's battlespace, ACE is more critical than ever as threats such as stand-off weapons, real-time open source intelligence, and rapid re-targetability of ballistic and cruise missiles pose significant challenges to Alliance Air Forces' ability to survive and continue operations. This article examines the benefits of ACE for NATO forces and why ACE is crucial for future NATO military operations.

During World War II, Air Forces routinely targeted adversaries' air power while on the ground. However, the weapon systems (primarily manned bombers and rudimentary rockets) were slow, easily detectable, and relatively inaccurate. Concealment, dispersion, and protection of assets and personnel while simultaneously taking advantage of the relative ease of repairing or



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replacing damaged aircraft were critical in reducing the enemy's effectiveness. During the Cold War, a large number of airbases with dispersed forces, fortified shelters, integrated air defences, and alert fighters able to intercept inbound bombers mitigated the threat from conventional weapons while deterring the threat of a nuclear strike with an assured second-strike capability. Modern systems are complex, expensive, easily damaged, and in almost all cases cannot be easily or quickly replaced. Concurrently, the Alliance has consolidated its forces onto fewer and more concentrated airfields, partly due to the high infrastructure costs and the reduction in the size of fleets. As an example, the USAF has reduced 65 % of its overseas military air bases since the end of the Cold War.[2] Thus, the resultant vulnerability and continued requirement to ensure the survival and protection of all Allied weapon systems during hostilities necessitates a posture that minimizes on-ground losses.

ACE is the US Air Force's solution to this problem set. According to the AFDN 1-21, 'ACE complicates the enemy's targeting process, creates political and operational dilemmas for the enemy, and creates flexibility for friendly forces'.[3] Once again, this is neither new nor innovative. However, with persistent overhead imagery, global air surveillance capabilities, the ease of locating on-ground assets using open-source tools, and the rapid re-targetability of modern hypersonic and ballistic missiles, the challenge for Alliance forces is much more difficult to overcome. The USAF states that 'to achieve freedom of action, ACE enables convergence across domains, presenting an adversary with dilemmas at an operational tempo that complicates or negates adversary responses and enables the joint force to operate inside the adversary's decision-making cycle'.[4]

Agility at Tempo is the Challenge

Modern weapon systems are complex and highly capable; however, they are generally not 'agile', requiring significant support in airlift, maintenance, logistics, and off-board mission planning or mission systems processing. For instance, ISR platforms, such as the RC-135U, require exquisite on-ground capabilities to download the collected data for processing and upload the required mission profiles to enable execution. Modern 5th generation platforms require unique systems to consolidate threat information, plan routings around or through integrated air and missile defence, and complete deliberate air-to-surface targeting. Without these on-ground capabilities, the effectiveness of the airborne system is reduced significantly. To ensure the continued effectiveness of these airborne assets, units must develop the capability to reposition the weapon systems' ground support elements. Most modern allied aircraft can no longer land on a highway somewhere and refuel, re-arm, maybe patch a few bullet holes, and resume the fight as effortlessly as in the past. The Alliance needs to develop options that enable and preserve the successful generation of air power.

Building new, alternate air bases around the world is a difficult and undesirable solution. So how can a highly complex force, with a long logistics trail and a limited number of personnel, operate with agility in a dynamic and unpredictable battlespace? The USAF's answer is a combination of base clusters, multi-capable airmen, interoperability with allies and partners, and mission command. Base clusters provide pre-defined and geographically grouped locations capable of mutual defence, mutual support, and unified Command and Control (C2). Multi-capable airmen are functional specialists with basic capabilities in related fields, such as avionics specialists trained in basic aircraft refuelling. Interoperability with allies and partners provides the capability and framework for weapon systems from one nation to recover and regenerate at a location operated by another nation. This interoperability includes not just 'Basic Cross Servicing', but also 'Mission Cross Servicing', including weapons handling.[5] The final and most challenging component is mission command, which is a leadership concept of empowering subordinates at the lowest capable level to make decisions and take decisive action under 'mission-type orders' thus enabling combat operations to continue amid degraded communications and without higher-echelon's guidance.[6]

Impact on NATO Air Power

The current operational challenges and global threats are not unique to US forces. NATO nations and partners demonstrate similar vulnerabilities stemming from interoperability issues, conventional and reliable force structure, and reliance on centralized command and control.

NATO nations must decide how best to focus efforts and resources. The USAF specifically emphasizes the need to 'create steady-state and contingency authorities with partner nations which allow for: overflight, direct coordination with host nation defence, [and] staging of material/equipment'.[7] NATO can certainly justify a complete re-vectoring of air power capabilities towards agility and resilience.

The NATO Defence Planning Process states that no nation should provide more than 50% of any single Alliance capability.[8] Although this limitation does not specify the precise contributions of a nation during a NATO operation, it does increase the likelihood that non-US NATO members will execute a significant portion of the mission. In a high-intensity, high-threat conflict where only US units are trained and equipped to execute ACE, the non-US portion of the Alliance's capabilities, deployed at unprotected and predictable fixed locations, may be more vulnerable to adversary action.

Nevertheless, there are many other ways for NATO to support the ACE concept. Several nations are currently replacing obsolete F-16s with modern F-35A aircraft. As the older aircraft are retired, these nations may have to return the ground support equipment and spare parts to the US if required, under their Foreign Military Sales programme. If used in support of the NATO ACE concept, these logistics components could be reallocated to remain in Europe and provide a powerful and cost-effective solution to at least a portion of the required pre-positioned, staged materiel.

Additionally, the F-16 operating nations transitioning to F-35 could continue to exercise the skills required to service F-16s, maintaining an acceptable interoperability level for these capabilities along with the additional interoperability for F-35. These options, keeping F-16 support equipment and maintaining aircraft cross-servicing skills, would enhance the NATO ACE mission considerably.

The NATO ACE Concept

NATO adopting the ACE concept Alliance-wide would offer several key advantages. First and foremost, it would increase the Alliance's ability to project air power promptly and effectively, particularly in regions where airbases may be limited or difficult to access. This is especially important considering the current geopolitical situation, with the ongoing war in Ukraine and the ever-present threat of conflict.

Furthermore, ACE provides a means of operating in contested airspace, which is becoming increasingly prevalent as potential adversaries develop advanced Anti-Access/Area Denial (A2/AD) capabilities.

ACE reduces the risk of having all air assets concentrated in a single location by allowing aircraft to operate from various dispersed locations. This, in turn, increases the survivability and resilience of NATO Air Power.

Another advantage of ACE, in theory, is its ability to morph the logistical burden associated with deploying and sustaining air assets. By enabling aircraft to operate from a broader range of locations, ACE may reduce the need for large, centralized bases and the associated support infrastructure, lowering the strategic value of any particular airbase in the target list of a potential enemy. If planned and executed effectively, with proper training and prepositioned support equipment, this concept not only reduces the cost and complexity of deploying air power but also increases the flexibility of NATO's air operations, as aircraft can be rapidly repositioned to respond to changing operational requirements with only a minimal support element. However, if not planned, trained, and executed correctly, the cost and complexity of the ACE concept can increase exponentially. In either case, there is an inherent risk associated with lean, forward logistics resulting in the reduced capability to sustain, repair, or replace damaged equipment.

Finally, embracing an ACE-like concept increases interoperability between NATO and its allies. By adopting a common approach to air power projection and sustainment, the Alliance will improve its ability to operate in a coordinated and effective manner. This can be particularly important in multi-domain and joint operations, where coordination and integration of different capabilities can be challenging and a high degree of synchronization and adaptation is required. NATO already prioritizes standardization and interoperability, adopting an ACE concept for NATO further supports this goal.

Challenges Remain

Implementing ACE requires a substantial shift in thinking and the development of new tactics, techniques, and procedures with the consequent impact on training requirements. Furthermore, it requires significant investment in infrastructure and equipment to support dispersed operations. For some NATO members, the financial burden of implementing ACE may be prohibitive.[9]

Additionally, ACE may not be suitable for all NATO members, as their military capabilities and geographic circumstances vary widely. Some NATO countries may lack the necessary aircraft, equipment, and personnel to implement ACE, while others may have well-protected airbases that can effectively support resilient air operations. In addition, some NATO members may face challenges in securing the necessary host nation support and access agreements to establish dispersed airbases, particularly in regions with high international political tensions.

USAF Airmen perform hot-pit refuelling on an F-35A Lightning II assigned to Eielson AFB, Alaska, at Northwest Field as part of Agile Combat Employment (ACE) multi-capable Airmen training during Cope North 21 at Andersen AFB, Guam, 16 February 2021. ACE, the new warfighting concept that Pacific Air Forces is operationalizing ensures agility, deterrence, and resiliency in a contested or degraded environment.

Finally, implementing ACE may present operational challenges in terms of coordination and logistics. Dispersed operations require a high degree of coordination and communication between units, which can be challenging in high-stress, high-tempo combat environments. Furthermore, the dispersed nature of ACE operations can increase the logistical burden associated with maintaining and sustaining air assets, as well as the need for frequent and rapid repositioning of aircraft.[10]

ACE and MDO

The ACE concept, which both supports and relies on the future Multi-Domain Operations (MDO) concept, can provide the Alliance with freedom of manoeuvre and deter enemy action by complicating adversary's planning by presenting dilemmas and operational ambiguity. However, many NATO nations can significantly enhance their ability to project air power by incorporating the ACE concept into their operations. This concept is not new, since NATO forces demonstrated similar operational capabilities throughout the Cold War.[11] The differences now are the speed of the adversaries' targeting and decision cycles, the ease of adversary weapons' re-targeting, and the increased accuracy. ACE, as currently envisioned by the USAF, seeks to manoeuvre across all domains, inside of adversary targeting timelines, increase ambiguity, and challenge the assumptions of their decision-makers, driving decisions favourable to the US and allies.

The ACE concept aligns closely with the MDO approach, which military organizations worldwide are increasingly adopting. MDO is an operational concept that seeks to integrate different domains of warfare (i.e. air, land, maritime, space, and cyber) to achieve a synergistic effect greater than the sum of its parts.[12] In this context, ACE can support MDO in several ways:

1. Enhanced Agility and Flexibility: The ability to rapidly respond to emerging threats and exploit opportunities is critical to achieving successful MDO. ACE can increase the agility and flexibility of air power, allowing it to be rapidly deployed and sustained in austere and contested environments.
2. Dispersed Operations: Adversaries normally will target centralized airbases as a means of disrupting operations, which would undermine the effectiveness of MDO. ACE enables dispersed operations, allowing aircraft to operate from a variety of locations and reducing the risk of having all air assets concentrated in a single location.
3. Integration with Other Domains: Integration of different capabilities across multiple domains is a key tenet of MDO. ACE can enable closer integration of air with the other domains, such as ground and maritime, by providing a means of rapidly deploying air assets to support.
4. Agile Forward Logistics: The need to responsively deploy, forward-deploy, and sustain forces at multiple location while executing operations across domains can place significant strain on logistical

capabilities but is necessary for MDO. Training and exercising agile forward logistics elements, to include multi-capable airmen and pre-positioned support equipment, minimizes the requirements for deploying and sustaining air elements, enabling agility for forward forces.

5. Improved Interoperability: ACE can enhance interoperability between NATO members and allies by adopting a common approach to air power projection and sustainment.

Conclusion

NATO has only recently begun exploring MDO due to the recognition that joint operations are no longer sufficient to achieve the strategic level effects necessary to coerce an adversary. With interoperability at its core, NATO MDO is the orchestration of military activities across all domains and environments, synchronized with non-military activities, to enable the Alliance to deliver converging effects at the speed of relevance.[13] ACE is one of the key enablers of this operational concept. As the Alliance continues to develop the MDO concept, NATO ACE will most likely be the best and most effective 'proactive and reactive operational scheme of manoeuvre executed within threat timelines to increase survivability while generating combat power'.[14] In short, ACE is crucial for future NATO military operations to assure survivability and sustained combat generation in a future high-threat, high-intensity conflict. ●

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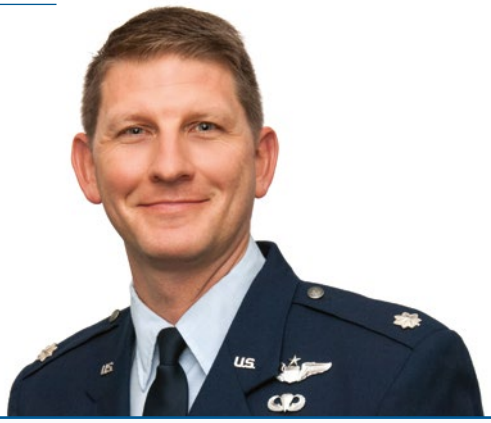

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The Heart of Decision Superiority

Evolve or Lose – Why Your Next War May Be Won or Lost in Seconds

By Colonel (ret.) Anthony Bellione, US Air Force

> *'The question is not whether NATO will need to evolve and develop its C4ISR capabilities but whether it can do so in time to meet the gathering threats to the Alliance.'*
>
> General James Cartwright,
> Former Vice Chairman of the Joint Chiefs of Staff

Vignette

Imagine you are a leader in a high-stakes operation where every decision matters and time is of the essence. Your eyes in the sky, a long-endurance RQ4 Unmanned Aerial Vehicle (UAV) meticulously scans the vast battlefield providing real-time, high-resolution imagery while maintaining persistent surveillance. Meanwhile, an Unmanned Underwater Vehicle (UUV) vigilantly patrols beneath the waves. Its advanced sonar, and Artificial Intelligence (AI) algorithms autonomously identify and neutralize treacherous sea mines. Up in the stratosphere, a Zephyr high-altitude platform station maps the ground below, meticulously tracking moving objects and providing unparalleled situational awareness, while small movable CubeSats satellites in low Earth orbit provide remote areas secure 5G internet via ground transceivers, allowing instant communication between soldiers, vehicles, planes, and ships. Close to the ground, the V-BAT Future Tactical Unmanned Aircraft System offers another set of vigilant eyes equipped for persistent aerial reconnaissance for ground combat and special forces teams. Behind the scenes, advanced AI systems process and analyse the avalanche of data from these advanced Intelligence, Surveillance, and Reconnaissance (ISR) systems turning data

into action-able intelligence. At the same time, a multi-domain, battle management network fuses the data and connects the right sensors to the right shooter regardless of the domain. In seconds, the X-47B unmanned combat air vehicle, serving as a loyal wingman to a B-21 bomber on another mission, receives a new tasking derived from the critical information provided by the network – mission accomplished.

What once took days or weeks of meticulous planning is now accomplished in seconds. Each advanced ISR system draws out patterns and offers predictions, cutting through the noise and emphasizing critical information allowing quicker, more precise decisions, and highlights why decision superiority is essential. Achieving military decision superiority relies heavily on the ability to make swift and informed decisions that outmatch those of the enemy. A crucial element in this process is having exceptional ISR capabilities.

Why Decision Superiority?

Decision superiority is achieved when a military force has better situational awareness, a more efficient decision-making process, and greater adaptability allowing for faster decisions than its opponent can react. Decision superiority means military forces own the decision advantage, allowing them to outwit and outmanoeuvre their adversaries and improve battlefield performance. Decision superiority melds advanced technology with cutting-edge sensors, platforms, and communication systems to efficiently collect, process, and precisely transmit data. You achieve decision superiority when you take advantage of superior information and convert it into knowledge that can be acted on by the right decision-makers. However, too much data is a liability too. Militaries that do not learn to integrate and fuse disparate data sources will become victims to information overload, decreasing operational effectiveness. Those who avoid this mistake will successfully prevent disruptions and enhance their mission-critical systems' overall performance.

Advanced ISR systems grant militaries a competitive advantage by enabling a force to outperform its opponents in decision-making by exponentially increasing situational awareness. Cutting-edge air, land, sea, space, and cyberspace ISR systems provide intelligence about an adversary's capabilities and activities, allowing users to prioritize and take prompt action. Advanced surveillance systems, like the NATO AGS (Alliance Ground Surveillance), greatly enhance troop deployment, enemy engagement, and friendly force protection.[1] Military forces can ensure decision superiority by leveraging innovative sensor technologies and embracing advanced Battle Management Command, Control, Communications, and Intelligence (BMC3I) concepts, thereby effectively closing the OODA (Observe, Orient, Decide, Act) loop. This approach significantly enhances multi-domain ISR warfighting and mission success.[2]

Leveraging Advanced ISR

One of the hallmarks of decision superiority is situational awareness and clarity. Decision superiority requires current, accurate information from multiple verified sources, risk-taking, and failure-learning. Commanders must act quickly to seize opportunities and counter threats while being flexible in their plans and decision-making. To stay ahead of an adversary's evolving technology and tactics, ISR systems must be adaptable to add value to the decision-making process.

Advanced ISR systems can enhance freedom of manoeuvre and resource allocation for commanders by providing a comprehensive battlespace understanding. For instance, persistent high-altitude ISR systems, like the RQ4 UAV, operate in potentially hazardous or inaccessible areas enabling the identification and tracking of enemy forces over extended durations. The RQ4 can also evaluate friendly fire efficacy and offers real-time updates to intelligence analysts. For future-minded military organizations, it is crucial to maintain focus on investing in and developing innovative ISR systems. This forward leaning approach will help maintain a decision advantage, improve situational awareness, and enhance operational efficiency.

Leveraging innovations such as a Multi-Domain Command and Control (MDC2) or BMC3I concepts, the alliance can forcefully disrupt adversaries across all domains, creating unrelenting dilemmas and empowering the leadership to dominate the battlespace decisively. Utilizing MDC2, BMC3I, and ISR, the alliance does not just respond to but exploits an adversary's actions. This proactive strategy reshapes the conflict's landscape, putting an alliance firmly in command.

The Kratos XQ-58 Valkyrie UCAV designed by Kratos.

Innovate Training to Win

To effectively adapt to modern warfare and utilize advanced ISR systems, military forces must foster a culture of innovation and invest in comprehensive training programmes. Additionally, military forces must prioritize innovation and calculated risk-taking to adjust to the ever-changing nature of warfare. A culture of innovation means leaders must resource and encourage creative thinking, reward initiative, and provide opportunities for ISR professionals to experiment with new tactics, techniques, and procedures.

By embracing a culture of innovation for ISR, military forces can develop novel approaches to leverage ISR capabilities and outmanoeuvre their adversaries. Instilling a culture of risk-taking also requires risk tolerance, accepting that some actions may not pay off. Calculated risks are a trade-off of risk-reward and avoidance of a catastrophic error. The best way to instil a risk-taking and risk-tolerance culture is to start from the top. Senior leaders must be willing to take risks by creating an environment where forces feel comfortable taking calculated risks, considering the potential for failure. One way to do this is to create a 'learning environment' where everyone is encouraged to learn from mistakes. In such a learning environment, failures should be viewed as opportunities to learn and improve. In support, tailored training programmes are required to educate staff members on the complexities of advanced ISR systems, to learn and master the use, interpretation, and analyses of the vast amounts of data that these systems provide. As US General Stanley McChrystal, former commander of forces in Afghanistan, stated 'Information is only of value if you give it to people who can do something with it'.[3]

Just as computers profoundly impacted our lives, changing how we work, learn, and communicate, ubiquitous advanced ISR systems with the data they provide will change how militaries will fight the next conflict. For advanced ISR systems to be effective, training must include understanding the capabilities

and limitations of integrating data into a comprehensive operational picture. If not, seams and gaps may be exploited by the enemy, reducing, or eliminating the advantage altogether. History is rife with stories of military technology failures.

Learning from ISR History

Early ISR was instrumental in achieving decision superiority in several previous conflicts. During the Battle of Britain in World War II, the United Kingdom's Royal Air Force (RAF) used a network of radar systems called the Chain Home System to detect incoming German aircraft. The RAF's early warning system provided information on enemy aircraft's location and altitude, directing the RAF to effectively deploy their fighter squadrons to intercept and engage the German Luftwaffe. Although the system effectively detected targets during the day, the Germans Luftwaffe shifted to night attacks to minimize losses. The importance of ISR in military conflicts cannot be overstated. By providing commanders with crucial information about the movements of enemies, they gain an unparalleled decision-making advantage over their adversaries.[4]

In 2011, after exhaustive practice and intelligence gathering, the US Naval Special Warfare Development Group, also known as SEAL Team Six, carried out Operation Neptune Spear. ISR played a critical role in the success this operation by aiding in locating Osama bin Laden. The Central Intelligence Agency utilized human intelligence, signals intelligence, and satellite imagery to identify and confirm the presence of bin Laden in a compound in Pakistan, which led to a successful raid. Without sophisticated ISR activities, locating Osama bin Laden and accomplishing a successful mission would have been challenging, if not impossible.[5]

These examples highlight the importance of innovating to maintain a competitive advantage. However, it is essential to note that there is always a potential for unforeseen challenges, limitations, or errors in any

military operation, including those involving ISR, which underscores the reason intelligence methodologies and decision superiority must continue to evolve.

The Limitations of ISR

One of the most significant limitations of ISR is the volume of collected data. Modern ISR sensors can generate huge amounts of data, easily overwhelming collection managers, who must sift through a mountain of information for the most relevant data to meet the commander's needs.

The difficulty of identifying enemy locations in complex environments can be deadly. For example, history has shown that it can be difficult to distinguish between civilians and combatants in urban areas.[6] Civilian casualties during military operations can damage a military's reputation, hinder strategic goals, cause public outrage, damage trust, and lead to instability and insecurity in the region. Management of ISR data is equally tricky. The effective management of ISR data requires a deep understanding of the environment, the enemy, and commanders' priorities, which are critical for operational effectiveness.

ISR Collection Managers are military intelligence professionals responsible for managing ISR data. They ensure that ISR sensors' capabilities are tasked to effectively gather the information commanders need to make decisions. Collection managers must be highly knowledgeable about the environment, the enemy, and the commander's priorities. Additionally, collection managers make demands on scarce ISR resources. The shortcomings of ISR, like outmoded collection or inadequate battle management, can significantly impact the effectiveness of military operations. Armed forces must emphasize resourcing innovative technologies, refining personnel training, and establishing streamlined collection protocols to tackle most inherent limitations.

In the 2011 raid that led to Osama bin Laden's demise, US forces were able to identify his compound using ISR data. However, they were not able to identify the people present at the compound, and some of bin Laden's family members were able to escape.

The 'V-BAT', Tactical UAS, on the hunt. The V-BAT 128 can achieve 90 knots and altitudes of 20,000 feet.

Another instance is the 2014 occupation of Ukraine's Crimea peninsula when Russian forces made extensive use of Electronic Warfare (EW) to disrupt Ukrainian ISR operations. Effective EW made it difficult for the Ukrainian military to collect intelligence on Russian troop movements.[7]

The Future of ISR

One way to overcome data challenges is with AI and Machine Learning (ML). AI and ML technologies allow computers to learn and act without explicit programming. ML is a subset of AI that focuses on using data to train machines to learn how to perform tasks. ISR faces significant challenges due to the mounting volume of data and the growing complexity of the battlespace. To improve the quality of data, collection managers should capitalize on the power of AI and ML. Both AI and ML have the potential to revolutionize ISR by automating tasks, identifying patterns in data, and making predictions that would be difficult or impossible for humans to do. AI and ML technologies will also create new methods for processing and analysing ISR data, allowing commanders to make better decisions faster.

Innovations such as the MDC2 concept, which aims to connect all sensors and shooters across the land, air, sea, space, and cyberspace in real-time, and the related Alliance Future Surveillance and Control (AFSC) programme, which promises to provide real-time situational awareness and targeting information to warfighters, help to create decision superiority. Both MDC2 and AFSC need ISR for better situational awareness to boost operational efficiency and reduce casualties by providing commanders with an improved battlefield picture.

Information sharing is critical for decision-making, especially in complex and contested environments against peer-adversaries. Developers are advancing ISR technology, big data analytics, and cloud computing to combat the increasing complexity of the battlespace, while the Military Internet of Things (MIoT) technologies increase battlespace awareness but complicate information volume and velocity issues by the increased available data.[8] Additionally, electronic warfare

RQ-4D Phoenix NATO Alliance Ground Surveillance (AGS).

and cyber operations could soon incorporate ISR to develop a more comprehensive approach to modern warfare. All of these will enable a military force to disrupt enemy communications and other vital functions.

Military forces can garner more effective decision-making by leveraging advanced ISR capabilities, advanced data analytics tools, and ISR-enabled innovations like MDC2 and AFSC. As ISR capabilities continue to improve, commanders will have access to more and more information. This data deluge can overwhelm antiquated systems. However, bold leaders who invest early will be able to create new opportunities and develop innovative ways to process and prioritize information. However, as much as this concept promises, it does come with some risks.

Risks of AI-enabled ISR

One of the primary risks associated with adopting AI is tainted data and the difficulty in verifying and validating AI systems that learn. 'Bad data' is particularly concerning given that the military's current verification and validation processes may not be suitable for learning-capable AI systems. If tainted data, possibly from adversaries, is used to train such systems, the consequences could be fatal. Another risk associated with using AI in military applications is the lack of trust in and transparency of AI systems. Military personnel must trust the systems they are using to make informed decisions and carry out their duties effectively. To establish trust in AI-powered systems, leaders must have a solid understanding of how these systems reach decision recommendations.[9]

To ensure the prolific use of AI in military applications, it is crucial to establish a comprehensive risk management framework. AI risk management will help identify potential risks and hazards associated with using ISR-enabled AI and allows measures to mitigate them. This framework should include actions to ensure AI systems' reliability, transparency, and security. It should also have processes for verifying and validating systems that learn and measures to protect data from manipulation.

The use of AI by the military presents a range of risks that must be carefully considered and managed.

While AI systems can potentially improve military operations, they also come with their own challenges and risks. For the safe and effective deployment of AI systems within ISR systems, the military must establish a comprehensive risk management framework that deals with possible risks.

Conclusions

To maintain a competitive advantage, military leaders should embrace innovation to achieve and maintain decision superiority on the battlefield. Militaries can gain a competitive edge and enhance their decision-making processes by employing specialized ISR systems like NATO AGS, advanced battle management systems, and AI and ML technologies. However, the use of AI presents a range of risks that must be carefully considered and managed.

Military organizations should prioritize allocating resources to acquire and develop advanced ISR technologies, to include autonomous ISR, battle management systems, advanced data, and analytics tools. Simultaneously, military leaders must foster a culture of innovation, risk-taking, and critical thinking, as well as implement training programmes that emphasize decision-making under pressure. Prioritizing training in critical thinking and adaptability is crucial for success.

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Colonel (ret.) Bellione is an Intelligence, Surveillance, and Reconnaissance professional with a service record spanning the Navy, Army, and Air Force. His 32-year career culminated in his retirement from the USAF as a Colonel with expertise in Cyber, Intelligence, Aviation, Maintenance, and Unmanned operations. Bellione's assignments took him to Europe, where he forged ties with NATO. He also had the honour of commanding a global Reconnaissance Operations and Maintenance group. His operational experience includes serving in Bosnia (IFOR), Allied Force, OIF, OEF, and OUP. Anthony has experience in strategic planning, security assessments, and critical thinking. His educational foundation includes a bachelor's degree, two master's degrees, and several specialty certifications.

Jet: © CC, Alex Beltyukov; Background: © RDVector – stock.adobe.com

Ukrainian Forces have recovered Russian Electronic Warfare (EW) equipment for technical intelligence purposes. This includes the Khibiny EW complex, which is integrated on several Russian combat aircraft, including the Sukhoi Su-34.

Electronic Warfare in Ukraine

Preliminary Lessons for NATO Air Power Capability Development

By Mr Duncan McCrory CEng FRAeS, Freeman Air and Space Institute, King's College London

Introduction

The Russian Federation has invested heavily in Cyber and Electronic Warfare (EW) since the 2008 military reforms as an asymmetric response to NATO military capabilities that depend on sophisticated electronic systems.[1] However, Russia has not fully capitalized on this investment during the current invasion of Ukraine. This paper highlights some key issues and offers recommendations for EW capability development to improve the survivability and effectiveness of NATO air operations in highly contested environments. This paper is based on a presentation delivered by the author at the NATO Integrated Air & Missile Defence conference hosted at the Italian Air & Space Operations Command in Poggio Renatico on 23 March 2023.

Electronic Warfare During the Initial Invasion

During the initial invasion, the VKS (Vozdushno-Kosmicheskiye Sily; Russia's Aerospace Forces) conducted intensive attacks on Ukraine's Ground-Based Air Defences (GBAD), using a combination of cruise and ballistic missile strikes and anti-radiation weapons.

Russia's invasion force also included its largest combat deployment of EW capabilities to date.[2] Russian electronic attack systems and aerial decoys jammed and confused Ukraine's air defence radars, many of which had to be taken offline and relocated.

Despite these combined kinetic and non-kinetic attacks on Ukraine's GBAD network, the Ukrainian Air Force (UAF) managed to prevent the VKS from gaining air superiority. This is a remarkable achievement, since the UAF pilots were significantly outnumbered by the VKS, who operate far superior combat aircraft equipped with better weapons, sensors, and EW systems, and were supported by airborne early warning platforms and space-based capabilities. Ukrainian aircrew also faced the persistent threat of Russia's strategic Surface-to-Air Missile (SAM) systems, including SA-21s deployed in Belarus and Crimea.[3]

Whilst these threats imposed significant tactical constraints, the UAF quickly adapted their tactics to survive and remain effective in this high-threat environment. By flying at very low altitudes, below 100 ft in some cases, the UAF pilots were able to hide below the radar horizon of Russian SAMs, using ground clutter and terrain masking to avoid detection, before popping up to engage VKS fighter aircraft.[4]

Russia's Command and Control Issues

Significant weaknesses in command and control compounded Russia's inability to gain control of the air. A lack of planning and preparedness, coupled with procurement and encryption key distribution issues, forced many units to use civilian handheld radios and mobile phones, instead of secure, jam-resistant tactical radios.[5]

Ukrainian EW forces exploited these weaknesses by eavesdropping on Russia's unencrypted transmissions, jamming their communications, and performing targeting for long-range weapons using direction-finding techniques.[6] Ukrainian EW forces also used electronic attack capabilities to degrade the performance of VKS's airborne early warning platforms, and one of these aircraft was sabotaged in Belarus with an Unmanned Air System (UAS) attack.[7]

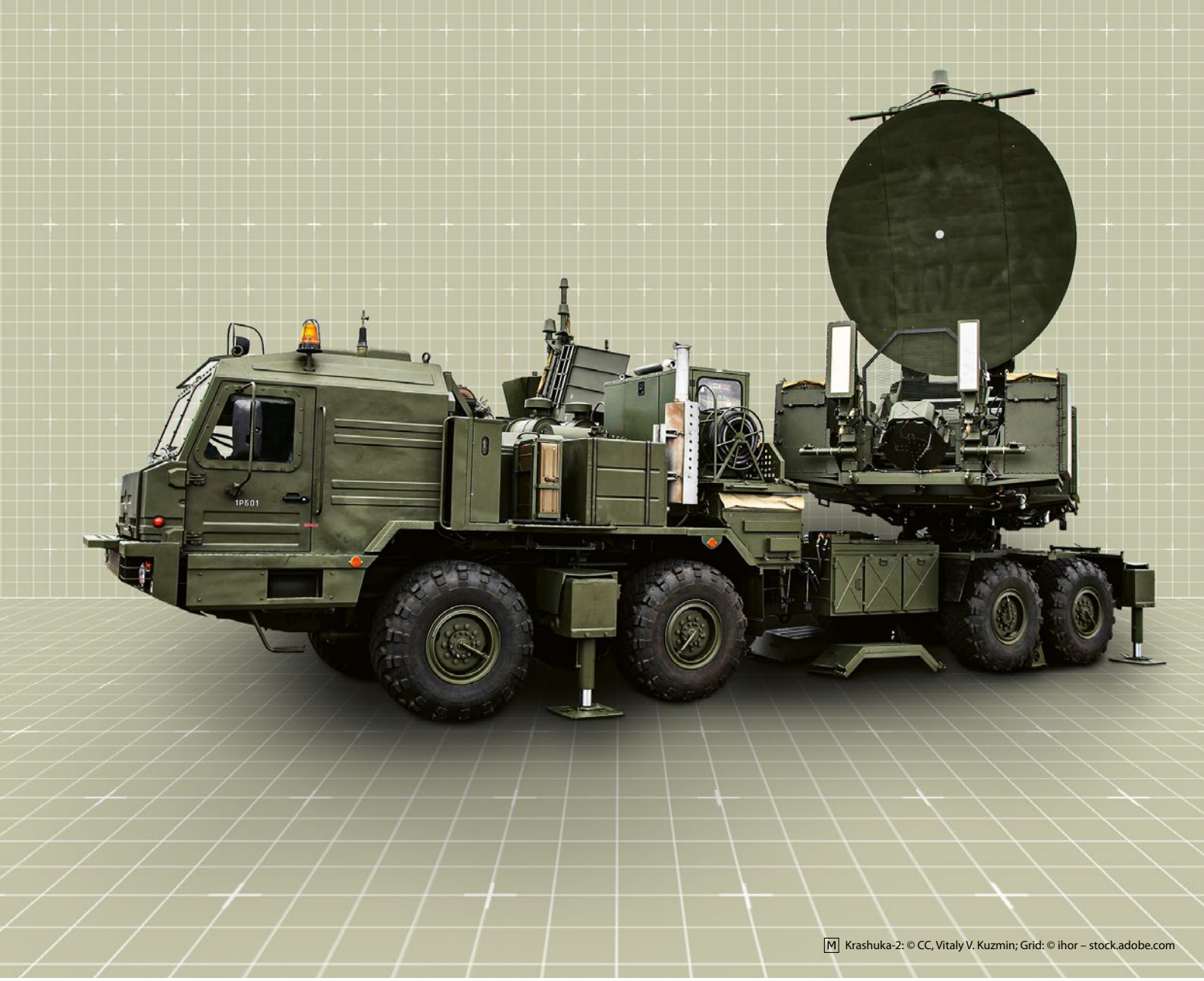
Russia's command and control issues hindered their ability to conduct joint air and land operations, and to make real-time tactical decisions in the battlespace. Additionally, the failure to de-conflict EW activities with the rest of their operations led to unintentional jamming of their own forces. The resultant confusion and disruption caused by this electronic fratricide led Russia to scale back its electronic attack efforts, thus enabling Ukrainian GBAD to become more effective.[8]

VKS's Vulnerability to GBAD

Once Ukraine's GBAD network recovered, much of the VKS's aircraft were also forced to fly at low altitude to avoid being shot down by Ukrainian medium and high-altitude SAM systems. Consequently, VKS aircraft came directly within the engagement envelopes of large concentrations of Ukrainian short-range air defence (SHORAD) systems. Ukrainian forces inflicted heavy losses on low-flying Russian fixed-wing aircraft and helicopters, primarily using Man-Portable Air Defence Systems (MANPADS), including the US Stinger, the Russian Igla-series, and the more sophisticated laser-guided UK Starstreak, which cannot be defeated by conventional countermeasures.

Witnessing Russia's heavy losses serves as a stark reminder of the threat posed by GBAD and the proliferation of MANPADS in particular. Platform EW protection capabilities, including Radio Frequency (RF) and Infrared (IR) countermeasures, will remain vital to safeguard NATO aircraft. The proliferation of MANPADS is set to continue, with nations such as China now actively competing with Russia for global exports. China has learned through reverse-engineering foreign weapons and has continuously upgraded and improved the performance of its indigenous systems. For instance, the FN-6 is a reverse-engineered copy of the European Mistral missile system.[9] However, the FN-6 is equipped with an upgraded digital infrared seeker for improved targeting and resistance to countermeasures, such as flare rejection.[10]

There is also evidence of a significant rise in the proliferation of advanced Chinese MANPADS in the hands of violent extremists and other non-state actors. For



Krashuka-2: © CC, Vitaly V. Kuzmin; Grid: © ihor – stock.adobe.com

Russian EW forces have attempted to disrupt NATO ISR operations with Electronic Attack capabilities. The KRET Krasukha-2 is designed to jam Airborne Early Warning and Control (AWACS) radar.

instance, in 2014, ISIL/Daesh operatives in Syria and Iraq were equipped with the FN-6, in addition to various Russian-origin MANPADS.[11] This highlights an unquestionable need to develop and procure advanced laser-based Directed Infrared Countermeasures to safeguard NATO air operations against the growing MANPADS threat.

Air Superiority Cannot Be Assumed

Although Ukraine has successfully blunted VKS low-altitude operations, Russian Su-35 and Mig-31 interceptors operating at high altitude have shot down significant numbers of Ukrainian ground attack aircraft using long-range radar-guided missiles. This threat, compounded by the presence of Russia's strategic SAMs, has led to a state of mutually denied air superiority.

Russia has improved the effectiveness of its EW operations since the initial invasion, with considerable success in countering Ukrainian UAS. Russian EW forces have also attempted to jam NATO ISR aircraft operating on the periphery of Ukraine's border.[12] Of greater concern are the aforementioned strategic SAMs deployed by Russia in Belarus and Crimea, which are holding NATO ISR aircraft at significant risk, in addition to harassment from Russian combat aircraft. Russian aircrew

have already committed several unprofessional and dangerous acts against NATO ISR platforms; the risk of further aggression and miscalculation ending in tragedy must not be underestimated.[13]

In addition to procuring weapons from Iran and North Korea, Russia is receiving non-lethal military aid and satellite imagery from China.[14] With President Putin having openly declared a 'no limits' relationship between the two nations, it is entirely possible that Russia could seek support from China to re-arm its military forces.

Ultimately, the crisis in Ukraine has demonstrated that, unlike the past two decades of counter-insurgency operations in the Middle East, control of the air cannot be assumed. Instead, we are seeing a return to conditions similar to those faced in Kosovo during Operation Allied Force, where NATO aircraft had to conduct operations in highly contested airspace.

NATO EW Capability Development Priorities

If a direct conflict were to emerge with Russia, NATO would need to fight hard to gain access, survive, and achieve air superiority. EW will be a key enabler, and NATO needs to develop a full spectrum of Suppression and Destruction of Enemy Air Defence (SEAD/DEAD) capabilities.

Air and Space-based ISR will remain vital to gaining intelligence on adversary air defences and informing the development of countermeasures. Mission planning, mission data, on-board defensive aids, and expendable active and passive countermeasures will be crucial to breaking the adversary's kill chain and maximizing the survivability and lethality of NATO aircraft in future hostile environments. Finally, a plethora of offensive systems, including electronic attack and anti-radiation weapons, will be necessary to disrupt, deceive, and destroy hostile air defence networks.

Ukrainian Forces have inflicted significant losses on Russian aircraft using Man-Portable Air Defence Systems (MANPADS), such as the UK Starstreak (pictured above), which cannot be defeated by conventional EW countermeasures.

Accelerating EW Capability Development

Time is of the essence and funding is often limited to flagship programmes. Therefore, NATO should seek to learn from and more fully exploit existing EW capabilities and new developments within allied nations. For example, Ukraine has captured several high-value Russian EW assets during the conflict, and is reported to have handed these over to allied nations for technical intelligence purposes.[15] NATO should aim to make best use of the intelligence gained from these efforts to develop and update electronic countermeasures.

Additionally, the Royal Air Force (RAF) Rapid Capabilities Office is reported to be experimenting with low-cost autonomous air systems, designed to operate in swarms and use compact EW payloads to disrupt and confuse air defence systems.[16] Furthermore, the RAF is integrating a Modular Air Platform Protection System onto crewed ISR platforms, which is compliant with the NATO Defensive Aids System (NDAS) standard and capable of integrating advanced RF and IR countermeasure systems to provide protection against a variety of threats.[17]

Doctrine and training are equally important to technology development and equipment acquisition. Cyber and Electromagnetic activities cannot be an afterthought; they must be tightly woven into joint force manoeuvre plans. Additionally, regular training in electronically representative environments will help allied forces to survive and remain effective in the presence of EW threats, such as those deployed by Russia in Ukraine. Further investment and strengthening of the NATO Joint Electronic Warfare Core Staff (JEWCS) is recommended to enhance their capacity to deliver this training across the Alliance. Specialist training will also be necessary to ensure that NATO aircrew develop proficiency in the tactics, techniques,

The NATO Joint Electronic Warfare Core Staff supports all NATO Headquarters and Commands in the development of EW policy, concepts, doctrine, and experimentations, in addition to providing expertise and training for operations in electronically-contested environments.

and procedures required to work together and deliver complex kinetic and non-kinetic effects, such as those employed on SEAD/DEAD operations. However, given the proliferation of space-based SIGINT capabilities, NATO will need to consider novel means to conduct EW training in the live environment, coupled with greater use of secure synthetic facilities to prevent adversary intercepts.

Ultimately, whether it is safeguarding our aircrew or disrupting, degrading, and denying adversary situational awareness, communications, and targeting, Electronic Warfare will be the fundamental enabler to more survivable and effective NATO air operations in hostile environments in the future. ●

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Where Every Move Counts: Total Synchronization Across the Battlefront.

The Challenge of Symbiosis

Synchronizing Kinetic and Non-Kinetic Ops

By Major Charilaos Nikou, GR Air Force, JAPCC

By Squadron Leader David Tucker, UK Air Force, Combined Air Operations Centre-Torrejon

Introduction

The landscape of modern warfare has undergone significant transformations in recent years, becoming far more complex and multifaceted. The parameters of this new era of warfare have broadened beyond the traditional military-focused model, encompassing a diverse array of components such as cyber, informational, economic, and diplomatic elements. This remarkable paradigm shift necessitates a thorough re-evaluation of the power concept and how it is wielded in today's conflicts. Joseph Nye's tripartite power framework offers an insightful perspective for analysing this evolution, elucidating the distinct yet interrelated roles of hard, soft, and smart power.[1,2]

Unpacking Power: Exploring Nye's Smart Power Framework

Joseph Nye's power framework, introduced in the 1990s, offered an innovative view of power as a multidimensional entity rather than a monolithic concept. Hard power represents the tangible elements of power, characterized by a state's traditional military and economic capabilities, and has historically been a pillar of national security strategy.[3] On the other hand, soft power denotes the subtle methods a state employs to influence others, usually achieved by projecting culture, values, and favourable policies. Despite being less tangible, soft power is equally vital, operating through attraction and persuasion instead of force.

Between Leonidas' battlefield and the Acropolis' skyline, the full spectrum from hard to soft unveils the essence of smart power.

Meanwhile, smart power symbolizes a strategic blend of hard and soft power, with its application dictated by context.[4]

The relevance of Nye's power taxonomy is particularly apparent in the context of current warfare, especially when distinguishing between kinetic and non-kinetic operations. Kinetic operations, including airstrikes and ground assaults, are typically associated with hard power, reflecting tangible effects. However, hard power extends beyond physical force to include non-kinetic actions that exert coercive effects, such as cyberattacks, information warfare, and economic sanctions[5,6]. Generally, soft power is characterized by its focus on influencing through attraction and persuasion, often manifesting in the projection of cultural appeal, ethical values, and diplomatic dialogue rather than coercive tactics. The concept of smart power, as a harmonious blend of hard and soft power, requires a holistic understanding of the potential synergies between kinetic and non-kinetic operations. It necessitates orchestration of diverse elements in a coordinated and effective manner, recognizing that non-kinetic effects may represent hard or soft power, depending on the actions taken, the context, and objectives but their combination with kinetic effect is 'smart power'.

Charting New Terrains: Integrating Multi-Domain Operations

The escalating prominence of non-kinetic operations in the global security landscape is one of the reasons NATO has been driven to integrate Multi-Domain Operations (MDO) as a central element of its modern warfare strategy.[7] MDO refers to integrating and synchronizing military capabilities across multiple domains – land, air, maritime, space, and cyber – to produce synergistic effects. This multi-domain approach is designed to enhance military operations' overall effectiveness and efficiency.

Acropolis: © TTstudio/Shutterstock.com; Leonidas Statue: © Anton_Ivanov/Shutterstock.com

Implementing MDO within NATO's strategic framework aims to optimize the Alliance's capacity to deter aggression from potential adversaries. In a world where warfare extends beyond traditional military fronts, the MDO concept is an adaptable framework that enables NATO to respond decisively and, if necessary, offensively to any form of aggression.[8]

The usefulness and necessity of MDO becomes strikingly apparent when considering the emergence of hybrid threats.[9] These threats blend conventional and unconventional tactics, combining military and non-military means, to achieve strategic objectives. Such threats could manifest in many forms, such as cyberattacks, information warfare, economic coercion, and subversive activities designed to undermine social cohesion, political support, or effective response. Responding effectively to these multifaceted threats necessitates a flexible, adaptive, and integrated approach. This approach should cover not only traditional domains of warfare but also the increasingly significant domains of cyberspace and information operations.

NATO's pursuit of MDO signifies its keen understanding of the evolving nature of power in modern warfare. By integrating hard and soft power capabilities and coordinating kinetic and non-kinetic operations across multiple domains, NATO seeks to enhance its ability to deter and counter potential adversaries in an increasingly complex and rapidly changing strategic environment.[10]

In an era where the nature of conflict is rapidly evolving, the successful application of MDO within NATO necessitates a nuanced understanding of the relationship between Nye's forms of power and the intersection of kinetic and non-kinetic operations. By embracing the concepts of hard, soft, and smart power and adopting a multi-domain approach, NATO can effectively navigate the complex challenges of modern warfare. This dynamic approach allows NATO to

Strategic Alignment: The Art of Orchestrating Air, Land, Sea, and Beyond.

maintain a robust and resilient security posture, enabling it to face a diverse range of dynamic threats with confidence and effectiveness. This flexibility and adaptability will ensure NATO's relevance and efficacy in preserving peace and security in the coming years.

Joint Effects Synchronization: From Theory to Practice

The need to concentrate on MDO is one of the many justifications for establishing a Joint Effects Synchronization Team (JEST) at NATO HQ AIRCOM.[11] However, let us not forget that 'J' in JEST represents 'Joint.' The JEST should not be merely perceived as an extra planning tool to speed up the normal process. Rather, its crucial capability is to facilitate joint planning, such that all component commands can synergize their operations and requirements, leveraging more multi-domain effects at the speed of relevance. It was always envisaged that the JEST should operate at the Joint level though it resides at AIRCOM, mainly because AIRCOM had done the work to develop the JEST.

However, the way JEST operates at the moment is too air focused; it is being used as a longer-term planning team for Integrated Air Effects in current operations rather than synchronizing joint effects. While such an air effects approach might be suitable when addressing challenges posed by Enhanced Vigilance Activities, it deviates from the core purpose for which JEST was originally established[12].

Returning to joint synchronization, one of the key advantages of a correctly employed JEST is the ability to synchronize Kinetic and Non-Kinetic Operations (K/NKO). In general, such synchronization brings challenges as the planning timelines for kinetic and non-kinetic activities vastly differ. The Air Component's traditional 72-hour Air Tasking Order (ATO) cycle does not work for Long-Range Stand-Off Weapons (LRSOW), which require 96 or even 120-hour planning windows to achieve optimum effects. Extending the planning timelines for kinetic air effects offers the opportunity to bake-in other long planning lead-times, including non-kinetic effects. This intent led to the genesis of JEST despite its current air domain

Power in Unity: Blending Kinetic and Non-Kinetic Efforts in Contemporary Multi-Domain Engagements.

focus. Shifting some aspects of air planning to a longer lead-time allows us to evaluate air activities within a broader context and paves the way for greater synchronization and strategic harmony across multiple operational sectors. It also allows for more comprehensive coordination with other extended lead-time initiatives like cyber operations, informational operations, and special operations forces activities. Such activities typically require longer planning lead times than conventional component activities, with some timelines extending into weeks rather than hours. Consequently, to ensure effectiveness, the JEST requires personnel who possess extensive background of kinetic and non-kinetic operations. Furthermore, the team should also include subject matter experts from other components, promoting a comprehensive and efficient operational planning process.

Drawing on Nye's concept of 'smart power', which is about combining instruments of power, we should do the same in adaptive planning in today's unpredictable operational environment. Through JEST's unique approach, NATO can seamlessly transition between or even combine its kinetic and non-kinetic capabilities, providing a more adaptable and dynamic response to varying challenges.

[...] *'The concept of smart power, as a harmonious blend of hard and soft power, requires a holistic understanding of the potential synergies between kinetic and non-kinetic operations. It necessitates orchestration of diverse elements in a coordinated and effective manner,...'*

By stepping away from the 72-hour ATO cycle, we can synchronize air effects with all other effects. For example, synchronizing LRSOW with cyber effects and electromagnetic warfare and baking some Suppression of Enemy Air Defence (SEAD) into the mix will amplify each effect. However, we must also consider the impact of our actions on the strategic communications narrative. K/NKO can either amplify, enable, or suppress each other, so they need to be synchronized to achieve the desired effect. For instance, in a peace

support mission, using physical force that unintentionally results in civilian casualties can contradict our goal of promoting peace.

This synchronization requirement brings a different set of issues. Placing timelines on some non-kinetic effects is very difficult. A cyber effect can depend on many variables. For example, a member of the adversary forces may collect a judiciously placed memory stick, insert it into their network, and trigger a cyber action, but the timing of this event is entirely unpredictable. Information operations may require the adversary to believe some insidiously placed information. Media operations may require the adversary media to pick up on a particular story.

Even if we master synchronizing K/NKO, we must also consider our actions' second and third order effects. This is especially important with NKO. Achievement of an effect using NKO often relies on influencing an enemy actor to behave in a particular way. However, humans are unpredictable and may behave in unforeseen ways with unexpected second and third order effects. These possible second and third-order effects must be considered carefully, particularly with NATO's emphasis on protecting civilians.

Incorporating a NKO Division (NKOD) into the NATO JFAC underscores the recognized significance of NKO. However, developing a separate division creates complications to the planning process. One of the strengths of the NATO JFAC construct is that all the planners work together, allowing integration and coordination of all Air Power aspects. The NKOD has taken an electromagnetic battle staff model[13]. This means that the NKOD staff is embedded into all the other divisions, creating some degree of integration. Yet, despite achieving this level of integration, the wide distribution of NKO specialists challenges the value of a distinct NKOD. The planning lead time for NKO tends to be protracted, and adding a dedicated division to manage NKO seems to slow the planning process further. The key is integrating all K/NKO effects into planning. This could be accomplished by establishing a doctrinal link between the NKOD and the JEST. Each NK effect should be treated as a tool in the toolbox and applied appropriately without a separate management level. This should, by extension, lead to better integration.

[...] *'In an era where the nature of conflict is rapidly evolving, the successful application of MDO within NATO necessitates a nuanced understanding of the relationship between Nye's forms of power and the intersection of kinetic and non-kinetic operations.'*

There may be an argument for a NKOD in Counter-Insurgency (COIN) operations. In COIN operations, NATO will generally enjoy a high level of control of the air. Furthermore, a higher premium is often placed on NKO as they typically cause less collateral damage than KO. Combining irregular warfare factors supports a dedicated NKOD for COIN operations. Some could argue that establishing an NKO division creates a mechanism to develop and promote NKO capabilities, but in the planning world it only slows the process by developing another layer of coordination. Rather than operating through a liaison across multiple capabilities for MDO, each respective NKO SME should integrate into the planning process alongside their kinetic operations counterparts. Well-planned MDO are required against peer adversaries. This, in turn, requires flawless synchronization to achieve the overall effect. If the decision remains for a NKOD, JEST arguably becomes the vital bridge between KO and NKO. KO in concert with NKO will be needed against a peer adversary, and the synchronization between the two will be essential, leading to the requirement for a properly functioning JEST.

At the same time, we must consider the hard and soft power balance. In both K/NKO, there's an inherent risk of collateral damage. Think of the current focus on NATO protection of civilians: it underscores the broader vision of not just achieving a military victory, but also securing lasting peace. NATO cannot afford to win the war but lose the peace. Irrespective of any tactical victories, losing the hearts and minds of the people leads to strategic defeat.[14]

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One Room, One Mission: Seamless Integration of Kinetic and Non-Kinetic Operations.

Steps Forward

- The symbiotic integration of K/NKO is indispensable for effectively managing modern warfare. The link between NKOD and JEST is critical, ensuring that our operations evolve in harmony.
- Coordination of K/NKO is inherently a multi-domain venture, addressing challenges that necessitate comprehensive solutions. Implementation should be unified, avoiding segmented or stovepiped approaches.
- An expansion of expertise in K/NKO is required within NATO Joint Force Commands (JFC) and Component Commands (CC). This enrichment is vital to fully leverage the advantages of joint effects in Multi-Domain Operations.
- A focus on education is paramount to fostering an understanding of joint effects and empowering JFCs and CCs with capable and experienced personnel to staff the JESTs. Investing in knowledge and personnel is crucial to making a significant, positive difference.

Conclusion

The transformation of modern warfare necessitates a comprehensive, strategic, and synchronized application of hard and soft power. A more nuanced understanding of the relationship between Nye's forms of power and the combination of kinetic and non-kinetic operations is required. The synchronization of KO and

NKO is vital. The symbiosis gained by doing so gives us a vital edge in joined-up manner. To do this successfully, NATO's JFCs and CCs will need to grow their expertise in K/NKO. Only then can the alliance leverage the strengths of Joint Effects within Multi-Domain Operations effectively. Education is needed to promote Joint effects and to allow the JFCs and CCs to fill JESTs with appropriately qualified and experienced personnel, empowered to make the difference we need. ●

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Joint Air Power Competence Centre

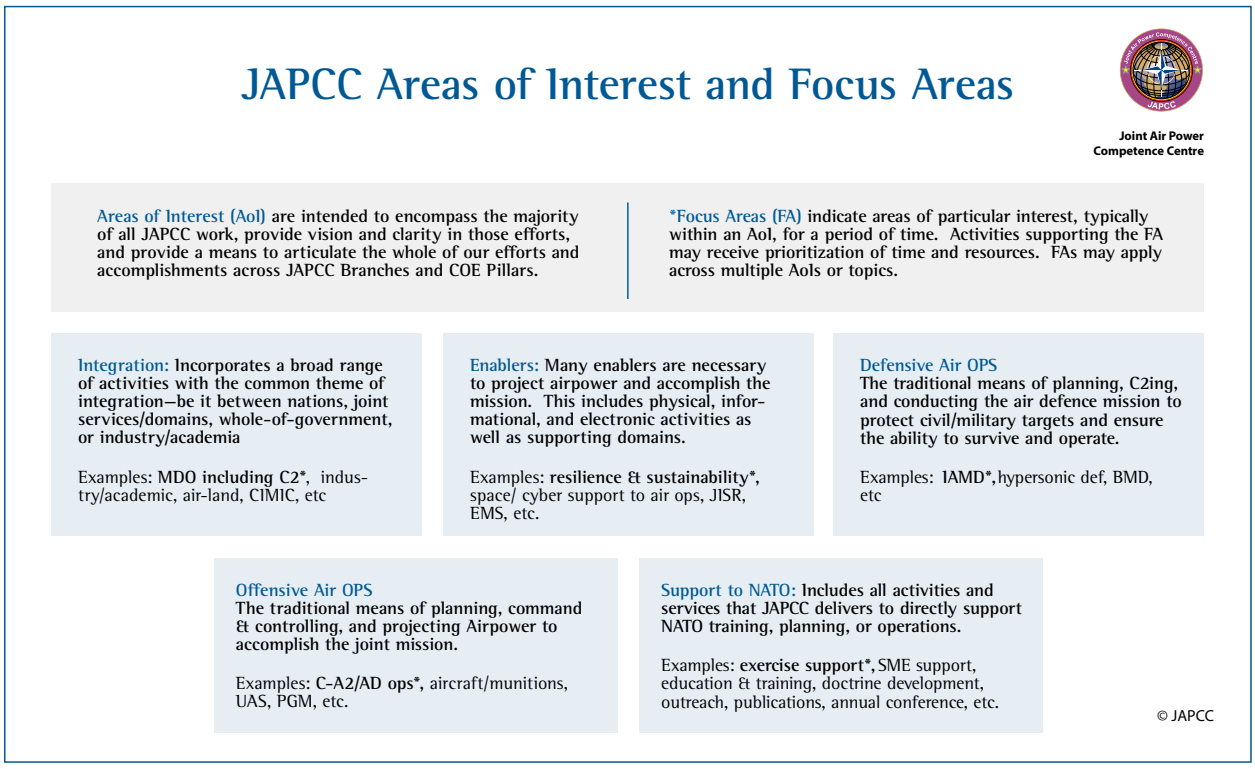
Redefining Priorities

An In-depth Look at the Revised Focus Areas Framework and Areas of Interest for JAPCC

The Joint Air Power Competence Centre's (JAPCC) Focus Areas serve as a clear roadmap for directing its activities and prioritizing the demands placed on the Centre. These areas are aptly reflected in our well-structured Programme of Work. They are reviewed annually and typically updated every couple of years to ensure that JAPCC's limited manpower resources are aligned with the priorities identified by NATO Summits, the NATO Strategic Concept, the NATO Political Guidance, the NATO Defence Planning Process, and Bi-SC Commanders' statements.

Since 2019, twelve identified and established Focus Areas have effectively served the overall interest and aim of the JAPCC. However, considering the constantly evolving global security situation and its direct implications on military posture, the JAPCC leadership recognized the need to better address current demands, tackle new challenges, and establish clear prioritization with the available manpower. As a result, this year, the JAPCC devised a new way of representing the Focus Areas.

To fully encompass the weight of our centre's efforts, the JAPCC introduced a new concept under a new framework, which consists of two categories: Areas of Interest and Focus Areas. The Areas of Interest are more extensive and comprehensive, capturing the majority of JAPCC's work, and cut across the doctrinal pillars of a COE: concept development and experimentation; doctrine development and standardization; education, training, exercise and evaluation; and



analysis and lessons learned. They provide vision, clarity, and a means to articulate our efforts and accomplishments. On the other hand, the Focus Areas indicate a specific interest for a certain period of time, and may apply to one or more Area of Interest. Activities falling within the Focus Areas may receive prioritization of time and resources.

This new approach allows the JAPCC to adapt more effectively to the ever-changing security landscape and ensures that our efforts are focused on the most pressing issues. By clearly defining both the broader Areas of Interest and the specific Focus Areas, we can allocate our limited resources efficiently and achieve maximum impact.

The following are the new Areas of Interest:

Integration: This category encompasses a wide range of activities that share the common theme of integration. This Area of Interest recognizes JAPCC's role as an integrator and agenda setter, such as between nations, joint services/domains, whole-of-government, or industry/academia.

Enablers: These are the essential components required to project Air Power and successfully accomplish the mission, including physical, informational, and electronic activities as well as supporting domains. This Area of Interest seeks to research, develop, and promote enablers like logistics, sustainment, and JISR. Such enablers are crucial to mission success by providing the necessary support and resources to ensure the effective execution of operations but may not receive the necessary attention.

Defensive Air Operations: This category covers both traditional and innovative methods of planning, commanding, controlling, and executing the joint mission. The related Focus Area of Integrated Air and Missile Defence (IAMD) is nested in this Area of Interest, but the Area of Interest encompasses the comprehensive effort necessary to safeguarding Allied airspace and protecting assets from potential threats.

Offensive Air Operations: Similar to defensive air operations, this category encompasses traditional and innovative approaches to planning, commanding, controlling, and projecting Air Power. This Area of Interest recognizes the many complementary efforts necessary to effectively employ air assets to achieve joint mission objectives and the type of power projection necessary for credible deterrence.

Support to NATO: This category includes all activities and services provided by JAPCC that directly support the NATO mission including training, planning, and operations. It emphasizes the Centre's commitment to supporting the collective defence efforts of NATO member nations and reflects the direct return on investment in the JAPCC, and the tactical and operational relevance of the JAPCC.

Under the Focus Areas category various activities or projects may fall, such as Exercise Support, Multi-Domain Operations (MDO) including Command and Control (C2), Resilience and Sustainability, Integrated Air and Missile Defence (IAMD), Joint Intelligence Surveillance and Reconnaissance (JISR), or Air-Land Integration (ALI).

Under the new framework, JAPCC is confident that our programme of work is now better aligned with increased relevance. We have established a true focus that highlights a limited number of priorities, taking into account the available resources and manpower, and ensures that our efforts are concentrated. ●

The 2023 Joint Air and Space Power Think Tank Forum

Enhancing Deterrence and Defence through a United Effort

On 23 March 2023, the Joint Air Power Competence Centre hosted the 10th Joint Air and Space Power Think Tank Forum (TTF) in Kalkar, Germany. JAPCC Assistant Director, Air Commodore Paul Herber, chaired the annual forum, bringing representatives from National Commands, Military Universities, Air Warfare Centres, and NATO International Military Staff (IMS). This year's TTF welcomed participants from the Hungarian Air Force Command, Belgian Air Component, Czech Defence University, German Air Force Command, IMS Joint Air Power and Space Staff Element, Italian Air Warfare Centre, Polish Air Force University, Polish Air Force 2nd Tactical Wing, Royal Danish Defence College, Royal Netherlands Air and Space Warfare Centre, Spanish Air and Space Force, and the United Kingdom Air and Space Warfare Centre. The TTF aims to share perspectives and discuss various developments and approaches in the Air and Space domains. The meeting also seeks to identify areas of mutual interest and potential collaboration to avoid redundant work and maximize our collective human capital.

In light of the changed security situation in Europe, this year's attendees' briefings reflected that NATO nations had identified their critical areas of weakness and vulnerabilities. Now, they are on the way to rebuilding essential deterrence and defence capabilities and are centred on Integrated Air and Missile Defence (IAMD), Unmanned Aerial Systems (UAS) and counter-UAS, doctrine and training, modelling and simulation, joint planning, Multi-Domain Operations (MDO), Space and Cyber Security, Air C2, Artificial Intelligence (AI), Agile Combat Employment (ACE), resilience, new platforms and integration, and ISR and EMS operations. A common feature of all nations is that all face similar challenges today, such as personnel and time-consuming procurement processes. All TTF participants counter these challenges with similar approaches and varied capabilities across the five operational domains.

The JAPCC extends its sincere gratitude to all the participants for their valuable and constructive contributions during the recent Think Tank Forum. We greatly appreciate your involvement and eagerly anticipate the next TTF. We cordially invite all interested national entities to attend the next TTF meeting to visit the JAPCC website www.japcc.org/events/ or contact us at ace@japcc.org.

JAPCC in the Vanguard of NATO Doctrine Development

Revision of the AJP-3.3 Allied Joint Doctrine for Air and Space Operations

The JAPCC directly supports NATO by actively participating in doctrine development and standardization, which is also one of the recognized pillars of a centre of excellence's work. The JAPCC has an extensive portfolio focused on the advancement of NATO doctrine, standards, and procedures. As the custodian of over ten NATO policies and doctrines, and an active contributor to over thirty others, the JAPCC plays a substantial role in NATO's doctrine development across various fields.

The JAPCC is the custodian of the AJP-3.3 'Allied Joint Doctrine for Air and Space Operations', NATO's primary doctrine for the Air Domain. The latest version, AJP 3.3 Edition B Version 1, was released in April 2016.

In March 2017, JAPCC was assigned the important task of revising the AJP-3.3. This directive was driven by the need to adapt to the constantly evolving security landscape, characterized by widespread instability and increasing strategic competition. Additionally, it aimed to ensure that we maintain our technological edge in the face of an expanding range of threats, facilitated by the relentless progress of technology.

Fighting through a series of delays, generated mainly by the arrival of the pandemic, the necessity to align with all related doctrines, and the need to account for the latest concept developments, JAPCC developed three Study Drafts (SD) through a series of meetings with participation from the NATO Command Structure and the nations. SD1 was published in Jan 2019, SD2 was released in October 2021, and SD3 in June 2022. Each SD release generated numerous comments, requests for modification, and recommendations from stakeholders. Addressing these inputs required significant effort and manpower to carefully read, evaluate, verify, and incorporate them into the final draft version. Following intermediate working groups, the first Harmonization Draft was released in May 2023, which prompted a renewed surge of valuable comments and feedback from nations.

There were three main changes and significant challenges present throughout all SDs, including the initial Harmonization Draft of the AJP-3.3. Firstly, Chapter 2 – Command and Control (C2) – has undergone a complete rewrite. This presented a second challenge as NATO HQ AIRCOM is currently revising the Air C2 CONOPS, and it has not yet been released, resulting in discrepancies between the two documents, particularly in terms of referencing. The third challenge involved the complete rewriting of Chapter 5 – the Space Domain. Despite NATO ACT assigning the new Space COE in Toulouse, France, in June 2023 to develop a new AJP-3 subseries dedicated to Space Operations, we have decided to retain the Space Chapter in AJP 3.3 and proceed with its rewriting, anticipating Toulouse will create the new Space AJP in the future.

With the dedicated support and active involvement of all stakeholders, our current intention is to release the second Harmonization Draft in September 2023, allowing a thirty-day period for providing comments. Following the receipt of comments, the ratification draft will be prepared and released in the fourth quarter of 2023. Noting that the most efficient way to incorporate changes compared to the formal comment process is by direct involvement during the revision process, we appreciate and encourage active participation of all interest parties in the writing process.

Experimentation: An Underrated Tool in MDO Concept Development

The Multi-Domain Operations (MDO) concept is still in the beginning of development and no applicable MDO doctrine exists. The JAPCC mission is to provide independent, timely, and innovative advice to NATO leadership. Hence, JAPCC is actively and openly exploring MDO opportunities and considering practical approaches. Core elements of product development within the JAPCC include out-of-the-box thinking and experimentation, which multiplies the number of possible solutions. Stand-alone experiments in exercises provides a means to develop, introduce, or test new practices or approaches with minimal cost or interference with primary exercise objectives.

Unfortunately, many organizations underestimate the value of experimentation, which makes for scarce opportunities to evaluate concepts in a controlled environment before fully committing resources. Providers and consumers of exercise and training events often consider experiments a risk to avoid, as the control and outcome of an experiment can be unexpected. Additionally, experiments require dedicated and time-consuming effort, which may appear to compete with the primary preparation of an event. However, isolated experimentation allows organizations to assess the viability and feasibility of new concepts in a relatively low-risk environment. A controlled approach helps to identify strengths, weaknesses, and areas for improvement, ultimately leading to more informed and strategic decision-making and a better organization in the long-term.

NATO introduced the MDO concept to cope with the challenges and threats of the future battlespace. MDO-focused planning and execution intends to synchronize effects across all domains and environments, creating multiple dilemmas to decisively influence the adversary. NATO ambitiously plans to ensure MDO initial operational capability by 2030, a transition requiring focused development during the coming years, but currently, the MDO concept is in uncharted territory. MDO execution is much more complex than Joint Operations, and NATO must develop fast, complex, new, and innovative processes and products to improve decision-making and collaboration across all domains and actors. The NATO Allied Command Transformation (ACT) MDO initial concept leaves room for interpretation and offers different venues to realize and implement the new way of operations.

To investigate opportunities for the effective and efficient employment of Air Power within the context of MDO, Commander Deployable Air Command and Control Centre (COM DACCC) implemented a Multi-Domain Operations Cell (MDOC) into exercise Ramstein Ambition 23 (RAAM 23). The MDOC, including its tasks, processes, or products, is not yet described in doctrine or Tactics Techniques and Procedures. COM DACCC initiated the experiment to explore how MDOC could contribute to cross-domain synchronization and coordination of Air Power efforts at the strategic and operational levels. The MDOC experiment was executed as a Table Top Exercise (TTE), isolated from RAAM23. COM DACCC provided broad guidance, which gave the TTE participants a good opportunity to think and discuss how to integrate cross-domain approaches to operational requirements.

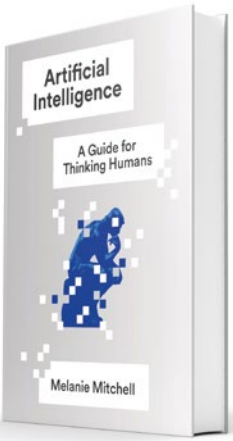
COM DACCC invited JAPCC to guide and moderate the TTE, whereas various DACCC subject matter experts represented the five domains (air, land, maritime, cyber, and space). First, the TTE used insights developed by the JAPCC concerning planning and collaboration in the MDO context. Second, a vignette acted as the baseline to identify and develop collaboration, cooperation, and planning processes in an MDO environment at the operational level. Third, the TTE used a practical approach to identify 'low-hanging-fruit' solutions to offer practical applications of MDO in the operational planning process. Finally, the TTE considered MDO-supporting initiatives in other organizations, like the Joint Effect Synchronization Team (JEST) at AIRCOM.

Although the preparation for the TTE was limited, the experiment delivered several fruitful and relevant insights for further MDO development. The TTE's primary output identified steps to standardize a capability-to-effect process based on the current Comprehensive Operational Planning Directive (COPD). The capability-to-effect process gives guidance to multi-domain planning teams to link joint capabilities to desired effects across domains, ensuring appropriate capabilities or resources are component or service agnostic. The JAPCC plans to further refine and standardize the capability-to-effect process and evaluate where it can be used throughout the operational planning process. Additionally, the experiment's results will contribute directly to the development of a White Paper concerning planning in MDO, which JAPCC plans to issue in the fall of 2023.

Aside the primary product, i.e., a capability-to-effect matrix, the JAPCC gained secondary insights about the MDO development process, namely that MDO is complex and not easy to comprehend. An organization's awareness and knowledge of MDO requires a concerted education and information plan to smoothly develop and implement MDO processes. A comprehensive, NATO Command Structure (NCS)-wide MDO development is lacking, moreover, a shared knowledge about MDO and its developments are missing. A solid MDO database or knowledge hub, managed by ACT, must accompany MDO implementation to ensure consistency and efficient maturation. Documents, like the AJP-01 (F) 'Allied Joint Doctrine', already introduced MDO terminology, but a broader understanding is necessary to transition to truly multi-domain operations. Likewise, everyone must understand that achieving MDO is not about introducing a particular technology or solving a particular tactical problem. Rather, at its core, MDO is about commanding and controlling joint effects across domains, an endeavour that is equal parts battlefield technology, Command, Control, Communication, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR) technology, and human decisions and processes such as battle rhythms. Finally, the complexity of the project requires an increased and coordinated cooperation and collaboration between the elements of the NCS.

What can we learn from the TTE? Experiments, even limited in scope or arranged at short notice, can deliver valuable insights for concept development. Thus, isolated experiments are perfect opportunities to stimulate and support advances in the context of MDO. There was no risk to the RAAM23 exercise itself; RAAM23 and the associated TTE demonstrated that exercise objectives could still prevail alongside experimentation. NATO must exploit more exercises for small experiments because they are a perfect venue for further maturing MDO and developing other innovative concepts. Experiments are not a risk for MDO development, but rather opportunities.

JAPCC will continue to be an active contributor to the promotion, advancement, and development of the MDO concept, providing expertise and advise whenever and wherever new opportunities arise. ●

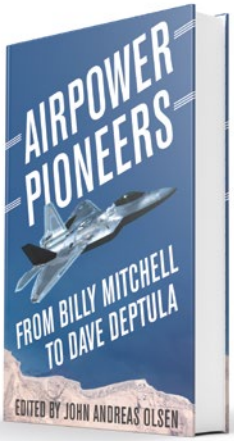


'Artificial Intelligence – A Guide for Thinking Humans'

This book provides a comprehensive and insightful overview of the current state of artificial intelligence. Mitchell's writing style is engaging and accessible, making even the most technical concepts easy to understand. Beginning with the history of AI research, dating back to the 1950s, the book explores the key figures and ideological branches that have shaped the field. Moving on to the evolution of machine learning techniques, from Rosenblatt's perceptron to Fukushima's neocognitron and LeCun's convolutional neural network, the book delves into AI's strengths, illustrated by its hottest algorithms, such as AlphaGo and IBM Watson. Deep neural networks are now ubiquitous, powering everything from image recognition to automated translation, virtual assistants, and autonomous cars. However, Mitchell acknowledges that the recent successes in deep learning are largely due to the availability of vast amounts of data and high-speed computing. She also highlights several fatal flaws in current techniques that will limit the extent to which AI can progress, providing examples of the roadblocks looming ahead in many of the AI subfields.

The author's prediction is clear: 'we humans tend to overestimate AI advances and underestimate the complexity of our own intelligence'. This book should be widely read, particularly by those with a technological or philosophical interest in artificial intelligence. ●

By Melanie Mitchell; Farrar, Straus and Giroux; 2019
Reviewed by: Lieutenant Colonel Cip Teletin, RO AF, JAPCC



'Airpower Pioneers – From Billy Mitchell to Dave Deptula'

John Andreas Olsen is a distinguished writer and a member of the Royal Norwegian Air Force, with a wealth of experience and a remarkable service background. His latest book, Airpower Pioneers, is a testament to his authoring talent and provides a key assessment of the fundamental leaders who built the USAF and modern airpower. This literary work describes the personal qualities and careers of individuals who distinguished themselves by advancing airpower theory, doctrine, and strategy, and in some instances, by implementing significant organizational changes in the USAF structure. These individuals were not only important during wartime, but also advanced aerospace power in innovative ways, shaping the future of airpower, which continues to evolve and requires new perspectives to match technological advancements.

The remarkable individuals highlighted in this book played a crucial role in driving the course of warfare and advancing aerospace technology through pioneering and innovative measures. Their unmatched impact has made an enduring impression on the ever-changing realm of airpower, which requires continuous ingenuity and fresh perspectives to keep up with the fast pace of technological progress. Airpower Pioneers is a must-read for anyone interested in the history of airpower and the individuals who shaped it. ●

By John Andreas Olsen; Naval Institute Press; 2023
Reviewed by: Major Tamás Oszlár, HU AF, JAPCC

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