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Moderator's Foreword

Esteemed Colleagues,

I am honoured to serve as your Moderator for the JAPCC Conference once again. For the second year in a row, we will convene amidst a major war being fought on the European mainland, right on NATO's borders.

Two years ago – a few months before Putin's illegal invasion of Ukraine – the then JAPCC Director, General Harrigian, spoke about how such an act should be a 'forcing function' for our governments and for NATO itself. The actions taken so far to support Ukraine and defend NATO nations have had significant effect and, after some initial hesitancy from some NATO members, have shown commendable unity and solidarity.

One great danger is that, as the war continues deep into its second year, a form of 'compassion fatigue' may affect public opinion and, in turn, the resolve of some NATO nations. The resolve of the Ukrainian people is unshakeable and as strong as ever. However, they continue to suffer losses of both their combatants and non-combatants and the destruction of their towns, cities, and critical infrastructure. Whilst the Russian invaders have substantial human resources and show an apparent willingness (even carelessness) to expend them in ill-considered offensives, Ukraine cannot afford to lose its men, women and children in similar numbers.

As I write this in Spring 2023, one positive move to address this first danger is the International Criminal Court's (ICC) decision to issue arrest warrants for Mr Vladimir Vladimirovich Putin and Ms Maria Alekseyevna Lvova-Belova for the war crime of unlawful deportation of the population (children) and that of unlawful transfer of population (children) from occupied areas of Ukraine to the Russian Federation (under articles

8 (2) (a) (vii) and 8 (2) (b) (viii) of the Rome Statute). Whilst some might see the ICC's move as merely symbolic, I believe this may have more far-reaching consequences. Those consequences include the reaction of actors and nations who still feel able to conduct 'business as usual' with Putin's regime. Nor should we discount the impact of 'mere symbolism'.

The second danger – that of the attrition of Ukraine and its people – can, at present, only be addressed by ensuring sure that Ukrainian forces have the equipment and training to fight smarter and have some degree of decisive overmatch against their aggressors. By so doing, NATO nations also enhance their own deterrence and defence. Nevertheless, make no mistake; a 'long war' serves Putin far more than it suits Ukraine and NATO. However, a recent article in The Economist (23 April) makes a far more subtle point:

'The question is not so much whether Russia can endure an even longer war of attrition (it can), but whether it can support the sort of intensification of the conflict Russia will probably need to transform its prospects on the battlefield. That looks almost impossible.'

Western sanctions are having a noticeable effect. Modern tanks need sophisticated optics and bearing assemblies. A recent Forbes.com article explains this well and cites as an example:

'A new T-72BM3 or T-90M tank requires modern optics, and those optics normally come from France. When Paris tightened its sanctions, it deprived Russian industry of the components it needs for the new tanks' Sosna-U digital sights.'

Vladimir Putin has proved to be NATO's greatest recruiting sergeant – as the recent accession of Finland and (pending accession of) Sweden shows. How ironic that the unprovoked invasion of Ukraine – said to be (in

part) to stop the encroachment of NATO on Russia – has prompted two previously non-aligned countries to seek NATO membership and add another 800 miles of NATO bordering on Russia. I welcome NATO's two newest members and acknowledge their contribution to NATO's enhanced deterrence and defence.

Finally, I draw your attention to the carefully curated collection of articles in this Read Ahead. They set the scene for our conference and provide an excellent introduction to the panel discussions.

I look forward to meeting you all in October!

Bruce Hargrave BSc MBA
Independent Air and Space Power Advisor

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Panel 1

The Role of NATO Joint Air and Space Power in Enhancing Deterrence and Defence

Abstract

Joint Air and Space Power is an important part of NATO's strategy and plays a crucial role in enhancing deterrence and defence. It provides key capabilities such as strategic mobility, rapid response, intelligence gathering through surveillance aircraft, unmanned aerial systems, and satellites. Space-based assets are crucial for communication, navigation, intelligence gathering, early warning, and generating situational awareness across all warfare domains. Air and Space Power is also the key enabler for our land forces executing manoeuvre warfare. Without Air and Space Power's ability to quickly create effects via friendly power projection, and the expeditious mobilization and redeployment of forces as needed by the Commander, conflict devolves into trench warfare.

Article Synopses

This panel presents two articles for the panel discussion on NATO Joint Air and Space Power in Enhancing Deterrence and Defence; the views

expressed in the chosen articles are meant to inspire critical thinking and to prepare those attending the 2023 Joint Air and Space Power Conference.

The first article was published by the Atlantic Council online on 18 April 2023. In 'NATO deterrence and defense: Military priorities for the Vilnius Summit', Kramer provides a recommendation for the future role of NATO Joint Air and Space Power in enhancing deterrence and defence. Written to inform the Vilnius summit, Kramer's article emphasizes the need for NATO to take six priority actions to effectively address the challenges posed by Russia's conventional military threat. Drawing upon lessons learned from the Russian-Ukrainian war focusing on mobility, sustainment, effective relationships, lower costs, command and control, and establishing the requisite funding associated with those efforts, Kramer presents a compelling argument highlighting their potential to significantly diminish the likelihood of future conflicts.

The second article, published by the Center for Strategic and International Studies (CSIS) on its online platform on 14 July 2023 after the Vilnius Summit, provides a succinct analysis of the outcomes during and around the summit. The international news headlines were initially focused on Sweden's acceptance into NATO. But these headlines were quickly drowned out by discussions regarding Ukraine's future prospects for joining NATO with perception from the news outlets leaning towards increased uncertainty for Ukraine. However, the actions by NATO, G7, and the EU overwhelmingly signal their commitment to Ukraine. Moreover, the alliance made a range of decisions to strengthen deterrence, adapt for the future, and deepen global partnerships.

NATO Deterrence and Defense: Military Priorities for the Vilnius Summit

By Franklin D. Kramer
Board Director, Atlantic Council

Article Courtesy of Atlantic Council

Introduction

At the North Atlantic Treaty Organization's July summit in Vilnius, the focus will necessarily be on support to Ukraine. But as NATO's Strategic Concept makes clear, the Alliance also needs to respond to a broader set of challenges, with those arising from Russia particularly acute. This issue brief focuses on the conventional military threat from Russia, and sets forth six priority actions that NATO should undertake to enhance its deterrent and defense posture.

In summary, the report recommends:

- enhancing NATO's mobility capability to meet the force-posture goals established at the Madrid summit through a combination of prepositioning; regular division, brigade, and air-wing forward training and exercises; establishment of new training areas; and increased host-nation support;
- establishing a sustainment initiative so that NATO maintains stocks sufficient to fight an extended-duration conflict, and that the defense industry has the capability to replenish such stocks in a timely manner;
- establishing effective relationships with key private-sector companies

that will engage in operational activities during a conflict, initially focused on cybersecurity for critical infrastructure, ensuring the continuity of information technology and communications networks and the utilization of private-sector space capabilities;

- establishing through the Defense Planning Process requirements for low-cost unmanned air and maritime vehicles, including with Artificial-Intelligence (AI) capabilities, and reviewing the potential role of mines as a deterrent capability;
- revising NATO's command-and-control structures at Joint Forces Command Brunssum and Joint Forces Command Naples to be regional commands capable of directing high-intensity warfare and focused on the east/north and the south, respectively; and utilizing currently available commercial technology to establish the capability for prompt command and control of multidomain operations; and
- establishing the requisite funding to achieve the foregoing, including a pledge by NATO nations of 2.5 percent of Gross Domestic Product (GDP) as a floor for defense spending and supporting the European Union (EU) creation of an EU security and defense budget focused on mobility, sustainment, and critical-infrastructure resilience.

The Russian Conventional Threat

NATO's Strategic Concept is clear as to the nature of the threat that Russia poses.

The Russian Federation is the most significant and direct threat to Allies' security and to peace and stability in the Euro-Atlantic area. It seeks to establish spheres of influence and direct control through coercion, subversion, aggression and annexation. It uses conventional, cyber and hybrid means against us and our partners. Its coercive military posture, rhetoric and proven willingness to use force to pursue its political goals undermine the rules-based international order…In the High North, its capability to

disrupt Allied reinforcements and freedom of navigation across the North Atlantic is a strategic challenge to the Alliance. Moscow's military build-up, including in the Baltic, Black and Mediterranean Sea regions, along with its military integration with Belarus, challenge our security and interests.[1]

The nature of the conventional threat that the Alliance faces is, of course, affected by Russia's engagement in its war against Ukraine. On the one hand, the threat might turn real in the near term. While Russia has not attacked into NATO territory, Russian President Vladimir Putin has been clear that Russia views the ongoing conflict as one in which NATO is involved.

During an interview aired on the state-owned Rossia-1 channel to commemorate the one-year anniversary of Russia's invasion of Ukraine, Putin claimed that by 'sending tens of billions of dollars in weapons to Ukraine' the North Atlantic Alliance was taking part in the war.

He further accused the West of having 'one goal: to disband the former Soviet Union and its fundamental part…the Russian Federation'.[2]

Whether any such escalation would occur – and how – is not knowable, including what Russia might do if Ukraine becomes more successful in retaking its territory.

A limiting factor, of course, is that the Russian military being heavily engaged in the fight against Ukraine reduces not only its current capability against NATO, but also its capabilities for the future, as noted in the recent Annual Threat Assessment of the US Intelligence Community.

Moscow's military forces have suffered losses during the Ukraine conflict that will require years of rebuilding and leave them less capable of posing a conventional military threat to European security…Heavy losses to its ground forces and the large-scale expenditures of precision-guided

munitions during the conflict have degraded Moscow's ground and air-based conventional capabilities.[3]

Nonetheless, Russia could determine that a direct attack into NATO terri-tory is necessary to disrupt NATO's support to Ukraine, particularly if Russia's position in the war deteriorates. Moreover, as demonstrated by Russia's proposed 'treaties' presented prior to its attack against Ukraine, Russia seeks to dominate the security of NATO's eastern members.[4] Under a calculus similar to that which led to the attack on Ukraine, Russia could, for example, attack the Baltic states or Poland. While Russia's conventional capabilities have been degraded, they can be reconstituted over time. Ad-ditionally, Russia has other nonconventional capabilities, which it might conclude enhance its prospects if it did decide to attack NATO territory.

- As part of such an attack, critical infrastructure would likely be targeted. As the US Intelligence Community has stated, 'Russia is particularly focused on improving its ability to target critical infrastructure, including underwater cables and industrial control systems, in the United States as well as in allied and partner countries, because compromising such in-frastructure improves and demonstrates its ability to damage infrastruc-ture during a crisis'.[5]
- Russia has recently announced that it will place tactical nuclear weap-ons in Belarus, and might use the threat of such weapons to constrain a NATO response to an attack.[6]

To sum up, Russia is a near-, medium-, and longer-term threat. Its willing-ness to go to war against Ukraine underscores that it might act on its stat-ed concerns regarding NATO. Accordingly, the recommendations below are intended to enhance NATO's deterrent and defense posture, both to reduce the probability of a conflict with Russia and to ensure a successful outcome if such a conflict occurs.

NATO Priorities

In conjunction with the issuance of NATO's new Strategic Concept at the June 2022 Madrid summit, NATO agreed to a 'New NATO Force Model'. While only in outline form, the new force-model presentation states that NATO will be able to provide 'well over 100,000 Tier 1 forces' in 'up to 10 days' and 'around 200,000 Tier 2 forces' in 'around 10–30 days'.[7] The discussion below sets forth six priority actions necessary to accomplish the goals of the new force model.

A. Mobility

NATO has not currently provided a breakdown of the composition of either Tier 1 or Tier 2 forces. However, NATO's military authorities, led by the Supreme Allied Commander for Europe (SACEUR), are presumably doing a detailed mobility analysis as part of effectuating those force goal requirements. Such a review should be utilized to develop the requirements for transportation (e.g., rail cars required, bridges that need to be reinforced), logistical coordination (e.g., time-phased rail and road movements), and finances (costs associated with achieving mobility requirements). The specifics can then be broken down and passed to nations via the Defense Planning Process, and to the European Union through the existing coordination mechanisms supporting military mobility.

In addition to the specifics from such a review, three operational considerations provide a basis for NATO actions to enhance mobility that should be approved at Vilnius.

First, prepositioning equipment forward significantly reduces mobility requirements, which can be quite substantial – particularly for heavy forces. By way of example, an armored brigade combat team moving in

the United States can require on the order of six hundred rail cars.'[8] While other NATO heavy brigades are generally smaller, they would likewise require significant movement and other logistical support including, for example, sufficient rail cars and heavy-equipment transporters, as well as theater-wide coordination of movements.

The NATO military authorities developing the force model can reduce the logistical burden, and speed the availability of forward forces, by including the establishment of substantial amounts of prepositioned materiel in the eastern portion of the Alliance as a key element in planning. In particular, while the United States already has six prepositioned sets of equipment in Europe, France, Germany, and the United Kingdom should each undertake prepositioning in the east, which will enhance their ability to have their forces ready for combat in accordance with the requirements of the new force model.[9] By way of example, the United Kingdom's recent Integrated Review Refresh provides for only one brigade to be sent forward in the event of a conflict with Russia, but appropriate prepositioning would allow for at least one more to be quickly available.[10]

Second, forces that are already forward deployed for training would obviously have a positive impact on mobility requirements in the event of a conflict. Some useful steps have been taken – including the establishment of enhanced forward brigades now present in eight countries – but the actual number of forces forward deployed by European countries is still relatively modest.[11]

- The United Kingdom, '[i]mmediately after Russia attacked Ukraine…very rapidly deploy[ed]…three Army battlegroups across Europe: tanks to Scandinavia, infantry and cavalry to Estonia and Poland, and battlefield helicopters and paratroops to the Balkans'.[12] However, a 'typical Battlegroup…could contain about 600 men', so the deployment is far from what would be needed in a conflict.[13]

- France has an approximately five-hundred person force in Romania as part of its leadership of the newly established multinational enhanced forward brigade of approximately eight hundred in that country, and has also deployed additional forces of about six hundred in exercises with the brigade.[14] This is an entirely worthwhile effort, but insufficient for the requirements of a conflict.

NATO should consistently increase the number of forces in the east by establishing regularized regional training schedules of larger force components – both land and air – for non-eastern countries, by having eastern countries establish useful training ranges, and providing effective host-nation support to facilitate such activities.

While the United States maintains substantial permanent and rotational forces in eastern Europe,[15] increasing the capacity of other NATO members to be able to likewise maintain larger forward forces will require both restructuring of militaries to add to active duty forces, and additional resources to support such forces as well as their forward deployment.

At present – and for the foreseeable future – the British Army is unable to maintain a continuous rotational presence of an entire armoured brigade outside the UK without announcing mobilisation. Its 3rd Division, intended for operations in the European theatre, will only complete the process of restructuring and modernisation by 2030, and will consist of two armoured and one reconnaissance and artillery brigade combat teams. That is why London is unable to assign a specific brigade to Estonia, but can only offer individual subunits.[16]

It is not only the United Kingdom facing such limitations.

The German Army will not have one fully equipped brigade available until 2023, when it will be on duty with NATO's Very High Readiness Joint Task

Force (VJTF). The Bundeswehr will only have one fully modernised division available by 2027, and a further two by 2031. It would thus only be able to permanently deploy one brigade in Lithuania on a rotational basis by around 2026. Canada also has the problem of deploying an entire brigade without prior mobilisation, as its peacetime armed forces consist of only three mechanised brigades.[17]

To support expanded forward training, the issue of infrastructure for training also needs prompt, high-level attention. While substantial upgrades to infrastructure, including a facility for prepositioned stocks, are taking place in Poland, and there are ongoing enhancements to airfields in Romania, much of the existing infrastructure in the east cannot support brigade-level activities and remediation plans are insufficient.[18] NATO needs to determine what is required in the southeast and especially in the Baltics, which could be the initial locus of a conflict but where host-nation support is currently insufficient.

An earlier Atlantic Council report identified a need for the Baltic countries to improve rail lines 'connecting with key military bases and likely staging areas' and to enhance the 'ability of roads and bridges…to accommodate heavy vehicles'.[19] The same study noted the limited capacity of Baltic nation training areas to conduct brigade-level training, as well as live-fire exercises.[20]

None of the Baltic states is in a position to provide the infrastructure necessary to station such (brigade) forces in the near future. The training grounds and barracks infrastructure is insufficient and needs to be significantly developed. Lithuania has declared that it will complete the relevant investments by 2026. Estonia, as agreed with London, will develop its military infrastructure so that it can accommodate an entire brigade. In Latvia too, the NATO battlegroup is making full use of the military installations there; Latvia has taken steps to expand them. The problems of inadequate housing for soldiers and the too small military training grounds in the Baltic states are not

new. The military infrastructure has been undergoing a process of modernisation for years there, but the scale of requirements remains very high.[21]

NATO should continue to utilize its own common-funded Security Investment Programme budget to support such efforts.[22] That budget was recently increased to one billion euros, but further increases are warranted.[23] Likewise, national funding comparable to the US European Deterrence Initiative (which is planned at $3.6 billion for fiscal year [FY] 2024) should similarly be directed by other non-eastern NATO members.[24] Moreover, as more fully discussed below, the European Union should establish a security and defense budget, with one key component being increased funding for NATO mobility requirements.

B. Sustainment

The duration of the Russia-Ukraine war has brought home the necessity for NATO to have the capability to engage in an extended conventional conflict. While the current focus has understandably been on ensuring Ukraine's ability to continue fighting, an effective deterrent and defense posture for NATO is also dependent on a sufficient capability to engage in conflict over an extended period.[25] However, NATO nations have long suffered from significant underinvestment, and munitions stocks and other materiel are at entirely insufficient levels. A study by the European Union highlighted that 'years of defence underspending…has led to an accumulation of gaps and shortfalls in the collective military inventories as well as reduced industrial production capacity'.[26]

At Vilnius, NATO needs to take three steps to acquire the necessary sustainment capabilities.

First, NATO needs to establish a mandatory sustainment target for nations. A reasonable goal would be to have sufficient stocks of key weapons and

associated logistical support on hand to be able to undertake an effective defense for a one-year period. The NATO military authorities, led by SACEUR, can establish goals based on analytic reviews and wargaming of such matters as rates of fire, expected losses, and required maintenance. Given that NATO nations are currently so substantially lacking in terms of sustainment, it will be important to set priorities with a focus on the most critical requirements. Not everything will be able to be acquired as promptly as would be desirable. Once overall prioritized goals are established, national goals can then be transmitted to individual nations through the Defense Planning Process.

Second, NATO needs to take steps to increase defense industry capabilities. Certain useful actions to that end are already being undertaken, including in the context of supporting Ukraine. Among other efforts, the European Union through the European Defence Agency has agreed on joint funding for expanded ammunition production:

Eighteen states sign[ed]…the European Defence Agency (EDA) project arrangement for the collaborative procurement of ammunition to aid Ukraine and replenish Member States' national stockpiles. The project opens the way for EU Member States and Norway to proceed along two paths: a two-year, fast-track procedure for 155 mm [millimeter] artillery rounds and a seven-year project to acquire multiple ammunition types.[27]

As the seven-year effort to acquire multiple ammunition types suggests, multiyear procurements are crucial for industry to be able to undertake the investments necessary to support NATO's enhanced requirements for sustainment.

The US Congress has similarly authorized multiyear procurements by the Defense Department (DoD), which the DoD has utilized in establishing its acquisition plans to be funded by the proposed FY 2024 budget.

This budget leverages unprecedented use of Multi-Year Procurement (MYP) authorities provided by Congress to deliver critical munitions affordably, while bolstering our inventories and providing a more predictable demand signal to the industry. This strategy will facilitate industrial production efficiencies because the industry would be incentivized to organize in a more cost-effective manner.[28]

Other nations, such as France and Germany, which are undertaking major defense-spending increases, should likewise utilize multiyear procurements.[29]

Third, multinational consortiums should be organized to combine spending on key equipment and materiel that the NATO military authorities designate as areas of highest priority. NATO already organizes a number of common efforts, ranging from acquiring high-end capabilities to establishing key logistical efforts, such as multinational ammunition warehousing.[30] Future such activities should be undertaken, as much as is practicable, in coordination with the European Union, which, as noted above, has undertaken similar efforts through the European Defense Agency.[31]

C. Engaging the Private Sector During Conflict

In the context of the Russia-Ukraine war, private-sector companies have been instrumental in coordinating with the Ukraine government to provide operational cybersecurity capabilities and help maintain Ukraine's access to the Internet.[32] The resultant continuity of operations has occurred despite significant Russian cyber and kinetic attacks.[33]

Those operational and coordinated activities by the private sector demonstrate that there is a 'sixth domain' in warfare – in addition to the five recognized domains of land, maritime, air, cyber, and space.[34] Specifically, the

private sector's 'sphere of activities' in wartime is itself a sixth domain, and it needs to be included as part of warfighting constructs, plans, preparations, and actions if NATO and its nations are to prevail in future conflicts.[35]

NATO needs to take the following actions to establish effective coordination with the private sector.

First, contrary to the expectations of many, cyber defense has proven quite effective for Ukraine in the context of the Russia-Ukraine war. That has largely been true because capable private-sector companies have been engaged with the Ukraine government in effectuating the cyber defense effort.[36] NATO needs to ensure that its member nations have likewise organized highly capable cybersecurity support from the private sector for those critical infrastructure necessary for effective military operations – which will generally involve the electric grid, pipelines, air, rail, and ports, as well as the information and communications networks themselves. NATO does not have the regulatory authority to require such actions, but the obligations can be included as part of the Defense Planning Process – and can then be harmonized with European Union and national cybersecurity regulations, including the European Union's recent network and information security (NIS2) directive which nations are required to comply with by October 2024.[37]

Second, a focused effort needs to be undertaken with respect to undersea cables. Transatlantic cables are instrumental to connectivity between North America and Europe, and undersea cables also support connectivity between the United Kingdom and Europe, as well as across the Baltic Sea.[38] As noted above, 'Russia is particularly focused on improving its ability to target critical infrastructure, including underwater cables.' In a conflict, undersea cables would be expected targets, both through cyberattacks and physical attacks, including at onshore cable landing points. Justin Sherman and John Arquilla have each set forth a variety of

recommendations to enhance undersea cable resilience.[39] At the Vilnius summit, NATO's Joint Task Force – Norfolk, which has responsibility for maritime operations should be tasked to work with Allied Command Transformation – and key nations including the United States, France, and the United Kingdom that have significant undersea capabilities – to develop the necessary plans to enhance the resilience of undersea cables.

Third, plans for the use of private-sector space assets need to be established. In the Ukraine conflict, the use of Starlink terminals has proved indispensable.[40] A variety of possible technical arrangements, particularly those focused on low-Earth-orbit satellites, can be utilized to support wartime activities, and NATO planning needs to evaluate and then organize those of important value. This includes both establishing contractual arrangements and, as appropriate, enacting legislation that ensures the availability of the necessary assets. In the United States, the Defense Production Act, which covers the provision of services, may provide the necessary legislative framework, but NATO and member nations should undertake a comprehensive review to determine what may be required.[41]

Fourth, plans and exercises need to be developed and undertaken with the private sector. While ad hoc arrangements – such as those put in place in Ukraine – can obviously be useful, an organized planning and exercising effort will be far superior.

Fifth, NATO needs to determine what role capabilities such as those provided by US Cyber Command's 'hunt forward' will play in achieving the resilience of critical infrastructure.[42] The United States through Cyber Command – as well as other nations with significant cyber capabilities such as the United Kingdom, France, and Estonia – need to work with SACEUR to determine how offensive operations should be integrated with defensive actions to achieve the requisite degree of resilience designed to protect key critical infrastructure operated by the private sector.

D. Low-cost Defense Planning –
Unmanned Vehicles and Land Mines

As noted above, NATO military capabilities have suffered from years of un-derinvestment by nations. While budgets have been increased, resource constraints are still significant. Accordingly, NATO and its nations should look carefully at low-cost capabilities that can substantially enhance deter-rence and defense. Unmanned vehicles and land mines both offer promise.

1. Unmanned Vehicles

The use of unmanned vehicles – both air and maritime – in the Russia-Ukraine war has highlighted their value for Intelligence, Surveillance, and Reconnaissance (ISR); for targeting; and for attack.[43] Unlike high-end and costly capabilities – exemplified by US unmanned air systems including the Gray Eagle ($127 million per copy), Reaper ($28 million per copy), and Global Hawk ($141 million per copy) – the unmanned vehicles utilized in Ukraine have been less sophisticated and cheaper.[44] However, as the con-duct of the war and the discussion below elaborate, inexpensive un-manned vehicles based on available commercial technology can deliver a high degree of capability for both surveillance and attack.[45] As is already the case for Ukraine, low-cost unmanned vehicles should become an im-portant element of NATO's deterrent and defense strategy.

A useful starting point to illustrate the value of low-cost unmanned vehi-cles based on commercial technology comes from two task forces estab-lished by US Central Command.

The Air Force's Task Force 99 was 'established in October at al-Udeid air base in Qatar, [and] aims to test commercially-available small, high-altitude drones linked by [a] mesh network.'[46]

[It] looks for new ways to deploy robotic platforms for ISR and other missions…'not just tracking objects in the air, but…finding things that could be on the ground…and how those could be a threat.'[47]

The unit 'recently concluded its first operational experiment, a successful test of using small drones for intelligence, surveillance, and reconnaissance roles'.[48]

Central Command's Task Force 59 has accomplished similar achievements in the maritime arena.

The Navy stood up TF 59 in September 2021…[in a] turn to the private sector [and]…[w]ithin a month, the new unit had begun deploying unmanned, unarmed, camera-laden sea drones linked by artificial intelligence into the Persian Gulf…

TF 59 has since conducted exercises with Bahrain, Jordan, Kuwait, Qatar, Saudi Arabia and Israel, and has deployed some two dozen drones – among them [private-sector] Saildrones, MARTAC Mantas T12s, T38 Devil Rays – with the goal that regional navies will contribute 80 such devices by the end of 2023.[49]

As these efforts demonstrate, currently available commercial technologies cannot only provide highly useful ISR, but such activities can be effectively integrated among nations – avoiding many of the issues that often face coordination of activities involving classified systems.

As useful as the ongoing efforts are, the potential for use of unmanned vehicles is much greater, as Thomas Hamilton and David Ochmanek have described.

[An] approach…to employ large numbers of relatively low-cost, attritable – low-cost, reusable, and ultimately expendable – unmanned aerial vehicles (UAVs) to perform a variety of tasks in support of joint force defensive campaigns…[S]uch an approach…could allow land-based forces to generate and sustain airpower without relying on fixed base infrastructure, such as runways and maintenance facilities.[50]

The Hamilton and Ochmanek analysis is built around Unmanned Aerial Vehicles (UAVs) being 'employ[ed] in contested zones to create a targeting mesh – a net of UAVs that work together'.[51] Their analysis focused on how such a network could be utilized to stop an attack by the People's Republic of China (PRC) across the Taiwan Strait, but the approach is equally applicable to an attack by Russia against NATO nations, as the 'object of a targeting mesh is to be able to guide a missile on to a specific [target]', which, of course, applies as much to Russian military assets as to those of the PRC.[52]

While Hamilton and Ochmanek's conclusions are analytic, ongoing developments such as those with Task Forces 99 and 59 underscore that the capabilities they describe are well within the reach of a commercially based effort. For example, the UAVs for the targeting mesh would have 'comparatively simple sensors based on commercial technology', and '[c]ommunication within the mesh…is provided by Millimeter-Wave (MMW) radio, a technology already widely used for 5G communications'.[53] T. X. Hammes has likewise described the ability of commercial drones to provide 'affordable ISR and attack' including the potential for the commercial sector to 'appl[y] advanced manufacturing techniques' that could lead to an 'exponential drop in the cost of precision-guidance technologies'.[54]

Undertaking an effort – for example, by a consortium led by the United States and working closely with the commercial sector – to build effective yet inexpensive unmanned vehicles such as for a targeting mesh and

precision-strike drones as critical capabilities for NATO should be an agreed outcome of the Vilnius summit.

2. Landmines

NATO needs to evaluate whether landmines would be an important capability to be utilized in the context of a high-intensity conflict with Russia – and also an important element of deterrence.

Landmines have proven valuable as part of the Ukrainian military's combined-arms approach. One example involved a 'three-week fight in the town of Vuhledar in southern Ukraine'.[55]

The Ukraine military had prepared a kill zone farther along a dirt road that the [Russian] tanks were rumbling down…

Anti-tank teams hi[d] in tree lines along the fields…armed with American infrared-guided Javelins and Ukrainian laser-guided Stugna-P missiles… Farther away, artillery batteries were ready. The dirt road had been left free of mines, while the fields all about were seeded with them, so as to entice the Russians to advance while preventing tanks from turning around once the trap was sprung.

The column of tanks becomes most vulnerable…after the shooting starts and drivers panic and try to turn around – by driving onto the mine-laden shoulder of the road. Blown-up vehicles then act as impediments, slowing or stalling the column. At that point, Ukrainian artillery opens fire, blowing up more armor and killing soldiers who clamber out of disabled machines.[56]

Landmines can also have deterrent value. Colonel John B. Barranco has described how Ukraine could use landmines as a 'planned border wall' if Russian forces were expelled, either as a 'continuous mine barrier along the

entire border, or one focused on crucial terrain that channels potential invading forces onto the ground of Ukraine's choosing'.[57]

For NATO, there could be substantial deterrent value in a border wall for the Baltic countries and Poland (and Finland now that it is a member) that utilizes mine barriers. South Korea utilizes just such mine barriers as an important element of combined deterrence and defense with the United States on the Korean peninsula.[58]

A decision to utilize landmines as part of NATO deterrence and defense would raise significant geopolitical issues. Currently, all NATO nations other than the United States are parties to the landmine treaty, which bars the use of such mines.

The launcher of such a mine must have direct visual contact with the location upon triggering it, [while]…mines banned by [the treaty] involve explosives set off by the proximity of – or contact with – the target.[59]

Moreover, the United States, because of a policy decision by the Joseph Biden administration, has limited its involvement in landmine use to only Korea.[60]

There is no doubt that indiscriminate use of landmines can be devastating to civilian populations; precisely that problem has arisen in Ukraine as a result of their use by Russia.[61] However, a Russian attack against NATO nations would undoubtedly cause enormous harm to civilians, as Russian attacks on Ukrainian cities have demonstrated – and the placement of landmines at the border might well be a valuable deterrent factor.

The nature of the security environment in Europe has significantly changed since the broad adoption of the landmines treaty. At Vilnius, NATO should generate a review of whether or not – and under what conditions – landmines should become part of its defense.

E. Command and Control

NATO's existing command-and-control arrangements have not been organized for a high-intensity conflict against Russia. At the Vilnius summit, NATO military authorities will present regional plans that include responding to such a contingency. As part of implementing those plans, NATO should revise the command structures at JFC Brunssum and JFC Naples to enhance the Alliance's operational capabilities for high-intensity conflict with Russia; and promote nations' adoption of commercially available technology that can provide for effective multi-domain tactical operations.

1. Revised Command Structures

In the years since Russia's illegal seizure of Crimea, NATO has undertaken a series of initiatives to upgrade its warfighting capabilities, including increasing the size of the NATO Response Force, establishing a NATO Readiness Initiative, and developing Graduated Response Plans.[62] However, none of those efforts involved the development of a fully articulated war plan for high-intensity conflict including the required command and control. To support the regional plans that will be presented at Vilnius and the force requirements of the New NATO Force Model, NATO military authorities need to review the command-and-control capabilities of the joint-force commands, and determine how operational control below the SACEUR should best be effectuated.

Key issues include the appropriate division of labor among the JFCs; whether there should be a new 'Northern Command' as Finland became a NATO member before Vilnius, and Sweden might as well; what should be the relationship between JFC Norfolk and the two European-based commands; and whether the JFCs need internal restructuring or strengthening to accomplish the goals of the new force model.

The principle of unity of command suggests several answers to those issues.

- First, in a conflict with Russia, there will be continuous interactive operations among and between the nations and militaries in and around the Baltic Sea. Maintaining unity of command suggests, therefore, that JFC Brunssum be organized to have responsibility for both sides of the Baltic Sea, as well as its waters. Or, to describe it in another way, JFC Brunssum would have both an eastern and northern focus.
- Second, JFC Naples would have responsibility for wartime activities in and around the Mediterranean Sea, including those on land or in the air from Portugal through Turkey. Moreover, given its maritime and geographical focus, JFC Naples should have responsibility for naval activities in the Black Sea, though Romania, and probably Bulgaria, should fall within JFC Brunssum's land-based area of responsibility (AOR). National forces moving from JFC Naples' AOR to JFC Brunssum's AOR would transfer to command under JFC Brunssum.
- Third, JFC Norfolk should maintain maritime command in the Atlantic, but forces once on land or in the Baltic or Mediterranean Seas should fall under the command of JFC Brunssum or JFC Naples, respectively.
- Fourth, NATO military authorities should be tasked to recommend any required restructuring and/or strengthening of JFC Brunssum, JFC Naples, and JFC Norfolk. Concomitantly, there should be a review of existing NATO command capabilities below the JFCs. For example, there are currently nine deployable NATO headquarters, but the manpower and financial resources for at least most of those headquarters would be better focused on the requirements for deterring and defending against Russia.[63]

2. Commercially based ISR and targeting for multidomain tactical operations

NATO's Strategic Concept underscores multidomain operations as a centerpiece of high-intensity warfare.

We will individually and collectively deliver the full range of forces, capabilities, plans, resources, assets and infrastructure needed for deterrence and defence, including for high- intensity, multi-domain warfighting…[64]

To accomplish effective multidomain operations, NATO needs 'to exponentially improve the quality and speed of shared awareness, decision-making, and action', as a recent report by retired Major General Gordon Davis states.[65] Nations have understood the need for such improvements, and are accordingly engaged in developing the requisite capabilities including, for example, the effort by the United States focused on Joint All-Domain Command and Control.[66]

NATO and nations could, however, substantially – and promptly – advance capabilities in this arena by the utilization of commercially available technology. The possibilities are exemplified by two systems – GIS Arta and the Delta Situational Awareness System – developed by Ukraine in the context of the Russia-Ukraine war. The systems integrate information from multiple ISR sources, increasing battlespace awareness, and allow for prompt targeting by weapons networked with the ISR information. They are discussed below partly to show their own value but, much more importantly, to demonstrate what is possible using commercially available technology.

The Delta Situational Awareness Systems 'provides a comprehensive picture of the current battle space displayed and summarised on a user-friendly digital map by collecting data from sensors and open and secret sources'.[67] It 'integrates real-time intelligence data from multiple sources and provides real-time monitoring of the battlefield for commanders of different levels'.[68]

A key aspect of Delta is that it utilizes available commercial technology to provide the information to users as the 'system…is ready to use on laptops, tablets or mobile phones'.[69]

The result is illustrated on an interactive map which locates enemy forces and gives troops on the ground a crucial advantage. The system is, simply put, a real-time command-and-control centre that brings Ukrainian forces cutting-edge capability in the network-centric environment of modern warfare.[70]

GIS Arta is another Ukrainian system, also based on commercial tech-nology that allows for coordinated targeting.

Forward observers, unmanned aerial systems, or other scout elements can share their observations of an enemy target's location in real time over an encrypted network. These networks are multiband, and can utilize satel-lite, internet, and radio protocols across a number of devices readily avail-able to all [Ukrainian] echelons.[71]

GIS Arta 'allows for immediate verification of a target, and a kill decision can be made in record time at a command team's [tactical operations center]' to provide targeting orders to multiple components and systems.

The request for fire goes out to whatever element is the most available. The ubiquity of GIS Arta's interfaces, being scalable down to an individual smartphone, means that the targeting assignment can be given to everything from the most sophisticated Multiple Rocket Launcher System to the lowest-tech ambush crews on Ukraine's Territorial Defense Force… Simultaneous fires from multiple vectors can be placed if deemed necessary, providing a joint-strike capability.[72]

Each of Delta and GIS Arta appears capable of effectuating important as-pects of multidomain warfare. They appear to be the kind of systems that would fit as part of a 'federated architecture [that] would retain local connectivity through mobile, ad hoc networks composed of nodes sharing data in multiple directions over short ranges'.[73] However, the point is not

necessarily to acquire those systems – that needs expert evaluation. Rather, at the Vilnius summit, NATO military authorities should be tasked with establishing a consortium to develop and make available such commercially based systems – including, but not limited to, a review of the value of Delta and GIS Arta – for utilization by nations on the high-intensity battlefield.

F. Resources

Acquiring the capabilities necessary for success in high-intensity warfare will require sustained higher levels of spending than NATO nations have undertaken since the end of the Cold War. To accomplish that objective, three initiatives should be agreed upon at the Vilnius summit.

First, NATO should agree that nations should spend at least 2.5 percent of GDP on defense instead of the 2-percent goal previously agreed. The United Kingdom has established such an aspiration, and Estonia has recommended such a requirement for all allies.[74] While only the United States, Poland, and Greece currently meet the 2.5-percent target, a number of nations – including France, Germany, and the United Kingdom, which have larger militaries – have increased, or set plans to increase, budgets.[75] It will be important for those additional budgetary amounts to be utilized to meet the requirements necessary to achieve the objectives of the New NATO Force Model.

Second, as discussed above, NATO should help develop – and nations should undertake to acquire – lower-cost, but still highly effective, systems based on commercial technologies. Exquisite and more costly systems will certainly continue to have consequential value, but they will be out of the reach of many nations. Those nations, however, can still provide effective capabilities utilizing lower-cost systems built around commercial capabilities. NATO should include the utilization of such lower-cost technologies as a focus of its implementation efforts.

Third, the EU could accomplish a great deal through the creation of a regularized EU security and defense budget focused on mobility, sustainment, and critical-infrastructure resilience. The EU has already taken steps that set a basis for establishing such a budget. It recently added 616 million euros to its spending on military mobility.[76] Through its European Peace Facility, it has provided 3.6 billion euros in funding for Ukraine, including to support contributions of military materiel by EU member nations.[77] Moreover, as noted above, it has established a funding mechanism for the acquisition of ammunition by EU members.

While each of these are valuable actions, regularizing such expenditures at significantly higher levels through an EU security and defense budget is called for, in light of the threat posed by Russia. The need is clear enough.

- 'In the context of the original mobility plan, the European Commission proposed a budget of approximately 6.5 billion euros. However, that proposal was reduced to 1.69 billion euros in the enacted budget, far from what would have been necessary prior to Russia's invasion of Ukraine and even less so now.'[78] The planned 616 million euros hardly remedy this substantial deficiency.
- In terms of sustainment, in addition to the plans for ammunition, the EU should provide budgetary support for key weapons systems needed for high-intensity conflict, including 'anti-armor capabilities and man-portable and medium-range air defenses, unmanned aerial vehicles for both sensing and attack, long-range fires, and precision-guided munitions'.[79]
- The EU recently issued 'important directives requiring that nations enhance the resilience of their critical infrastructure…[b]ut implementing the directives will require significant fiscal expenditures'.[80] The EU is currently developing the Cyber Solidarity Act whose 'purpose is to establish a 'cyber reserve' made of private trusted providers that

would qualify with certification and would support responses to significant cyber-attacks'.[81] If the legislation is enacted, that would establish a 'budget that provides complementary fiscal support for following the new directives, rather than leaving those responsibilities solely to nations.'[82]

Conclusion

At the Vilnius summit, NATO should take steps to enhance its deterrence and defense capabilities to meet the challenges presented by the Russian conventional military threat. Key areas include mobility, sustainment, private-sector interaction, unmanned vehicles, artificial intelligence, mines, command and control, and ensuring adequate resources. Undertaking the required actions will reduce the probability of conflict, but ensure that NATO will prevail if conflict does arise.

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What Happened at NATO's Vilnius Summit?

By Sean Monaghan, Sissy Martinez, Otto Svendsen, Carlota García Encina, and Mathieu Droin, Center for Strategic and International Studies

Article Courtesy of CSIS

T he leaders of 31 NATO allies gathered in Vilnius, Lithuania, for the annual NATO summit. Attendees included new member Finland, prospective member Sweden, several non-NATO partner nations, and Ukrainian president Volodymyr Zelensky. The meeting began on Tuesday, 11 July, 503 days[1] after Russia's full-scale invasion of Ukraine began. While Ukraine's bid for NATO membership captured most of the headlines, the alliance made a range of decisions to strengthen deterrence, adapt for the future, and deepen global partnerships.

Q1: What is the status of Ukraine's bid to join NATO?

A1: The position held by the alliance on Ukraine's NATO application[2] was the key question ahead of the Vilnius summit. While imminent membership was not in the cards, as all parties, including Ukraine[3], had already agreed to wait until the war ends, President Zelensky at least expected[4] to receive an invitation. The language agreed on by allies in the Vilnius communiqué[5] fell short of his request, stating: 'We will be in a position to extend an invitation to Ukraine to join the Alliance when Allies agree and conditions are met.' This position reflects the desire of the United States[6] and other allies to minimize any risk of Russia escalating the conflict in Ukraine or beyond.

However, allies went further than ever before on Kyiv's membership by removing the requirement for a Membership Action Plan and creating a new NATO-Ukraine Council.[7] NATO also upgraded its Comprehensive Assistance Package to a multiyear program[8] 'to help transition Ukraine from Soviet-era to NATO equipment and standards'. Whether or not the Vilnius package fell short[9] of expectations, the summit appeared to represent a step change in the discussion about Ukraine's membership prospects. The Vilnius communiqué[10] mentions Ukraine 48 times (compared to 13 mentions in the Madrid declaration). As UK defense secretary Ben Wallace said[11]: 'The win here for Ukraine is the sort of cultural acceptance that Ukraine belongs in NATO'. Or as President Zelensky himself put it[12]: 'For the first time, not only do all allies agree on this, but a significant majority in the alliance is vigorously pushing for it.'

Q2: What other support did Ukraine receive in Vilnius?

A2: Although NATO membership is the ultimate security guarantee[13], President Zelensky arrived in Vilnius seeking[14] security assurances from allies to bridge the gap. In response, the G7 – which includes the United States, United Kingdom, Canada, Japan, Italy, France, and Germany – published a 'joint declaration of support for Ukraine'[15] which clarified their 'unwavering commitment' to supporting Ukraine's freedom 'for as long as it takes.' The declaration seeks to hold Russia accountable, pursue Ukrainian reforms, offer Ukraine additional aid in the event of further aggression, and increase military and financial assistance to Ukraine.

The declaration does not detail specifics, instead providing a 'multilateral framework' for signatories to make their own 'bilateral security commitments and arrangements' with Ukraine. In effect the agreement launches bilateral 'negotiations' between its signatories and Ukraine to begin 'immediately'. This means it is now up to the G7 nations – and others, who 'may join this Joint Declaration at any time' – to follow through. While

further military aid was announced around the Vilnius summit – including US cluster munitions[16], French long-range missiles[17], additional German tanks and vehicles[18], and more British tank ammunition and vehicles[19] – Ukraine will now expect its allies to propose bilateral, multiyear packages of military and financial aid. Kyiv will hope this provides certainty its allies will keep military aid flowing in the face of unpredictable domestic politics and elections – most of all in the United States, its biggest backer. Meanwhile, NATO allies will hope the declaration influences Moscow's calculation over the long-term viability of its war in Ukraine.

Q3: How did NATO strengthen its deterrence and defense in Vilnius?

A3: Building on their commitments at last year's Madrid summit[20] to strengthen deterrence and defense, in Vilnius NATO allies agreed[21] on 'significant measures to further enhance NATO's deterrence and defence posture in all domains, including strengthening forward defences and the Alliance's ability to rapidly reinforce any Ally that comes under threat'. These measures are designed to deter conventional and nonmilitary hybrid threats.

Conventional deterrence measures agreed to in Vilnius included the following:

- Three new regional plans were agreed on to defend NATO allies on all flanks, along with new command and control arrangements.
- Progress on the NATO Force Model[22] (300,000 troops ready to deploy within 30 days) was hailed and a new 'Allied Reaction Force' established. However, it is worth noting progress on the new force model appears slow – Chair of the Military Committee Admiral Rob Bauer cautiously admitted[23] before Vilnius that NATO is 'working towards those numbers' – and no detail is available yet on the new reaction force.

- The eight Enhanced Forward Presence battlegroups 'are now in place' and the ambition to scale up to brigade-sized units 'where and when required' remains. Before the summit, Canada offered[24] to double its contingent in Latvia, adding 1,200 troops, while Germany confirmed[25] it would send a permanent brigade of up to 4,000 troops to Lithuania in the future.
- Enhancements were made to NATO's Integrated Air and Missile Defence posture, including rotating modern air defense systems across the eastern flank and increasing readiness. To further strengthen air exercises and activity, Estonia, Latvia, and Lithuania also signed[26] a Declaration of Cooperation on cross-border airspace management.

Measures to deter nonmilitary hybrid threats included new resilience objectives; anew 'Maritime Centre for the Security of Critical Undersea Infrastructure'; a new cyber defense concept, a cyber defense pledge, and 'Virtual Cyber Incident Support Capability'; a NATO Space Centre of Excellence in France; and a commitment to protect energy infrastructure and secure energy supplies to military forces. NATO also opened a new Centre of Excellence for Climate Change and Security in Montreal, Canada.

Q4: What did allies agree to on defense spending?

A4: As expected, allies agreed on a new commitment to spend at least 2 percent of GDP on defense. This commitment replaces the Defense Investment Pledge made in 2014[27], which has seen European allies increase defense spending by more than a third to $ 375 billion this year, according to NATO's latest figures[28]. The new pledge seeks to close the gap in NATO defense spending left by the 20 allies that currently do not meet the 2 percent guidance (although 26 allies meet the requirement to spend at least 20 percent on modernization). However, this still leaves

the issue of the need for more investment in defense to deliver on the ambitious force goals announced in Madrid and Vilnius. The communiqué phrase that 'in many cases, expenditure beyond 2 percent of GDP will be needed' may be viewed as inadequate by those nations who far exceed the 2 percent target, such as the United States, the Baltic nations, and Poland. Equally, divisions in threat perception, domestic politics, and economics – including fiscal debates[29] in the European Union – will continue to make it difficult for all allies to exceed 2 percent.

One perennial issue with blunt spending targets like 2 or 20 percent is that they are political rather than technical and do not provide an accurate understanding of the defense output[30] actually generated by allies. For this reason, NATO should look again[31] at the 2 percent metric to design better ways of measuring contributions and output, including accounting for the capabilities that allies actually provide in practice. The burden-sharing debate[32] will likely be a big part of NATO's next summit in Washington given it features prominently in US domestic politics; NATO needs better information to inform the debate.

Q5: What did allies agree to on emerging and disruptive technologies?

A5: Beyond the Defense Investment Pledge, which partly aims to increase investments in research and development related to procurement of major equipment and through integrating innovative technologies into forces and capabilities, the joint communiqué included more specific technological initiatives. Allies agreed[33] to accelerate 'our own efforts to ensure that the Alliance maintains its technological edge in emerging and disruptive technologies', specifically noting the recent launch of NATO's Defence Innovation Accelerator for the North Atlantic (DIANA) and the forthcoming investments in deep tech from

the NATO Innovation Fund, the world's first multi-sovereign venture capital fund. The communiqué also notes that the alliance will develop strategies for quantum technologies and biotechnology, in addition to recently announced alliance-wide plans for artificial intelligence and autonomy.

Q6: Where does Sweden stand in its application process?

A6: Perhaps the most unexpected aspect of the Vilnius summit was Turkey's sudden realignment with its Western partners on key issues. On the eve of the summit, Secretary General Stoltenberg announced that Turkey had dropped[34] its objections to Sweden's membership bid and that President Erdoğan would 'work closely with the Assembly to ensure ratification'. Hungary, the other holdout to Sweden's application, also lifted[35] its veto shortly thereafter. In the lead-up to the summit, Turkey also voiced[36] its support for Ukraine to eventually enter the alliance and allowed[37] commanders from Ukraine's controversial Azov brigade to return to Ukraine, while Turkish defense company Baykar began[38] construction of a drone plant in Ukraine. Ankara appears to have relented as part of a deal to receive F-16 fighter jets from the United States, a transfer which was announced[39] by the Biden administration the following day. Turkey will also be pleased that the Vilnius communiqué includes[40] Ankara's preferred language on terrorism as a threat to NATO, 'in all its forms and manifestations'.[41]

While Turkey will likely remain a fickle NATO ally, maintaining[42] amicable ties with the Kremlin, Sweden's imminent accession is undoubtedly a boon to the alliance. Along with Finland, Stockholm will bring significant capabilities to bear, turn the Baltic Sea into a NATO lake, streamline operational planning and information sharing in the Baltic-Nordic region, and strengthen NATO's deterrence in the Arctic.

Q7: What was announced on NATO-EU cooperation?

A7: NATO summits are interesting barometers to appraise the evolution of the indispensable yet complicated relationship between the alliance and the European Union. The past year has displayed the great potential of complementarity between NATO, the cornerstone of collective defense, and the European Union, with its nonmilitary tools (sanctions, aid) and, increasingly, its security and defense instruments. But complementarity does not mean cooperation, which remains scarce[43].

The European Union was well represented at the summit with the European Council and European Commission presidents, Charles Michel and Ursula von der Leyen. But the final communiqué does not signal a clear appetite to rev up the relationship, relying mostly on existing language either from the Strategic Concept adopted last year or from the joint declaration adopted in January this year. Although it reiterates NATO's acknowledgement of the 'value of a stronger and more capable European defence', it also restates the usual caveats to cooperation, such as 'unnecessary duplication'. Among the few interesting novelties is the establishment of a NATO-EU Staff Coordination on Ukraine.

Q8: What are the implications for non-ally partners?

A8: 'NATO is a regional Alliance, but we face global challenges', said[44] Stoltenberg following the conclusion of the Vilnius summit. The leaders of Japan, South Korea, Australia, and New Zealand were present at the summit, demonstrating the alliance's commitment to deepen ties with Indo-Pacific partners in response to 'Beijing's global assertiveness' that continues to challenge the interests, security, and values of the alliance. Deepening ties will happen through 'tailored partnership programmes'[45] on joint issues such as maritime security, cyber, climate change, resilience,

and emerging technologies. This announcement came on the heels of disappointment following the absence of language in the communiqué on the proposed NATO office in Japan, which was reportedly[46] rejected by France and criticized by China. When asked about the office in a press conference, French president Emmanuel Macron reiterated[47] that the alliance should keep its focus on the North Atlantic region. Despite its absence in the communiqué, Stoltenberg noted in a separate[48] press conference that there are still discussions happening on the idea and nothing has been set in stone quite yet.

Vilnius demonstrated that NATO remains committed to supporting non-allies who are on the path toward membership but face several democratic and security roadblocks apart from Ukraine. This was demonstrated by representation from not only Indo-Pacific partners but also the foreign ministers of Georgia and Moldova, as well as the deputy foreign minister of Bosnia and Herzegovina. Several sections in the communiqué[49] are dedicated to emphasizing support for stability and security in the Balkans, Georgia, and Moldova through promoting the continuation of democratic and security reforms, as well as reiterating support for their territorial integrity and sovereignty. Strengthening stability and security in the aforementioned countries would be a benefit to the alliance, but work remains to be done for continued NATO enlargement.

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Panel 2

Enhancing Readiness, Availability and Resilience for NATO Joint Air and Space Power Operations

Abstract

Readiness, Availability and Resilience are key enablers for effective NATO Air and Space Power. High levels of readiness ensure that personnel are trained and proficient, their equipment is properly maintained, and logistical support is in place. Availability ensures that a sufficient number of operational systems are mission capable and deployable for missions, enabling timely and effective response to potential threats or operational requirements. By maintaining high levels of readiness and availability, Air and Space Power deters our adversaries and is ready for defence. As NATO nations invest more and contribute additional forces to the NATO Force Structure and Quick Reaction Force, it is critical that they analyse the lessons learned from the Russo-Ukrainian war and better fund readiness and availability of current and future forces.

Article Synopses

This section presents three articles to inform readers of the Enhancing Readiness, Availability and Resilience for NATO Joint Air and Space Power Panel discussion. The articles are intended to inspire critical thinking and prepare attendees for the 2023 Joint Air and Space Power Conference.

The first article, a collaboration between Supreme Headquarters Allied Powers Europe (SHAPE) and JAPCC, 'Achieving Sustainable Air and Space Readiness in Light of the Ukrainian War,' emphasizes NATO's crucial responsibility to provide credible deterrence as the most effective method of preventing conflict. The article highlights the need for NATO to continuously adapt its Military Instrument of Power and take further steps to strengthen readiness, solidarity, and determination.

The second article, titled 'The Relevance of Quantity in Modern Conflict' written by Lieutenant Colonel Dennis Wartenberg from the JAPCC, delves into the ongoing debate surrounding the importance of mass and numbers in confrontations between peer or near-peer. In this context, having smaller numbers of superior equipment may prove insufficient for winning a prolonged war of attrition against a peer or near-peer adversary. The loss of a single recently fielded aircraft can significantly impact NATO's capabilities, leading to reduced effectiveness and increased risk to mission objectives. It is becoming increasingly evident that the replacement of new highly capable platforms is cost-prohibitive. The Russo-Ukrainian war highlights the significance of having a sufficient quantity of platforms and munitions, in addition to superior technology, for achieving success in air denial or air superiority strategies. By acquiring a sufficient quantity and the correct quality of assets, NATO can maintain affordable air power at an optimal scale.

The final article, 'Enhancing Resilience in NATO's Air and Space Power to Generate Deterrence and Defence in an Interdependent World,' authored by Colonel Maurizio de Angelis from the Italian Air Force, JAPCC, explores the concept of resilience as a crucial factor in maintaining readiness and availability during conflict. Colonel de Angelis uses historical examples to analyse how NATO's strategy has changed over the decades to deter Russian aggression proposing how the strategy must continue to adapt, implementing readiness, availability, and resilience into future strategies.
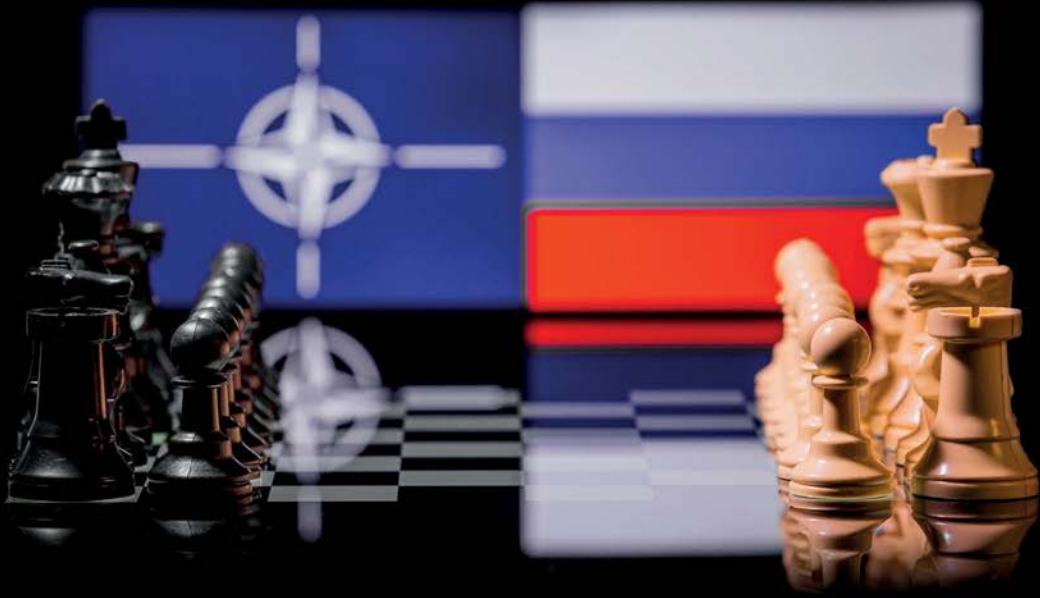
Achieving Sustainable Air and Space Readiness in the Light of the Ukrainian War

Imperatives from Russia's Invasion of Ukraine – 'The New Normal Readiness'

By Lieutenant Colonel Rafael Ichaso Franco, SP Air Force, Commander Aaron Shiffer, US Navy, and Major Tamás Oszlár, HU Air Force,
Joint Air Power Competence Centre,
Lieutenant Colonel Stefan Lax,
Operational Concepts and Standard Branch within Plans Directorate for the Supreme Headquarters Allied Powers Europe

Introduction

In the dynamic and ever-evolving strategic landscape, NATO continually adjusts its Military Instrument of Power via the 'Concept for Deterrence and Defence of the Euro-Atlantic Area', and the 'NATO Warfighting Capstone Concept'.

As a military Alliance, NATO's primary objective is to provide credible deterrence and defence, recognizing deterrence as the most effective means of preventing future conflict. It is essential for the Alliance to eliminate any doubts – both among NATO's allies and our adversaries – regarding NATO's readiness and commitment to safeguard every inch of the Alliance's

territory. Russia's aggression against Ukraine has underscored the urgent need for NATO to enhance its readiness in order to deter potential adversaries. Consequently, the Alliance is actively reviewing and developing strategic documents and plans that have wide-ranging implications for NATO. These initiatives are designed to enhance NATO's availability, readiness, and resilience across all domains.

This article will specifically focus on readiness in the Air and Space domains, highlighting their significance as critical factors for NATO's defence and as powerful tools for deterrence. However, the scope of this article is limited to the readiness lessons identified from the Russia's aggression against Ukraine (RUS-UKR war).

Readiness

One of the fundamental lessons imparted to soldiers upon joining the military is the imperative to be prepared for any situation, at any time and in any location. This principle of readiness remains relevant across all aspects of military forces.

Among the various definitions used throughout the Alliance, the US Department of Defence offers a comprehensive definition of readiness as the capability of its forces to 'fight and meet the demands of assigned missions'. This encompasses both the ability to swiftly deploy forces and the capability to sustain them once they are deployed. NATO, in assessing readiness, employs a range of metrics such as troop availability, level of training, and the condition of equipment, including enablers.

The ongoing unjustified and illegal aggression by Russia in Ukraine underscores the critical importance of NATO's readiness. Consequently, the Alliance has augmented the size of its rapid reaction force, known as the

NATO Response Force, and has devised efficient mechanisms to swiftly reinforce from North America and mobilize forces within and across Europe. Additionally, NATO is actively striving to enhance the inter-operability of its forces, enabling them to collaborate more effectively.

NATO's readiness plays a vital role in preserving the ability to deter aggression and defend member states. By maintaining a high level of readiness, the Alliance fulfils its defensive obligations and deters potential adversaries from engaging in any form of aggression.

NATO's Air-Domain Readiness

Airpower possesses inherent strength through its combination of speed, reach, altitude, agility, and concentration, creating multiple dilemmas for adversaries. To harness these capabilities effectively, NATO's Air Power must be prepared to engage in combat and fulfil assigned missions and tasks. This entails defending NATO forces, populations, and territory from threats originating from all strategic directions, safeguarding the integrity of airspace, demonstrating Allied solidarity, and reassuring NATO Allies.

Preparedness for NATO Air Power operations, as an integral part of readiness, necessitates well-maintained equipment, proficiently trained personnel, and the ability to deploy at the right time and place. To meet these requirements, NATO has consolidated some of its competencies through the NATO Integrated Air and Missile Defence (IAMD) system. This system provides a highly responsive, robust, time-critical, and persistent capability, enabling the Alliance to maintain desired control of the assigned airspace and carry out a full range of missions in peacetime, crisis, and conflict. NATO has already made significant strides in enhancing the readiness, awareness, and responsiveness of its IAMD forces, ensuring the availability of appropriate capabilities.

The NATO IAMD system serves as the foundation and backbone for a prepared and capable Air Power that serves to deter and defend. Ongoing efforts will continue to focus on four key areas: enhanced Air Policing, combat training, force integration and interoperability, and comprehensive training and exercises. Considering the adversary's initial activities in armed conflicts often involving missile strikes as witnessed during the early stages of the Ukraine conflict, the NATO IAMD system is critical in the current strategic environment and must always remain available. Consequently, substantial collaborative efforts are required. The most visible aspect of these efforts is Air Policing, where continuous airborne surveillance and fighter patrols represent a significant step forward as a 'show of force' compared to the pre-Ukraine conflict era, not only as a demonstration of force available but also of readiness.

Following the commencement of the Ukraine conflict, NATO notably increased the presence of Air Power on its Eastern flank (as depicted in Figure 1 opposite), with the aim of denying Russia any opportunities to expand or escalate the ongoing conflict with Ukraine into a broader conflict involving NATO.

Currently, NATO's increased Air Power posture demonstrates the Alliance's resolute determination to defend its territory against aggression while seeking to avoid escalation through effective deterrence.

However, these 'new' activities, including the increased posture, have been built upon plans and directives conceived years ago, in a vastly different strategic environment. While revision of old documents ensues, NATO has proven the viability by employing a comprehensive range of ready Air Power directly along its Eastern flank, spanning from the High North to the Southern regions of NATO's territory, in a visible and impressive show of determination. Analysing observations and applying the NATO Lessons Learned Process from the RUS-UKR war is essential for

Figure 1: *Air Domain activities.*[1]

capturing valid and practical best practices for the organization's evolution. This process is already underway in real-time, with NATO adapting strategic documents, developing new plans, and reviewing key Air Power-related documents based on assessments.

The readiness level and posture of the Air Force is expected to be maintained as the 'new normal'. This new normal must encompass a 360-degree approach, tailored to address threats originating from all strategic directions. As mentioned earlier, NATO is adapting plans, doctrines, and concepts to sustain this new normal, while also improving and adjusting its' equipment and systems. For instance, the retirement of NATO's Airborne Early Warning and Control System (AWACS) is planned for around 2035, after more than 50 years of service

as NATO's key surveillance and control asset. Recognizing its crucial role in the Alliance's comprehensive defence, NATO has already initiated the Alliance Future Surveillance and Control (AFSC) project to acquire a follow-on capability. This project aims to develop options for future NATO surveillance and control capabilities, employing a system of systems that may involve a combination of air, ground, maritime, and space assets working together to collect and share information, facilitating a Multi-Domain Operational (MDO) approach. Designing and implementing such a complex and comprehensive architecture will take several months if not years to fulfil the requirements. The objective is to establish capable systems that are adaptable to a changing security environment, leveraging existing assets and fostering pragmatic Air and Space readiness, preparedness, and willingness for NATO's future.

Space-Domain Readiness

The NATO space program forms the foundation for accessing Data, Products, and Services (DPS) provided by Alliance members, supporting a wide range of activities. The key aspect is that NATO enables essential space functionality across the Alliance but relies on the contributions of space-based DPS from various member nations.

NATO upholds the principles of free access and use of the space domain to serve the objectives of each nation's space program. Ensuring space domain readiness within NATO entails securing the availability of space-based DPS for every member nation's forces. While not all NATO members have developed their own space programs, through the Combined Forces Space Component and the NATO Space Centre, all Alliance members have access to space-based DPS benefiting war fighters and enabling NATO's mission.

Nonetheless, achieving sustainable readiness in NATO's Space domain is a complex and challenging endeavour that demands a comprehensive approach encompassing all readiness aspects, ranging from developing of new capabilities to personnel training. The development of new capabilities stands as a crucial facet of readiness, with NATO supporting national Space programs to foster internal resilience and provide Alliance-wide access to space-based DPS. NATO is actively developing the tools required to effectively receive and disseminate nationally contributed space-based DPS across all domains throughout the Alliance.

However, the paramount aspect of readiness lies in education and training personnel. NATO must prioritize the internal training of the Command and Force Structure to effectively utilize the space-based DPS contributed by member nations. This effort has become a top priority, evident through the integration of the Space domain into strategic exercises and the provision of space-centric training courses at the NATO School in Oberammergau. Additionally, the establishment of the NATO Space Centre of Excellence in Toulouse, France, further underscores the importance of the Space domain in NATO's daily activities. While these steps mark significant progress, there is still much more to be accomplished.

Drawing lessons identified from the conflict in Ukraine, NATO must cultivate a culture of readiness that includes the Space domain as well. However, achieving sustainable space domain readiness is a long-term endeavour requiring unwavering commitment from both NATO and its member states. A unified effort is currently underway to enhance Space domain readiness, spearheaded by the Bi-Strategic Commands in collaboration with the NATO Space Centre of Excellence. Looking ahead, several specific issues must be addressed by NATO to further strengthen Space readiness:

- Continue building upon NATO's nascent Space Power strategy. This strategy should continue to build-up NATO's Space Power goals, and it should outline the steps that NATO should take to achieve those goals.
- Continue investing in new Space capabilities to exploit and disseminate nationally contributed DPS.
- Continue training and exercising personnel to use new Space capabilities.
- Exercise and evaluate NATO forces on using Space capabilities in combat.
- Continue developing a culture of readiness.
- Resolve classification and sharing issues among Nations and inside NATO.
- Set up the physical networks that will connect various national space centres with NATO and National HQs.
- Search for potential shared ventures to reduce cost and improve interoperability.

Overall, achieving and maintaining sustainable readiness in the NATO Space domain is a complex and challenging endeavour. Nevertheless, it is a crucial investment in the security of the Alliance. By implementing the steps outlined above, NATO can guarantee it possesses the necessary capabilities to deter aggression and protect its member nations.

Conclusion

As a military alliance, NATO has a crucial responsibility to provide credible deterrence and defence as the most effective means to prevent conflicts. To achieve this, NATO continuously adapts its Military Instrument of Power, while implementing the Concept for Deterrence and Defence of the Euro-Atlantic Area and the NATO Warfighting

Capstone Concept. Russia's full-scale invasion of Ukraine in 2022 has prompted the nations to take further steps in strengthening NATO's readiness, demonstrating unwavering solidarity and determination.

In order to fulfil these objectives, NATO must undertake a thorough review and development of strategic documents and plans that have wide-ranging effects across the Alliance. This process aims to enhance NATO's availability, readiness, and resilience across all domains. These adaptations to NATO's Air and Space posture are aligned with the broader adaptation of the Alliance's posture for deterrence and defence, maintaining a defensive and proportional approach.

The aggression displayed by Russia in Ukraine has emphasized the urgent need for NATO to improve its readiness effectively deterring potential adversaries. NATO is resolute in countering these threats, recognizing the various air and missile threats posed by Russia's evolving capabilities, as well as the increasingly diverse and challenging threats from other state and non-state actors, including unmanned aerial vehicles (UAVs) to advanced missile systems, including hypersonic missiles, in addition to more conventional threat.

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Commander Aaron Shiffer commissioned into the United States Navy in 2000. Initial training pilot training was in the P-3C Orion serving two US operational tours and a 3rd with the Royal Australian Air Force. After completing a tour on board the USS GEORGE HW BUSH, he transitioned to the P-8A Poseidon completing several operational test events with VX-1 for 9 different platforms. His staff tours include Regional Air OPSO for Europe, Africa and Central as well as the Deputy Program Manager Sustainment lead for MQ-4C Triton. Currently he is assigned at the JAPCC, Combat Air Branch, as Maritime Air Operations including Carrier Operations (FW) SMW.

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Lieutenant Colonel Stefan Lax joined the German Air Force in 1986. Professionally trained as a Master Controller in a Control and Reporting Centre, he gained experience in several CRC units throughout Germany. During his service, he has commanded the German Deployable Command and Control Centre. Thereafter, he was employed at the German Air Force Command as POC for Air Policing and Renegade. Furthermore, he served in NATO at the Deployable Command and Control Centre in Italy, while being responsible for NATO Lessons Learned.

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The Relevance of Quantity in Modern Conflict

What Does Russia's Approach in the Russo-Ukrainian War Reveal?

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Introduction

On 24 February 2022, Russia launched a full-scale war on Ukraine. Various experts and analysts predicted the outnumbered Ukrainian Armed Forces (UAF) would last only a few days against the overwhelming Russian forces. Things turned out differently. After one year of fighting, the Russian Federation Armed Forces (RFAF) losses were high. About 200,000 Russian soldiers were killed or wounded in action – on average, 548 per day. More than 6,500 infantry fighting vehicles and armoured personnel carriers were destroyed. The RFAF have lost possibly two-thirds of its T-72 main battle tanks that are in active service or recoverable storage.[1] In the air domain, Russia – while having one of the largest and most technologically sophisticated air forces in the world – has failed to establish air superiority over Ukraine.[2] Despite the predictions of many analysts, Moscow's ten-day plan soon turned into a war of attrition.

Nevertheless, Western analysts believe that the war may be entering a critical phase where both sides look to launch offensives with improving weather conditions in the spring of 2023. Yet, the UAF are still under tremendous pressure. The Ukrainian Air Chief and his staff remarked: 'A small

Red Army will never beat a big Red Army. Reliance only on the Soviet-production weapons will never allow us to reach quantitative or qualitative parity with the enemy, saying nothing about gaining an advantage', concluding, 'we can win only by countering quantity with quality.'[3]

Although the Western equipment delivered to Ukraine is qualitatively superior to Russian equipment, it will only affect the war's outcome if it arrives in time and in sufficient numbers, is used effectively and is supported properly. The quality of military personnel, and training is also crucial to maximize use of the superior quality of the equipment; otherwise, the qualitative benefits cannot be adequately achieved.

The current situation in Ukraine demonstrates that despite the military advantage implied by the size of the RFAF, quantity alone is insufficient for a quick victory. Exacerbated by Western sanctions, the lack of economic and technological power likely hampers Russia's attempt to modernize its military hardware and gain a notable qualitative advantage. Russia's limited economic power and poor domestic technological base led to the only available option of reliance on quantity over quality in their military warfighting concept. Although the RFAF may be able to achieve short-term victories, in the long run, its overall concept may fail, and at a terrible human cost.

This article will explore how the emphasis on quantity over quality in the Russian military's warfighting concept impacts its military performance in Ukraine and what implications this holds for the relevance of quantity in NATO's future air power strategies. To this aim, this paper will address the Russian concept of quantity, describe and detail the shortage in high-tech equipment, highlight the relationship between quality and quantity experienced on the Ukrainian battlefield, and draw conclusions on the relevance of quantity for the Alliance.

A Concept of Quantity

From an operational perspective, Russia always emphasized mass-fire offensive strategies. According to Andrew S. Bowen, an analyst in Russian and European Affairs, 'the concentrated use of artillery and rocket artillery, along with large tank units, remains at the core of Russian military doctrine'.[4] The easiest way to explain the Russian concept of quantity is to expound on the case of tanks.

Western Main Battle Tanks (MBT) are assessed as qualitatively superior to the Russian MBTs fighting in Ukraine.[5] Western governments' decisions to supply tanks to Ukraine revived the quality versus quantity debate. The Russian and Soviet-manufactured MBTs are good examples to explain the quantity concept within the RFAF.

In general, tanks are designed according to the doctrine for which they are made. For Western manufacturers, survivability, ergonomics, maintenance, and battle damage repair were the most essential parameters to guarantee a tank's best battlefield performance. By contrast, Soviet and Russian tank doctrine emphasized the tank as a building block to a larger formation, requiring an expendable supply of interchangeable pieces. The focus is not on one-on-one tank duels but instead on the overwhelming force. In this doctrine, quantity determines the quality of the total force. This fits with the Soviet and Russian conscription systems, requiring less demanding training for crewmembers. This also makes the individual crew more expendable. It is already priced in that the T-72 tank will probably lose a duel with a Leopard, Challenger, or Abrams MBT. But more tanks can be built because the tank is so light, small, and simple in design. Crews are replenished faster. For example, the Russians believe that a tank formation consisting of twelve T-72 MBTs engaged in battle with four superior Leopard tanks will eventually overpower the Leopards.[6]

Describing this concept as 'mass instead of class' falls short because it is a biased view. It is a different approach. Russian doctrine anticipates that tank formation battles are more likely than one-on-one tank battles. When a few superior tanks fight against many inferior ones, the advantage can quickly tip towards the many. Thus, the superior tank can only exploit some of its advantages on the battlefield before being possibly destroyed. Therefore, much time, money, energy, and resources are spent on producing and maintaining high-quality vehicles, which may not be fully utilized on the battlefield. It can be seen as a quality that the Soviet tanks are very basic and of limited design, to be used as expendable assets in a tactic of saturating and overwhelming the enemy by sheer numbers.[7]

Lack of Electronics and the Absence of Prestige

High-quality equipment requires advanced microelectronics; let us look at Russia's defence industry, and its state-of-the-art weapons systems. Since 2000, Russia has had a leading position in global defence markets with a 25 % market share. It was second behind the United States (US), but its market share has declined. Russia's share of the global defence export market fell from 29 % in 2011 to 11 % in 2021.[8] The two biggest markets for Russian defence exports are China and India, but, China is increasingly self-sufficient, and India seeks supplier diversification. Both countries are no longer so reliant on Russia.

Furthermore, US sanctions have had a chilling effect on customers, whereas EU sanctions affect industrial production.[9] Since the invasion of Ukraine, the EU arms embargo has been tightened. Even by 2020, defence exports to Russia were negligible. Now, semiconductors and cutting-edge technologies are added to the sanctions list. This is critical, because over the prior decade, almost 100 % of machine tools for Russian defence production and 79 % of electronics for space applications were imported.[10]

An examination of 27 pieces of captured or destroyed Russian military weaponry revealed that it contained some 450 foreign-made components critical to their operation.[11] This highlights that Russia is relies heavily on imports of Western technology.

Russia needs access to chips to power missiles and other smart munitions for its invasion of Ukraine but is reportedly currently facing a severe shortage of high-technology spares due to trade sanctions. Therefore, keeping modernization programmes like the T-14 Armata and Su-57 Felon viable becomes increasingly difficult. Russia is forced to use outdated microchips, including imported commercial chips from China and, allegedly, other intermediary countries.[12] The lack of high-quality electronics will limit Russia's ability to maintain, enhance, or develop new and efficient weapon systems, forcing the RFAF to continue using outdated and less effective weapons. In short, Russia's reduced access to Western microelectronics significantly affects modernizing and producing new equipment for RFAF inventories.

Concerning the prestigious Su-57 Felon, Russia has employed its most advanced combat aircraft in operations against Ukraine since at least June 2022, according to the UK Ministry of Defence's (MoD) reporting. However, 'these missions have likely been limited to flying over Russian territory, launching long range air-to-surface or air-to-air missiles into Ukraine', the UK MoD said in its Defence Intelligence Update from 9 January 2023.[13] On the surface, the Su-57 Felon looks like a fifth-generation platform, with stealthy configuration in all aspects except from the rear, although analysts have expressed doubts as to the true extent of its combat capabilities.[14] All in all, the Su-57 Felon is conspicuous by its absence over Ukraine. It is only a deterrent platform produced in token numbers to support Russia's narrative of superior technology. Russia is likely trying to avoid reputational damage from any Felon losses in Ukraine, which may reduce export prospects.

Quality versus Quantity

At the beginning of the war, Ukrainian fighter jets were outmatched and outnumbered by Russian aircraft. Russian Aerospace Forces (VKS, in Russian) conducted extensive fixed-wing strike operations, while initial attacks suppressed Ukrainian Ground-based Air Defence (GBAD) capabilities. Russian fighters, particularly the Su-35S and MiG-31BM, were initially highly effective in combat against Ukrainian aircraft. However, since March 2022, the Russian military has lost the ability to operate in Ukrainian-controlled airspace except at very low altitudes due to Ukraine's effective and mobile Surface-to-Air Missile (SAM) systems and man-portable air defence systems.

During the first months of the war, Russian airstrikes have mainly targeted pre-designated targets with unguided bombs and rockets, with limited use of standoff missiles and anti-radiation missiles to suppress Ukrainian SAM radars. Without air superiority, Russia's attempts at strategic air attacks have been limited to a sustained bombardment of the Ukrainian electricity grid using cheap Iranian-supplied loitering munitions while using cruise and ballistic missiles against larger targets, often indiscriminately against cities.[15] The inefficacy of the VKS surprised many analysts. All in all, the world's second-largest Air Force failed to establish air superiority despite the VKS's apparent advantage in quality and quantity.[16]

From October 2022 onwards, Russia has been destroying Ukraine's infrastructure with an abundance of cruise missiles and drones, leaving major cities without necessities such as water and electricity. Among the most lethal weapons used by Russia are the Iranian-made Shahed-136 drones, which can carry a 110-pound warhead and act as loitering munition. As a result, Ukraine's air defences are under constant pressure. With a 100 % quota for shooting down aimed Shahed drones and cruise missiles, the German-donated IRIS-T short-range air defence (SHORAD) system has

become a critical part of that defence.[17] The quality of the IRIS-T system is undisputed. However, each system costs € 150 million, and the price for each missile is around € 500,000.[18] In contrast, the Iranian-made drones cost as little as € 20,000 to produce.[19] Although this calculation does not reflect the value of the Ukrainian assets protected, the imbalance could, over time, favour Russia and be costly for Ukraine and its allies.[20]

In summary, Russia still has a quantitative advantage over Ukraine in terms of relatively low-tech munitions, supported by much smaller numbers of higher-quality weapon systems. If not replenished by the West, Ukraine could lose the ability to defend itself, creating offensive opportunities for the RFAF.[21]

Concluding Considerations

During the war, the Russian military moved to a strategy of funnelling human and material mass in pursuit of operational or even minor tactical objectives despite extraordinarily high losses. The Russian approach overwhelms and outlasts the better-led, more purposeful, and increasingly better-equipped UAF. It seems that the Russian leadership believes that time is on their side and that this exhaustion strategy can be managed without leading to a general military or society collapse.[22] Such judgment relies on the premise that 'Russian mass can and will overcome Ukrainian courage and Western arms'.[23] In doing so, Russia is accepting significant casualties and equipment losses in exchange for only small territorial gains – as incremental steps on the way to its desired end state of having full control over the four previously annexed Ukrainian provinces.[24]

Russia faces the challenging task of rebuilding its military forces and combat power in a timely manner as it currently relies on outdated computer chips intended for household appliances. The economic sanctions against

Russia will lead to a further deterioration of its industrial and military production, which in turn will lead to delays and cost increases. To compensate, Moscow is exploring alternative sources, such as Iran and North Korea, for missiles, drones, and ammunition. The extent of China's military support to Russia remains uncertain.[25] Although the RFAF combat power is much diminished in the short- to medium-term, Russia maintains a large force and focuses on some high-quality capabilities, such as integrated air defence and long-range strike capabilities.

In his analysis of warfare from the Romans to World War II, Cathal Nolan argues that wars between peer or near-peer adversaries almost always become a war of attrition.[26] The current operational environment in Ukraine is characterized by increased use of loitering munitions and other low-cost, hand-held, easy-to-operate, unmanned aerial systems and anti-tank missiles. The IRIS-T vs Shahed example clearly shows the financial imbalance of quality versus quantity equipment. Even with a quality-related strategy, preparing for such an attritional conflict requires enough mass to win outright or sustain a more protracted fight. Unmanned systems are often much cheaper than manned aircraft. Advanced manufacturing plants using 3D printing and robotics have the potential of cheap and fast production so that a return to mass (in terms of numbers) is possible.[27]

Another noteworthy aspect is Russia's failure to establish air superiority over Ukraine. Ukraine's success in contesting the skies turns NATO's air power paradigm, which traditionally prioritizes gaining air superiority first, on its head because it offers an alternative vision for pursuing airspace denial rather than air superiority.[28] Given its limited capacity and irreplaceable pilots, Ukraine has wisely chosen a sustainable course that is probably the only way to counter the RFAF.

The air war in Ukraine suggests that denying air superiority is sometimes a smarter operational objective than trying to gain it outright.[29] NATO's

militaries have expensive and high-quality capabilities, such as the F-35 Lightning II stealth multirole combat aircraft. It will cost around $ 100 million each, compared with the $ 30 million cost of the F-16 it is supposed to replace. Due to the cost increase, NATO's fighters have become more capable, but the overall fleet size is much smaller. Norman Ralph Augustine, an American aerospace businessman who served as Under Secretary of the US Army, explains that defence budgets grow linearly while the unit cost of a new military aircraft grows exponentially over time. At the current rate 'in the year 2054, the entire defence budget will purchase just one tactical aircraft. This aircraft will have to be shared by the Air Force and Navy 3½ days each per week except for leap year, when it will be made available to the Marines for the extra day.'[30] As Augustine observes, the current trend is unsustainable and will lead to far less capacity than is required for operational effectiveness, especially in large-scale combat operations.

In conclusion, NATO's smaller number of superior aircraft may be inadequate to win a long, destructive war of attrition with a peer or near-peer adversary. These days, losing one aircraft can mean numerous targets remain unengaged, reducing effectiveness and delaying campaign objectives. A paradigm shift comes increasingly into view as expensive, high-quality manned platforms are hard to replace. With either air denial or air superiority strategies, success depends on having a sufficient quantity of platforms and munitions, not just superior technology, as the current situation in Ukraine indicates.

A possible solution could be a mix of manned aircraft and large numbers of smaller, cheaper unmanned aircraft and missiles.[31] The right quantity and quality assets would allow NATO to have affordable air power at a reasonable size.

Lieutenant Colonel Wartenberg joined the German Armed Forces in 2005. His past assignments include deputy company commander and section head at 212th Panzergrenadier Battalion. He studied Political Science and International Relations at the Helmut Schmidt University in Hamburg from 2008 to 2012, graduating with a Master of Arts degree. In 2014, he was transferred to the 9th Armoured Brigade as military intelligence officer, responsible for collection, processing and dissemination of intel products. Since 2022 he serves as subject matter expert for Research, Analysis and Intel Support at the Joint Air Power Competence Centre.

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Enhancing Resilience in NATO's Air and Space Power to Generate Deterrence and Defence in an Interdependent World

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Introduction

The 2023 JAPCC Conference's theme, 'Enhancing Deterrence and Defence through Joint Air and Space Power – credible, capable and available', is a promising subject that allows a reflection on all aspects of Air Power (AP) that contribute to one of NATO's three core tasks, namely Deterrence and Defence. This article aims to stimulate thoughts and discussion on how resilience in Air and Space Power contributes to the overall accomplishment of Deterrence and Defence. The intent is to raise questions on what provides resilience for deterrence, whether a resilient Air Power is sufficient to deter adversaries, and how to assess one's level of resilience.

Setting the Scene:
The Offset Strategy, a Path for Deterrence

Deterrence is a strategy that aims to prevent an adversary from taking an action by convincing them that the costs or risks of that action outweigh the potential benefits. The core principles of deterrence

include credibility, capability, communication, proportionality, and continuity.[1] Since the end of World War II and the start of the Cold War, concepts like Military Resilience and Military Deterrence were easily understood, widely shared, and commonly referred to.

During the Cold War, extensive military plans were designed to prepare the Alliance's Defence, deter aggression, and create the conditions to resist an attack and continue to operate. In 35 years of this static confrontation, NATO played its role in containing the Soviet Union. The success of this deterrence is primarily attributed to the West's ability to develop new technological and capability gaps relative to the Soviet Union. These gaps would eventually be corrected and thus reopening the race for a further advantage. This occurred over successive strategies developed by the US and NATO.

The US never tried to compete solely on 'mass' with the Soviet Union. Robert Work, who served as the US Deputy Secretary of Defense from 2014 to 2017, popularized the term 'Offset strategies' to help explain the different attempts made by the US government over the years to use technology to 'offset' the opponent's potential superiority in conventional strength and numbers. The US developed the First Offset Strategy (1OS) during the Cold War under President Dwight D. Eisenhower's administration in the 1950s. At the time, it was not referred to as the 1OS but as the strategy of nuclear deterrence or the 'New Look' policy. This 1OS aimed to maintain the US military advantage over the Soviet Union by leveraging superior nuclear capabilities to offset the numerical advantage in conventional forces held by the USSR. This 1OS proved to be effective in deterring a new World War.

By the mid-1970s, the Soviet Union achieved strategic and tactical nuclear parity, so the 1OS was no longer a credible deterrent, and the

need for conventional mismatch resumed as a military problem. These circumstances spurred what we now call the Second Offset Strategy (2OS), which started under the Defence Advanced Research Projects Agency (ARPA) program of 1973. Once again founded on superior technology, the 2OS exploited and developed precision-guided munitions together with a new operational concept known as Assault Breaker, which was designed to find, fix, and target Soviet moving rear echelon armour and ground forces massed behind enemy lines, with precision stand-off weapons. These new conventional 'reconnaissance-strike complexes' represented what military theorists called a 'Revolution in military affairs'.

Ultimately, the 2OS persuaded the Soviets that NATO had reached conventional superiority, effectively holding the Soviet Union at bay until its collapse. In these years, Air Power took a more prominent role in deterring the USSR. According to President Carter's Secretary of Defense, Harold Brown, 'some of the Second Offset's deepest roots lay with the Air Force'. Over the past 30 years, Air Power has demonstrated numerous successes in operations beyond NATO territories, enabled by continuous technological advancements, bolstering its role in deterrence.

The end of the Cold War would bring about unexpected challenges to deterrence.

The End of the Cold War – New World, New possibilities, New Challenges

After the collapse of the Soviet Union in 1991, new geopolitical factors started to change the operating environment. While NATO and its member Nations diverted their attention and resources to other

priorities and areas of development, our competitors worked hard to close the technological gap.

Since the first decade of the new millennium, Russia started to challenge the international order with an increasingly aggressive posture towards its neighbouring countries (Estonia, Georgia, and Belarus), culminating in the annexation of Crimea in 2014 and the current war of aggression on Ukraine. Not only had Russia reduced the existing technological gap by advancing new capabilities, they actually seized the initiative in some areas, partially offsetting Western military powers. Russia fielded powerful Anti-Access, Area Denial (A2/AD) networks to deter, disrupt, and possibly defeat NATO's power projection capability while building a robust umbrella for its power projection threatening the countries and NATO Allies nearest to Russia's claimed sphere of influence (Baltic states, Ukraine, Belarus, etc.). Furthermore, Russia accompanied its material development with a new concept of operation: Hybrid Warfare. Hybrid Warfare is a fusion of military, non-military, and covert/overt actions using conventional and unconventional Instruments of Power (IoP), irregular tactics, criminal activities, and extensive cyberattacks, propaganda, and disinformation campaigns. Russia often uses hybrid warfare to attain military and political objectives while remaining under the threshold of armed conflict, thus avoiding a full and protracted war.

Slow to adapt and respond to these new challenges, the US and NATO were forced to think of a new offset strategy. Originating in November 2014 from the United States Department of Defense under the leadership of Mr Work and still ongoing, the Third Offset Strategy (3OS), also known as the 'Defence Innovation Initiative', aims to maintain a strategic advantage by once again leveraging emerging technologies and innovative operational concepts. The exploitation of Emerging and Disruptive Technologies (EDTs), such as Artificial Intelligence (AI),

Machine Learning (ML), Quantum Computing, Big Data, and Hypersonic weapons, together with the new Multi-Domain Operations (MDO) concept, is intended to outthink, outpace, and outlast our adversaries.

But today, new EDTs are largely available to all competitors. One other important aspect is that many NATO nations have outsourced most of their enabling assets (i.e. private military contractors, dual-use commercial space assets, commercial private clouds for military applications, etc.) and logistic capabilities, therefore creating a dependence on the civil sector and eroding their own military resilience, capability, and capacity. As of today, the NATO enterprise and NATO Nations have developed a much broader collaboration with commercial providers in many sectors, including space capabilities and space support to operations as well as in Cyberspace. Highly beneficial, these partnerships allow modern militaries the flexibility to muster and utilize new capabilities and technologies quickly. However, this also increases the dependence and reliance on these private enterprises when it comes time to defend against threats directed at these capabilities.

For all these reasons, a new offset strategy alone will not be enough. In the event of a peer-to-peer confrontation, the Alliance can anticipate kinetic strikes and hybrid actions throughout the continuum of operations that occur below the threshold of conflict. The Alliance must recognize this new norm and be able to survive, resist, and react under all conditions. The Alliance must be resilient!

This leads to several questions. Does resilience contribute to deterrence and defence? If so, how can we enhance resilience to improve deterrence? Is there still a role for Air Power to generate deterrence? Is NATO's Air and Space Power resilient, and how do we measure it?

Enhancing Resilience in Air and Space Power and Through Multi-Domain Operations

NATO defines resilience as 'a society's ability to resist and recover from such shocks as natural disaster, failure of critical infrastructure, or a hybrid or armed attack'. Resilience in the face of armed attack is a fundamental commitment in NATO's 1949 Treaty, with Article 3 stating that 'parties to the treaty will separately and jointly, by means of continuous and effective self-help and mutual aid…maintain and develop their individual and collective capacity to resist armed attack.'

Resilience is also a critical aspect of Air and Space (A&S) power. An Air Force or Space Force is considered to be resilient when it is able to withstand, adapt to, and recover from various challenges, threats, and disruptions. This naturally translates into mission assurance; therefore, we can conclude that resilience directly contributes to deterrence (in both denial and punishment).

Several critical elements should be considered when addressing resilience for Air and Space Power. These core principles include redundancy and diversity, training and readiness, infrastructure and facilities, interoperability and interconnectedness, robustness, cybersecurity, flexibility, agility, and collaborations and partnerships.

To improve the resilience of NATO's A&S Power aimed at granting mission assurance, we must re-educate new generations of personnel to recognize the importance of resilience. The Alliance must continue to improve its active & passive Air Defence (AD), Battle Management, Command, Control, Communications and Intelligence (BMC3I), and Surveillance as part of NATO's Integrated Air and Missile Defence by developing a credible multi-layered defence posture, where more interoperable AD systems and sub-systems will generate stronger

resilience. As NATO no longer faces a single common threat, we have to accept that both home bases, and deployed operating bases, are equally at risk. For this reason, the Alliance should implement concepts like Resilient Basing looking for deep and broad vulnerability assessments, and acknowledge that a sudden interruption of enabling activities will rapidly affect overall NATO operations.

Basic military tactics designed to enhance resilience, such as dispersal and redundancy, are much more challenging, if not impossible, to achieve nowadays, as we have to look for greater resilience and consider our extensive reliance on and interdependence with civilian support organizations. We have to change our general, reactive response to this challenge – tackling problems as they occur and managing the consequences – and implement a proactive approach to prevent undesirable disruptive events in the first place. Moreover, when, notwithstanding our efforts, NATO's main operating bases are targeted, the Alliance must be able to continue to operate from forward operating bases, forward operating sites, contingency locations, or even bare bases. Implementing a proactive and reactive operational scheme of manoeuvre, a concept currently referred to as Agile Combat Employment (ACE), enables resilience and survivability while generating combat power throughout the integrated deterrence continuum.

Special attention and resources should be given to developing resilience in our Air C2 systems, networks, and organizational processes. Redundancy, Interoperability, Cybersecurity, and agile forms of C2 like mission command, distributed, or organic control will all represent a necessary condition for the overall resilience of Air Power.

Alliance member nations should maintain the latitude in the future to produce different capabilities from different national or

multinational productions. Still, they should develop them as interoperable by design while today doing everything possible to achieve interoperability with legacy systems. To generate greater resilience, future A&S power capabilities should be developed as a system of systems. Concepts like Manned-Unmanned Teaming (MUM-T) or collaborative employment would maximize mass when needed and employment flexibility in all circumstances.

Air Power, similar to Land, and Maritime Power, heavily depends on capabilities within the Space and Cyberspace domains to establish comprehensive cross-domain support. In particular, threats to NATO nations' space capabilities and satellites will only continue to evolve and become more sophisticated. By recognizing the Space Domain as the essential enabler of both modern military operations and civil life, the Alliance must implement every possible and innovative concept capable of generating resilience in Space, such as:

• Resilient/responsive/disaggregated launch capability;
• Hosted payloads (two or more missions supported by a single spacecraft);
• Dynamic SATCOM frequency re-allocation;
• Distributed satellite constellations;
• Quantum satellite uplink encryption.

As the increasing reliance on data-centric technologies and methodologies has made Cyberspace the primary sub-threshold battlespace and cyber threats and disruptions more frequent and sophisticated, resilience becomes a critical aspect of cyberspace as well. The ability to resist and recover from cyber-attacks is essential to ensure the integrity, availability, and confidentiality of information and systems. The principles of redundancy, diversity, and flexibility are particularly relevant to building resilience in cyberspace, as they help to mitigate

the impact of attacks and minimize their effects on operations. By embracing resilience as a core principle, NATO nations can enhance their ability to operate in a dynamic and complex cyber environment, and ultimately strengthening their deterrence posture against any adversary.

Lastly, the Alliance must shift its training focus to scenarios involving degraded or denied C2 and communications. This includes situations without SATCOM and GPS, returning to dispersed operations training, and progressing towards distributed control scenarios.

Training also represents a critical tool the Alliance can use to determine how resilience is measured. The latter is a challenging task, requiring a comprehensive and multifaceted approach that includes risk assessment, performance metrics, modelling and simulation, and comparative analysis.

Before further diving into our analysis of Air and Space power resilience, it is essential to recall the 3OS and its accompanying Multi-Domain Operations (MDO) concept to see if they have a role in enhancing deterrence through resilience. Implementing MDO in the future will require integrating all the domains of warfare: land, sea, air, space, and cyberspace. It involves the orchestrated and coordinated use of a wide range of military capabilities synchronized with the other Instruments of Power (IoP) to deliver converging effects in, through, and across multiple domains at the speed of relevance, so creating multiple dilemmas for the adversary while achieving tactical and strategic objectives. When properly executed, MDO provides NATO warfighters with persistent situational understanding, information superiority, faster decision-making cycles and cross-domain command capability.

The above envisioned and desired outcomes and the five tenets of MDO (understanding, agility, interconnectivity, unity, and creativity), are all prone to resilience enhancement as they contribute flexibility to act and react in a dynamic and complex operational environment. The nations that focus on improving the five tenets will improve operational effectiveness and set the conditions to mitigate risks and possible vulnerabilities in a single domain by using the strengths in other domains and environments. In other words, when achieved, MDO is inherently resilient by its very nature. Embracing this concept of operation in combination with 3OS technologies, as previously mentioned, will enhance resilience and mission assurance that, in turn, will represent a stronger deterrent for any opponent.

Learning from Ukraine –
A Holistic and Comprehensive Approach
to Resilience for Deterrence and Defence

It was only in 2014, with the Russian invasion of Crimea and eastern Ukraine, that NATO recognized the need for much broader political, economic, technological, and societal resilience in facing hostile acts below the threshold of war. The 2016 Warsaw Summit established seven baseline requirements for national resilience. In NATO's 2020 Warfighting Capstone Concept, 'layered resilience' was addressed as one of the five 'development imperatives' to ensure success in an era of persistent competition below the level of war. More precisely, during the 2021 Brussels Summit, an official announcement stated that enhancing resilience was 'essential for credible deterrence…and the effective fulfilment of the alliance's core tasks'. Finally with the new 2022 Strategic Concept, 'ensuring our national and collective resilience' is assessed as 'critical to all our core tasks and underpins our efforts to safeguard our nations, societies and shared values', a

concept subsequently recalled and highlighted throughout the entire document.

From 24 February 2022 to the present day, the Russian war of aggression in Ukraine shows us and teaches us what being resilient in a comprehensive way really means. Armed forces will never be resilient enough if not supported by political cohesion and the willingness and determination of the whole population. The war in Ukraine provides several key lessons that NATO can learn about resilience, such as being prepared to respond to hybrid warfare, the importance of strategic communications, prioritizing interoperability and agility to share intelligence, and protecting critical infrastructure. By incorporating these lessons into its planning and operations, NATO nations can enhance their resilience and ensure that they are better prepared to address future challenges and threats.

Conclusion

Resilience has always been a critical factor in the history of military operations. It is an operational requirement composed of a set of measures that incorporates enormous value. When addressing the role of resilience for deterrence and defence, the Alliance sends a message to the adversary to refrain from pursuing its intended course of action, as it will prove futile. The Alliance will persist and relentlessly counter-act any challenges, ultimately achieving victory. When adequately perceived by the enemy as the ability to resist first and to grant mission assurance after, resilience will undoubtedly play its role in contributing to deterrence and defence as the enemy will be reluctant to take action because costs or risks will be higher than potential benefits. Therefore, it is fundamental to create a resilient A&S Power together with the needed level of resilience in the other military domains.

However, because of the characteristics of the current complex and multi-faceted environment, NATO and its Member Nations can expect to be targeted across various domains and environments, particularly in areas where they are more vulnerable and less resilient, as adversaries will likely avoid areas where the Alliance demonstrates greater strength and resilience. For this reason, aiming at deterrence through improved resilience in solely military domains and capabilities will not be enough and will not reach the final desired effect.

On one side, operationalizing MDO will enable NATO's Military IoP to prepare, plan, orchestrate, and execute synchronized activities across all domains and environments at scale and speed in collaboration with other IoP stakeholders and actors. This delivers tailored options at the right time and place that build advantage in shaping, contesting, and fighting, and presents dilemmas that decisively influence the attitudes and behaviours of adversaries and relevant audiences. Consequently, the Alliance's embrace of MDO will produce a higher level of deterrence and defence as this new operational concept is designed to be resilient by nature.

Taking a final step further, the Alliance will reach optimal deterrence through resilience only when Nations and Partners are resilient at 360 degrees. Implementing a holistic and layered resilience approach towards every aspect, from the Unity of Alliance, through political will and civil preparedness and down to military domains, capabilities, and operating concepts, will send a unique and strong message for deterrence and defence to any adversary.

Colonel Maurizio De Angelis joined the Italian Air Force Academy in 1990 and obtained a degree in Aeronautical Sciences from Federico II University of Naples. He graduated as a Military Pilot in the US and was assigned to the 18th Fighter Squadron at the 37th Fighter Wing – Trapani Birgi (Italy) flying F104-ASA-M and F 16 A. He is a Specialized Air Defence Operational Tactics Instructor on both F-104 and F-16 with more than 2,500 flying hours. He fulfilled several air force position from the squadron to the Air Staff level. He serves as C4 ISR & Space Branch Head at the Joint Air Power Competence Centre.

Endnote

1. P. M. Morgan, Deterrence Now. Cambridge University Press, 2003.

Panel 3

NATO Joint Air and Space Power Capabilities for Collective Defence

Abstract

NATO's Joint Air and Space Power capabilities are vital for protecting member states and deterring potential threats. These capabilities include rapid response, maintaining air and space superiority, and integrated defence systems. During the Russian aggression against Ukraine, NATO quickly deployed joint air and space power to the eastern flank, ensuring a timely and capable collective response from member nations. NATO's Command, Control, and Communication (C3) structure integrates national assets and facilitates efficient coordination among member states. By leveraging these capabilities, NATO strengthens collective defence, maintains superiority, and enables rapid response, contributing to the security and defence of the Alliance.

Article Synopses

This section presents three articles which will introduce various ideas and issues to inform the NATO Joint Air and Space Power Capabilities for Collective Defence Panel discussion; the views expressed in these articles are meant to inspire critical thinking and to prepare those attending the 2023 Joint Air and Space Power Conference:

The first article, from JAPCC's Combat Air Branch, titled 'The Relevance of Joint Air and Space Power Superior Technology in NATO's Deterrence and Defence', highlights how superior technology provides a significant military advantage. However, having superior technology alone does not guarantee victory; effective military leadership, training, and strategy can never be replaced and must evolve in tandem with superior technology. Winning conflicts depends on a multitude of factors, including political and social will, superior technology, effective military leadership, sound military strategy, and the readiness and morale of personnel.

The second article, written by Major Brian Ladd, US Air Force, JAPCC, titled 'NATO Space Deterrence: Defence through the Lens of DIME', stresses the need for a comprehensive approach to deter aggression in the space domain and underscores NATO's role in promoting responsible space behaviour. Major Ladd recommends establishing space norms, enhancing situational awareness, implementing hosted payloads, and securing additional space funding and cooperation to shape the Russian and Chinese decision-making calculus and deter future conflict.

The last article, 'Protecting our Forces and other relevant entities for a war effort (from the front to the rear area)', by Wing Commander Jeremy Parkinson, Royal Air Force, JAPCC, highlights the loss of the 'rear area' in modern conflict emphasizing the concept of a contiguous battlespace that covers all dimensions. It discusses the willingness of potential adversaries to break international law by employing hybrid warfare, and exploiting the vulnerability of high-value low-density platforms. Wing Commander Parkinson advocates for investing in greater resiliency in terms of basing, supply support, and protection of critical infrastructure. JAPCC supports associated research, named the 'Resilient Basing Project' which aims to identify common trends, and offer recommendations ensuring NATO's Air nd Space capabilities are available when called upon for collective defence.

The Relevance of Superior Joint Air and Space Power Technology in NATO's Defence

By Colonel Tyler Niebuhr et al.
US Air Force, Joint Air Power Competence Centre

Introduction

E volution in the military is driven by the need to defend yourself and defeat your enemy, sometimes at all costs. The victor, in general, first develops a military force capable of evolving and incorporating new technologies at a scale superior to his competitors or adversaries. In the past few centuries in particular, military engineers and inventors have developed many key technologies that considerably altered the character of warfare. One of the most important was the invention of gunpowder, which changed how militaries fought their battles, enabling smaller armies to defeat larger ones at greater and safer distances. The subsequent invention of rifles, machine guns, and artillery made large battlefields more lethal, allowing single soldiers to hold large numbers of attackers at bay and forcing armies to fight from entrenched defensive positions. During World War I, further technological advancements in combination with motorization and enhanced steelworks led to the development of the first tanks, which changed the character of warfare again. Tanks made it possible to cross no man's land and break through enemy lines, forcing opposing armies to develop new strategies, doctrines, and weapons to deal with them.

Additionally, the invention of the aeroplane in the early 20th century radically changed how militaries fought. Aircraft made it possible to gather intelligence, conduct reconnaissance, drop bombs on enemy targets, and conduct aerial fights, making the battlefield overall much 'smaller' and more accessible. However, no invention holds such a tremendous impact on the fundamental concept of war itself as nuclear weapons, which can destroy entire cities with a single bomb.

As conflict and innovation have often led to remarkable advancements in warfighting capabilities, it begs the question – what exactly do we mean by 'superior technology'? When we talk about superior technologies, we refer to tools, systems, or weapons that are more effective and efficient, providing a significant advantage over existing competing technologies. These technologies are typically innovative and reliably provide better performance, capabilities, and/or cost-effectiveness compared to their predecessors or alternatives. By utilizing superior technologies, military forces can gain a stronger position on the battlefield and significantly improve chances for success.

Current Technologies and Their Potential Impact on Future Warfare

The military field has seen a significant surge in the development of new technologies in recent years. Research and development of these technologies have become crucial due to the emergence and resurgence of competing military powers, making it essential to have an advantage to prevent a possible confrontation. There are two main categories of technologies in the military field: underlying technologies, and actual weapons systems that utilize them. In the following discussion, we will highlight some examples of both and explore their potential impact on future warfare.

Underlying Technologies

Artificial Intelligence and Automation: The use of machines and tools to support human workflow is nothing new. After the advent of modern computers, these machines became capable of ever more complex, adaptable, and quicker algorithms, significantly increasing the use cases for supporting human workflows. Depending on the speed of the necessary calculations and the processing power of the computer, different applications for command and control systems can be integrated into existing or emerging systems. These applications can range from strategic decision aides for the political/military level to automated mission execution for unmanned systems.[1] For military application, deterministic algorithms are currently easier to handle since their behaviour can be completely predicted by the input.

Algorithms are also the building blocks of Artificial Intelligence (AI), Machine Learning (ML) and Deep Learning (DL), with DL a subset of ML, and ML a subset of AI. AI enables machines to learn from experience, adjust to new inputs, and perform some human tasks. Therefore, decision processes are generally not predefined but learned over time with the goal of further improvement. The validation and verification of AI output is a major issue in accepting this technology in military applications. Therefore, using AI as a decision aide for various levels of automation, if the system reliably produces trusted outputs, not only enables using more data for decision-making but also helps commanders to keep up with warfare's ever-increasing speed. Automation allows a decision to be supported or made by computers when a human cannot make it in time (time-critical reactive engagements) or a human decision is not generally available. Some of the major problems for AI in military operations are:

- Identifying quality assurance mechanisms for AI.
- Fielding it early enough to prevent competitors from gaining a non-compensable advantage with their own AI applications.
- AI may produce outputs that we cannot understand in a relevant timeline.
- AI may produce outputs the operator will not understand in general.
- What decision outputs are appropriate for AI?
- How to train AI for military applications.
- Moral/ethical considerations of AI.

Quantum Technology (QT): Primarily describes technology stemming from the second quantum revolution, which focuses on manipulating and controlling individual quantum systems to drive advances in quantum computing, sensing, cryptography, and communications. These fields have the potential to influence military capabilities significantly. It is important to note that Quantum Computing (QC) will not replace traditional computers but will significantly accelerate resolving highly complicated problems. Additionally, QC can support machine learning, close to real-time simulations, and data analysis. Thus, providing a decisive information advantage over competitors or adversaries, particularly when faster C2 decision cycles are based on big data and battle cloud concepts. QT also strives to optimize, miniaturize, and synchronize certain systems, significantly enhancing sensing and communication capabilities. Overall, QT will help to strengthen military capabilities to evolve into more secure and capable systems. However, it is important to note that these advancements will also allow competitors to threaten our information and Command and Control (C2) superiority.

Stealth Technology: Using materials and designs that make military equipment less visible for sensors in certain radio frequencies, stealth technology makes it possible for military forces to conduct operations with less risk of early detection. Stealth technology is particularly

important, providing a significant advantage in air-to-air combat and air-to-ground strikes.

Electronic Warfare (EW): EW systems utilize electromagnetic signals to disrupt, jam, or spoof enemy communication and radar systems. These systems minimize our adversary's use of the electromagnetic spectrum (EMS), while allowing our troops to make maximum use of it. EW systems are critical enablers of modern warfare and empower our military to gain an advantage in the battlespace.

Directed Energy Weapons (DEWs): Weapon systems that offer several advantages over conventional kinetic weapons by utilizing high-power lasers or microwaves to damage, destroy or temporarily blind enemy targets. These advantages include immediate impact, increased accuracy, reduced collateral damage, and an almost endless capacity. DEWs have the potential to revolutionize modern warfare with their advanced capabilities.

From an Air power-related technologies point of view, we can find many examples of technologies that provide significant advantages to the owners:

Weapons Systems Using Enabling Technologies

Hypersonic Weapons: Hypersonic missiles pledge to have a much higher survivability, combined with precision strikes and extremely fast delivery times. In addition, hypersonic weapons imply warhead ambiguities, late sensor tracking, and shortened reaction times. At present, hypersonic weapons are comparatively expensive and are therefore only practical when equal effects cannot be achieved by cheaper means. However, many questions still need answers regarding hypersonic weapons. For example:

- What penetrating effects can be delivered?
- How fast can these missiles be programmed or re-programmed?
- How much and when can they manoeuvre, and at what cost?
- What are the trade-offs between terminal speed, manoeuvrability, survivability, and precision correlation?
- What is their non-manoeuvring minimum range?

Polemically, one could argue that successfully pretending to invest in hypersonic technology can have a substantial effect on enhancing one's deterrence capabilities and will force, especially a risk-averse adversary, to invest in hypersonic defensive systems. Such systems are also very expensive and will take away from a limited defence budget, potentially preventing investments in other, possibly more necessary, means.

Unmanned Aircraft System (UAS): UAVs have revolutionized modern warfare by allowing military forces to gather intelligence, conduct offensive operations, and increase dwell times without risking human lives. In addition, during the war in Ukraine, we have witnessed how small and relatively cheap technical improvements have increased UAVs' lethality and employment options. For example, Ukrainian military forces utilized UAVs to provide target details of enemy forces or employ them as kamikaze drones or deliver weapons against hardened targets like tanks.

Precision-Guided Munitions (PGMs): PGMs are either guided by GPS or other advanced technologies to accurately hit targets. PGMs have drastically reduced the overall number of ordnance needed to destroy a target while minimizing collateral damage. By targeting enemy forces with greater accuracy, PGMs became a key technology in modern air power and a significant contributor to our deterrence posture.

Considerations

Although new stealth technology and advanced precision-guided munitions brought the US resounding success in the 1990–91 Gulf War, a different result ensued during the post-9/11 conflict in Afghanistan. Having superior technology by itself does not guarantee victory in future wars. Effective military leadership, training, and strategy can never be replaced, and need to evolve with technology. A military with advanced technology may be able to strike quickly and efficiently, but if its leaders fail to understand the political and social context of the conflict, the military's efforts may not be effective in achieving its goals – as we have witnessed in Ukraine. Advanced technologies must be thoroughly understood and integrated on all levels for optimal employment. Even with cutting-edge technology, military operations are not impervious to other environmental factors, such as weather and terrain, that may affect the effectiveness of weapons, systems, and tactics. Overall, winning conflicts depend on a multitude of factors, including political and social will, the quality of military leadership, the effectiveness of military strategy and tactics, and the readiness and morale of military personnel.

Creative innovation plays a crucial role and is driven by both the civil and military sectors; both bring unique perspectives and expertise to the table. However, the military's unique needs and requirements drive innovation in specific areas, which may not always be compatible with industry's focus or advanced speed-to-scale production models. Gaining and maintaining the strategic advantage is the driving force behind innovation for the military. Maintaining a superior position in a rapidly changing world makes collaboration and cooperation between all sectors crucial. Sharing knowledge, expertise, and resources is necessary to ensure the rapid development of practical and effective applications for the military. The industry and military sectors have

symbiotic roles in driving innovation and ensuring that the military remains at the necessary edge of technology.

However, innovation can only happen with significant defence investments. Managing national defence budgets requires careful and far-sighted prioritization and consideration of the Alliance's threats. Given that defence budgets are quite constrained, despite recent policy changes throughout NATO countries after the Russian invasion of Ukraine, it is important to invest in the correct areas which provide the most value and security over time for the Alliance. Nevertheless, merely investing in the Research and Development (R&D) of advanced technologies can generate fiscal pressure on competing nations to counter a perceived imbalance. Such pressure could generate a return to a type of Cold War arms race, forcing an opposing nation to overextend its budget to match and exceed its opponent.

Therefore, how do Nations prioritize their investments? Nations and NATO should procure capabilities that maximize deterrence and enhance the defensive posture should deterrence fail. Capabilities are needed to support the strategic communications position of a superior military force, elevate the threshold to commence military action and, foremost, enable NATO through indications and warning to have a superior situational awareness in all phases of competition, crisis, and conflict. NATO must be prepared in times of competition to overcome the fog of war, driving the need to maximize ISR with robust and resilient capabilities. Cybersecurity must be a 24/7 mission for NATO nations, enabling advanced warfighting technology and securing critical civilian infrastructures and businesses. Additionally, innovation will continue producing game-changing effects on warfare; thus, NATO nations need to emphasize continuous R&D to stay ahead of its competitors. Ultimately, the most effective investment strategy is highly dependent on a common threat perspective, which can only be

achieved by unconstrained information sharing between allies. Developing a shared understanding and a coordinated effort may help prioritize investments for an optimal cost-to-benefit ratio to maintain or regain a stable security environment.

The article is a joint product of the Combat Air Branch with the Branch Head in the lead.

Colonel Tyler Niebuhr entered the US Air Force in 2001 when he graduated from Weber State University with a Bachelor of Science degree in Applied Physics, earning his commission as a distinguished graduate from the Air Force Reserve Officer Training Corps. Colonel Niebuhr has worked in various flying assignments across the US, Pacific, and European regions, serving at the squadron, group and wing levels. Colonel Niebuhr's educational background includes a Master of Human Relations and a Master of Arts in International Relations from the University of Oklahoma; Air Command and Staff College, Maxwell AFB; and a Master of Strategic Studies, with an emphasis in Joint Planning, from Air War College, Maxwell AFB. Colonel Niebuhr is an F-16 pilot and Forward Air Controller (Airborne) Instructor with over 3,300 flight hours, including over 190 combat sorties and 760 combat hours. Since 2022 he has served as the Combat Air Branch Head at the JAPCC.

Endnote

1. NATO STO AVT359, Study of Hypersonic Capabilities, Phase 1 Chapter 5.3, release March 2022.

NATO Space Deterrence – Defence through the Lens of DIME

By Major Brian Ladd,
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Introduction

When discussing deterrence, one must first understand what it is. Deterrence can be described as a strategy aimed at dissuading potential adversaries from taking aggressive actions or pursuing hostile policies by convincing them that the costs, risks, and consequences of such actions outweigh the potential benefits. It seeks to shape the decision-making calculus of potential adversaries, making them think twice before engaging in aggressive behaviour. At NATO's June 2022 Summit in Madrid, it rewrote the alliance's assessment of the threat environment due to the war in Ukraine. The summit noted that Russia presents the most significant threat to the allies, and that China's ambitions and coercive policies are a challenge to NATO's interests, security, and values. NATO confirmed its three core tasks: cooperative security, crisis prevention/management and deterrence and defence. However, the NATO alliance elevated deterrence as its primary task. During the summit, NATO set a new baseline for its deterrence and defence posture in line with its 360-degree approach across the land, air, maritime, cyber and Space domains, and against all threats and challenges.[1] One framework for foreign policy – and the one used in this paper – is the Diplomatic, Informational, Military, and Economic (DIME) form analysis.

Due to the size and scope of the NATO alliance, the elements within DIME translate to an effective roadmap for deterring aggression in the Space domain.

In summary, the report recommends:

- NATO establishes Space norms and be willing to take action against those who violate them.
- Develop a process for sharing intelligence across the alliance with the NATO Space Centre as the focal point.
- Increase the alliance's Space Situational Awareness (SSA) capacity to respond to the ever-increasing Space catalogue.
- Encourage hosted payloads as an avenue for NATO nations with little to no established Space program to gain access to the Space domain.
- Ensure that Space funding is considered as important as other domains.
- Create a mechanism to withdraw Space expenditures from countries that present a potential threat to the alliance.
- Affirm a commitment by all NATO members to invest, cooperate, and develop Space technologies and to build a robust Space industry within the alliance.
- For both established and non-established Space countries, look to commercial Space providers as a gap filler where military capability is lacking or non-existent until a national and or multi-national capability is achieved.

Space Deterrence Utilizing Diplomacy

At the December 2019 London Summit, NATO declared Space as its fifth operational domain. This announcement communicated to the

world that NATO determined the information collected by satellites is critical to NATO activities, operations, and missions, to include collective defence. In 2020, the establishment of the NATO Space Centre further emphasized how NATO intended to best implement Space effects into NATO operations. Finally, at the 2021 Brussels Summit, NATO recognized that attacks to, from or within Space present a clear challenge to the security of the alliance and could lead to the invocation of Article 5 of the North Atlantic Treaty.[2] The final step where Article 5 could be invoked is a critical element in how the alliance views where Space is situated relative to the other domains, and sends a clear message to its potential adversaries on what consequences they would face in the event of hostile actions in Space. The potential use of Article 5 is not enough for the diplomatic element; NATO must also be a beacon to the world on using Space responsibly.

NATO and its allies have pledged to use Space in accordance with the Outer Space Treaty of 1967, which serves as the foundation for Space law and also the Code of Conduct for Outer Space Activities. The EU Code of Conduct aims to promote responsible behaviour in Space, enhance transparency, and prevent Space debris. It includes provisions for sharing information, collision avoidance, and responsible Space operations. These and many other actions in Space are known as Space norms, where NATO must take the global lead in using Space for peaceful purposes. In the event of an egregious violation of the basics of Space norms – such as Russia's destructive 2021 Anti-Satellite (ASAT) test which created a cloud of debris in orbit – NATO must be resolute in their condemnation of these actions and be prepared to take action. Response options are limited; however, sanctions, divestment in the Russian Space industry, and finally, non-kinetic options are all possible actions available. Additionally, NATO nations should do everything possible to reduce debris events such as the UN resolution to ban ASAT testing in the future.

Space Deterrence Utilizing Informational Exchanges

In orbit 29,000+ 10mm or greater sized objects that pose a potential hazard to the 8,000+ satellites in orbit. The alliance tracks these objects via Space Situational Awareness (SSA) assets ranging from ground-based radars and Space-based radar to ground-based and Space-based telescopes. The vast majority of the Space catalogue is developed and maintained by the US; however, countries such as France, Germany and the United Kingdom are expanding their SSA capability to augment the US capability. France provided its GRAVES and SATAM radar systems, and Germany the Tracking and Imaging Radar (TIRA) and German Experimental Space Surveillance and Tracking (GESTRA), to name a few. For a detailed list and more information on the SSA, the JAPCC White Paper Command and Control of a Multinational Space Surveillance and Tracking Network explains in great detail how the alliance is attempting to address the growing threat of a contested, congested, degraded, and operationally limited environment.

An area that NATO is looking to improve upon is its intelligence sharing for Space. The NATO Space Centre was established in 2020 to bring together all of the upcoming Space operations centres and to allow for a framework to share Space Data, Products, and Services (DPS), while acting as a central node for Space intelligence. The combination of SSA and Space intelligence can also be referred to as Space Domain Awareness (SDA). Accomplishing SDA is critical to facilitate informational exchanges when applied to an Article 5 discussion.

To invoke Article 5, NATO members must first gain recognition of an attack. Once an attack is recognized, the members need to determine the nature and scope of the attack. If the alliance does not have a robust SDA capability, then attribution of an attack in the Space domain cannot occur. In a recent Science and Technology Organization (STO) Space

deterrence war game, players desired nearly 100 % attribution. This provides insight into how NATO Senior Leaders might address Article 5 decisions involving hostilities against a Space asset in a real-world scenario. Due to the vastness of Space and the sheer number of Space assets, the alliance must not only work together to augment its SSA capacity but also share and disseminate Space intelligence. At the 2021 Brussels Summit, NATO announced plans to develop a Strategic Space Situational Awareness System (3SAS) at NATO Headquarters. This capability would allow the alliance to better understand the Space environment and Space events, and their effects across all domains. This is a promising first step, but the alliance should consider more.[3]

Space Deterrence Utilizing Military Cooperation

The NATO Madrid Summit highlighted that resilience underpins all of NATO's core tasks. When discussing resilience for deterrence, one must first be aware of deterrence through denial. Deterrence through denial is a strategy nations employ to dissuade potential adversaries from taking aggressive actions by making it difficult or costly for them to achieve their objectives. It focuses on denying the adversary the benefits or advantages they seek to gain through military or hostile actions. This approach aims to deter aggression by demonstrating the ability to counter or negate the attacker's capabilities and objectives.

When applied to Space, one should look at the numbers first. The US military satellites total 231, while the rest of NATO has 43. Expanding the focus to all of the Space capabilities, the rest of NATO has ~1,200 active satellites, and the US has ~3,500. NATO members constitute 60 % of all active satellites in Space. This sheer fact contributes to the overall resiliency; however, the alliance must note that the US still possesses the vast majority of on-orbit capacity. In the event the US is

unavailable to support, the alliance would be unable to provide Space effects to their warfighters.

A method that the alliance can use to address this disparity of assets is through hosted payloads. Hosted payloads are when two or more nations and or companies collaborate with either multiple payloads or access to a satellite bus to generate a single spacecraft. Hosted payloads offer many advantages to the alliance by providing cost-effectiveness, accelerating deployments, and gaining access to Space for nations that have not yet established a launch or full Space program. The collaboration and sharing of resources across the alliance enables greater access to Space for all members of the alliance. The employment of hosted payloads is not new to the alliance. There are successful examples such as the Athena-Fidus Satellite – a joint satellite mission between the French Space Agency (CNES) and the Italian Space Agency (ASI)[4] – and the SES-14 satellite operated by the Luxembourg-based company SES that hosts the NASA Global-scale Observations of the Limb and Disk (GOLD) instrument.[5] The NATO Communication and Information Agency (NCIA) has established the Allied Reachback Hosted Payload Initiative, aiming to enhance the capabilities of NATO member states by hosting national payloads on commercial satellite platforms. It allows nations to leverage existing commercial satellite infrastructure for a variety of applications such as communications, Earth observation, and scientific experiments.

Lastly, NATO must continue implementing Space into their training, exercises, and war games. By doing this, NATO forces can understand that Space is inherent to supporting all domains. As NATO moves forward with Multi-Domain Operations (MDO), training 'a day without Space' brings awareness of the importance of Space operations and, therefore, the importance of deterring aggression in Space through denial.

Space Deterrence Utilizing Economic Investment

In 2014 NATO leaders made a Defence Investment Pledge and agreed that as a guideline, each NATO nation should spend at least two percent of its Gross Domestic Product (GDP) on defence. Since the 2014 pledge, the majority of NATO nations have struggled to achieve that GDP goal; however, the war in Ukraine has been a wake-up call and has re-energized the alliance to make a greater commitment to the pledge. Nonetheless, nations must recognize that even though the attraction to heavily invest in aircraft and tanks is great at the moment, investing in Space cannot be forgotten. As mentioned above, the US controls 82 % of NATO's Space capabilities. As a rule in the NDPP, no ally should provide a contribution representing more than half of a capability, other than in exceptional cases. The last portion of the previous statement might have previously been relevant to the Space domain. However, Space is no longer an exception to warfare and since 2019, has been identified as a separate domain. If Article 5 is invoked, NATO will not be assigned Space capabilities but instead will inherit the effects that nationally owned on-orbit assets provide. With only 18 % of the total capacity offered by the rest of NATO, it is impossible to meet the 50 % rule.

It is time for the alliance to recognise the importance of Space and invest accordingly. There is, however, a correct and incorrect way to invest in the Space domain. First, one incorrect way to invest is how for years, the European Space Agency (ESA) utilized Russian-made RD-180 rocket engines to gain access to Space. After the annexation of Crimea, the ESA ignored the warning signs and continued to utilize and buy into the RD-180 engine program. At the same time, the US understood that continuing to invest in the RD-180 program provided an economic and strategic vulnerability and decided to spur domestic Space engine production by selecting SpaceX and Blue Origin engines after a competitive industry contract bidding process. SpaceX is now the leader

for NATO's launch program and provides a domestic capability, while removing leverage from an adversary.

An example of investment done correctly would be the recent development and launch of Türkiye's Imece reconnaissance satellite. About 80 % of the satellite's production and design was done by Turkish scientists, but for the remaining portion, Türkiye looked to its NATO allies to provide the expertise to complete the program. On 15 April 2023, Imece was launched from Vandenberg Space Force Base on a SpaceX Falcon 9 booster and reached orbit ready to perform its missions of target identification, detection of natural disasters, and imaging applications for agricultural use. Investment within the alliance strengthens our industry base and provides a powerful deterrence to any potential adversary who believes that it can impact NATO's resilience in Space. Lastly, the war in Ukraine has provided profound examples of how the commercial Space industry can impact wartime operations (see most recent JAPCC Journal for more information). To that regard, the NCIA has determined that to allow NATO forces to communicate more securely and quickly, NATO is investing over one billion euros in procuring satellite communications services from 2020–2034. This marks the largest-ever investment by NCIA in satellite communications, making NATO forces more resilient and acting as a massive deterrence.

Conclusion

Each element of DIME mentioned above can encompass a host of deterrence activities, but when combined, they form a complex web of deterrence. At this point, adversaries must carefully evaluate whether engaging in hostilities in the Space domain would yield the anticipated advantages, or if they would instead encounter resilience. A significant challenge to deterring adversaries and in evaluating deterrence

activities is determining the effectiveness of the actions taken and deciding whether to continue on the same path or make adjustments. The concept of deterrence is an ongoing strategic game, akin to a constant game of chess between two or more players. As NATO transitions towards a comprehensive 360-degree approach to deterrence, it becomes imperative to establish a capable deterrence in the Space domain. One way to achieve this is by examining the elements of DIME.

Major Brian Ladd graduated from Bowling Green State University in 2005 with a Bachelor's degree in History and received his commission by AFROTC. His first tour was at the 4th Space Operations Squadron at Schriever AFB in Colorado Springs, CO, where he was a Satellite Operator of the MILSTAR communications system. His other operational tour was as the Liaison Officer at RAF Fylingdales Strategic Missile Warning Radar. He has completed many Space Staff assignments at Joint Base Pearl Harbor-Hickam, Vandenberg AFB, and Offutt AFB. He transitioned to the US Space Force in October 2020. Since June 2021 he serves as the Chief of Cyber and Space Readiness at Joint Air Power Competence Centre.

Endnotes

1. NATO, 6 July 2023, https://www.nato.int/cps/en/natohq/topics_133127.htm, (accessed 11 July 2023).
2. NATO, 23 May 2023, https://www.nato.int/cps/en/natohq/topics_175419.htm#top, (accessed 11 July 2023).
3. Ibid.
4. Italian Space Agency (ASI), 2019, https://www.asi.it/en/tlc-and-navigation/athena-fidus, (accessed 11 July 2023).
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Ensuring the Availability of Capability

Wing Commander (ret.) Jez Parkinson,
Joint Air Power Competence Centre

'Invincibility lies in defence; the possibility of victory in the attack.'

Sun Tzu

There is no longer such a thing as a Rear Area, only a single Contiguous Battlespace that covers all dimensions concurrently, including the Electromagnetic Spectrum. Potential adversaries are demonstrating their willingness to break international law in pursuit of their agendas and will exploit the concept of a contiguous battlespace to do so. They will look to degrade NATO capability when and wherever possible through any means conceivable. Therefore, the challenge is to ensure NATO's capability to create sufficient space for NATO's political decision-making process to function, while simultaneously positioning to deliver a decisive military response if attacked.

NATO is a defensive alliance and, by definition, reactionary. Even if described as 'responsive', there must first be some stimuli that prompts action, that first action being diplomatic (unless attacked without warning). Therefore, we need to create time and space for diplomatic activity, through a robust deterrent posture. This posture must be capable of seamless progression to active defence before ultimately, and only if authorised, transitioning to offensive action designed to regain territory and neutralise the threat.

Ensuring the Availability of Capability (AoC) demands an understanding of the capabilities to be ensured and the surrounding environment. This

setting will comprise a significant number of high-value assets operating in all dimensions; a vast electromagnetic signature; a diverse population (military and civilian), and large quantities of volatile and fragile materiel, all within a delineated, NATO-owned space. All activities must be coordinated with all operators, enablers, co-located entities and adjacent units; any of which may be coalition partners. Conceptually, this operating space may be described as the Complex All Domain Environment (CADE).[1] Furthermore, any operating space of the future will be contested – The Contested, Complex All Domain Environment (CCADE).[2] While this description of the NATO Air and Space Power (ASP) operating environment predominantly focuses on the airbase, the concept applies equally to the entire NATO Joint endeavour.

Consider now that NATO ASP is the Alliance's asymmetric advantage – it is what our adversaries fear most. Here, one could offer our own doctrine and the roles of ASP (in other words, the things we are good at) as justification for this statement. However, what matters is the perception of our adversaries. As the component most likely in the vanguard of any response to aggression, Allied ASP must first be degraded for the adversary to have a chance of achieving their objectives.

At the political level, an ASP response is often the preferred response, if not the default one, because of its flexibility. Suffice to say, the use of ASP is perceived as effective and resource efficient, and, crucially, may negate the need for 'boots on the ground' and the complexity and risk that this brings. Therefore, the question for the Alliance becomes, on the day every advantage is required, will the asymmetric advantage provided by ASP be available as anticipated, and will the freedom to use it in a manner of our choosing exist? The corollary to this perspective is that if ASP is our advantage, then by default, it is what our adversaries will seek to neutralise at the earliest possible opportunity, and certainly before the advantage can be fully employed.

Also, if NATO is to prevail in any future conflict, then it is not just ASP capability that must be ensured, but all warfighting capability, the availability of all Instruments of Power and Critical National Infrastructure. Again, any protective activity to ensure the AoC must be undertaken in a manner that maintains Alliance freedom of action. Therefore, ensuring AoC is not just an ASP endeavour, but a truly Combined, Joint and Comprehensive effort. Furthermore, NATO ASP has a significant role to play in ensuring the availability of a broad spectrum of other capabilities. There is a truly symbiotic relationship between the ability to ensure the availability of ASP and the ability of other domains to ensure the availability of their capability.

So, what do we need to ensure the availability of ASP? The exceptional capability of our platforms is routinely discussed. On occasion, how incredibly complex and expensive they are might be mentioned. The argument is made that because of the increased capability of modern platforms; there is no longer the need to procure so many. However, the unit price of these platforms is now so eye-wateringly high that the primary driver of the quantity procured is not military necessity but rather affordability. While they may be hugely capable, given that there are relatively few of them (what may be described as high-value, or even exquisite[3], yet low-density), the situation now exists where the loss of one, let alone several, can have true strategic impact.

It can be argued that complexity contributes to capability, but operating complex platforms, particularly in a contested environment, brings its own significant challenges. This is not least because complexity also creates inherent fragility. This fragility comes not only from the complexity of the technology itself, but also from how current generation platforms have been designed to operate[4]: no longer single self-contained capability packages, but with the platform as part of a system or even a system-of-systems. Therefore, if we are to ensure the AoC, we now need to be thinking in terms of ensuring the availability of complete systems, not just individual assets.

The challenge is to ensure the availability of capabilities that have a role in ensuring the availability of a range of other capabilities. This challenge exists in the CCADE environment described above. The complexity continues to build as the concept of the contiguous battlespace is introduced, together with an adversary that will exploit all available threat vectors to pursue their objectives. Capability is contained within high-value, low-density platforms that to function need to be incorporated into wider systems; this is not just being 'network-enabled', but the plethora of people and materiel required to enable a platform to function as intended. Lastly, the systems discussed have been conceived during the era of 'Wars of Choice'[5] rather than in the Cold War or the current epoch. They were developed using the business management strategies of the day, where efficiency took precedence over resilience. Not only are the platforms themselves lacking in resilience but also the system(s) that enable their use.

It is offered that we do not yet, face a true peer adversary. No state has the technical superiority, the ability to sustain forces at scale, and/or at range, or sufficient mass to take and then hold ground. In a confrontation with Russia (or a similar adversary), we would undoubtedly prevail, although the cost in every respect would be astronomical. Therefore, force-on-force confrontation with a near-peer adversary is something we should continue to strive to deter and to do this, our capability and the ability to use it has to be assured. From the reciprocal perspective, our future adversaries will try to avoid open conflict, because they assume they will ultimately be defeated. Therefore, it is suggested that a future adversary will seek to substantially degrade NATO, below the threshold of open conflict in the grey space that exists between now and any future NATO declaration of Article V. This includes the possibility of the Shattering of Alliance Cohesion[6] via hybrid means before there is the opportunity to decide, let alone act. The intelligence community talks a lot about 'Indications & Warnings', but what if there are no warnings, we miss them or indeed, ignore them?

Now bringing the pieces of the puzzle of ensuring capability together. The first step is to accept that we have a problem that needs fixing. Returning to the earlier proposition that NATO ASP is the Alliance's asymmetric advantage, if that advantage can be mitigated, then that is what an adversary will seek to do. Also, if that adversary no longer functions in accordance with the rules-based international system and aims to exploit the concept of a contiguous battlespace, then by default, ASP becomes the target of choice at the point when an adversary perceives that confrontation with NATO is either inevitable, or becomes their chosen course of action.

'If we lose the war in the air, we lose the war and lose it quickly.'
Field Marshall Bernard L. Montgomery

The JAPCC's Resilient Basing Project[7] seeks to identify all that needs to be ensured to conduct air operations. This substantial work demonstrates that even a cursory look at how we deliver ASP today will reveal that we have been too willing over the last three decades to make savings against enablers.[8] So while having continued to invest in front-end capability, we have concurrently reduced investment in support to continue to afford the platforms themselves. In doing so, we have 'hollowed-out' our air forces and created a situation where we can no longer ensure the AoC. Why? Because while we may have created effective business models and procured exquisite capability, we have simultaneously lost sight of the need to operate in contested environments, particularly from the home base. Put simply, we have lost the ability to fight a determined, capable, and intelligent enemy that will use all means necessary to win.

The adoption of concepts such as 'just in time supply', or the civilianisation of many previously military-delivered activities have resulted in forces that are much less resilient than their Cold War counterparts. Consider that our competitors will have already done their analysis in preparation for future escalation and identified the lack of resilience in our systems. Many of

these vulnerabilities are unlikely to be located at or close to the platform, more likely elsewhere within the system or system-of-systems. Examples could include, but are not limited to:

- Key personnel limited in number but with irreplaceable abilities or skills;
- Manufacturing or maintenance facilities, particularly for key components;
- Vital support infrastructure, to include information technology.

The fact is that to have ASP available when it is needed requires it to be properly resilient and fully enabled all of the time.[9] Each base should be (as it was in the Cold War), a complete, self-sustainable fighting platform further subdivided into sectors that can be operated with a degree of autonomy. In addition, with at least one pre-identified alternative operating location. This construct creates resilience, as any adversary had to neutralise a far greater number of assets spread over a far wider geographic area. Notwithstanding that previous platforms were easier to sustain with fewer resources and were difficult to affect without direct action that was instantly identifiable and attributable. Furthermore, our assets and their enablers[10] were properly protected because it was recognised that an adversary would look to target Airpower where it was most vulnerable, a truism that endures.

'It is easier and more effective to destroy the enemy's aerial power by destroying his nests and eggs on the ground than to hunt his flying birds in the air.' **General Giulio Douhet**

The reality of the Cold War was that any airbase could be subject to attack, and robust concepts of operation existed, understanding that an adversary would attempt to do everything possible to degrade, if not fully neutralize the airbase. If this mentality had continued and evolved as an enduring principle, rather being discarded as an unnecessary peacetime resource cost, would we now lack the necessary resilience or need to be

discussing the concept of Agile Combat Employment (ACE)? The Air Component of the Cold War era was more dispersed and had redundancy built-in; more air bases, and more aircraft.

'Quantity has a quality all of its own.' *Joseph Stalin*

Adversaries will endeavour to nullify any advantage, prioritising the targeting of identified vulnerabilities. Weaknesses identified will be fully exploited, with any single point(s) of failure being explicitly targeted. The Resilient Basing Project set out to explore what it takes to project capability, and as a corollary, what an adversary would undoubtedly seek to target to neutralise a capability. To fully appreciate the problem first requires an appreciation of the truly interconnected nature of everything we do to function as effective, technologically advanced air forces operating complex platforms. Just getting to the point where a platform leaves the ground fully mission capable requires a vast number of processes (fuelling, arming, planning, data uploads, etc.) to come together at the desired location, in the correct order and at the right time. All of this must be a resilient system of systems if we are to ensure the AoC. In many respects, we have lost the ability to operate our bases as fighting platforms against an intelligent, capable, adaptable adversary.

'No works or equipment not provided in peace, and no measures of defence and protection not practiced in advance, will be found of any effect in the opening stages of an emergency when the need for them will be at its height.' *Air Commodore Douglas Evill*

Resilience[11] is a simple concept, but creating true resilience across an entire system is incredibly difficult. We have neglected the issue of resilience, including developing robust concepts for the enablement of ASP, for too long, and we will now have to reverse-engineer much of the resilience we require, likely at a significant cost. There are multiple examples of how we have failed to maintain the resilience we worked so hard

to achieve in the Cold War, in pursuit of the so-called 'Peace Dividend'[12] as this piece has intimated. We expected to be attacked at speed and scale and, as a result, created mechanisms to allow NATO to survive the initial onslaught and then rapidly deliver a decisive response. This was not just about retaining sufficient mass to respond but about retaining full capability and the freedom to use it. It is offered we are now incredibly vulnerable both at the home base and in respect of our Lines of Communication, and we are at risk of being defeated before we can bring our much-vaunted capability to bear – we can currently no longer ensure the AoC and remedial action is urgently required.

Looking at how we conduct the business of delivering ASP today, one quickly realizes how much of what we do is based on supposedly effective and highly efficient business practices coupled with a desire to constrain defence spending. The reason these business models are 'efficient' is that they minimise the resource requirement. In many cases, these business models proved to be flawed during the COVID Pandemic as large areas of our economies struggled to function as soon as supporting systems started to fail and problems multiplied as delicate supply chains were disrupted. If current business models cannot facilitate business continuity during a pandemic, how can they be expected to work during warfighting?

Despite all of the complexities involved in a discussion about ensuring the AoC, the concept at the heart of the solution remains simple: There is a need to speak truth to power – tell decision makers and budget holders what they need to hear, not what it is perceived they want to hear. A failure to reinvest in enabling ASP, including enhancing system resilience, to ensure its availability when needed is gambling with deterrence. ASP needs to be available and must survive any pre-emptive action by a future adversary. This requires urgent investment in enhancing resilience, including procuring the right amount of enablers to match the number of platforms. Finally, it needs to be understood that we cannot ensure the

availability of everything, all of the time so, there are going to be some difficult discussions ahead about priorities.

'He who wants to protect everything, protects nothing, is one of the fundamental rules of defence.' **General Adolf Galland**

Wing Commander (ret.) Jez Parkinson is a RAF Regiment Officer with 35-years regular Service; over half in the Multinational environment and in excess of 7-years on operations. He continues to work as a Reservist in the Force Protection Environment and as a civilian on Asset Protection collaborating with the military, industry and academia. He is the author of NATO FP Policy, FP Doctrine for Air Operations and the current Custodian for Joint FP Doctrine. He is responsible for the development and delivery of NATO FP Courses as well as writing several publications and articles on FP.

Endnotes

1. A concept present in ongoing discussions regarding doctrine.
2. Ibid.
3. OED: Extremely beautiful yet delicate.
4. Designed when the challenges of today were considered to be in the past or unlikely to endure.
5. From an article in the Washington Post by Richard N. Hass, 23 November 2003.
6. A phrase in regularly use and often cited as NATO's Centre of Gravity.
7. More information is available on the JAPCC Website and for those wishing further information, the project can be discussed with members of the JAPCC at the Conference.
8. In this context, 'enablement' (OED, giving someone the authority or means to do something) is all that is required to get a platform to the point where it is mission ready. This includes, but is not limited to, logistics (fuel & gases), weapon load, intelligence and mission planning, all aspects of engineering support and personnel – in short, everything needed other than the platform itself, to deliver effects from the air.
9. E.g., with 30-days, Daily Operating Stocks of all NATO classes, with all enabling capability, to include personnel, contained within a secure, well-defended space that extended well beyond the airbase perimeter
10. What many would recognize as Combat Support and Combat Service Support.
11. OED: The capacity to withstand or to recover quickly from difficulties; toughness.
12. The Peace Dividend was a political slogan popularised by US President George H. W. Bush and UK Prime Minister Margaret Thatcher in the light of the 1988–1991 collapse of the Soviet Union. It described the supposed economic benefits of a decrease in defence spending. The term was frequently used at the end of the Cold War, when many Western nations significantly cut military spending such as Britain's 1990 Options for Change defence review.

Panel 4

Sustaining NATO Joint Air and Space Power

Abstract

Sustaining NATO Joint Air and Space Power is essential to maintain the readiness, effectiveness, and long-term viability of these capabilities. It requires a comprehensive approach encompassing resource allocation, maintenance and logistics, incorporating new technological advancements and cooperation among member states.

NATO member states must allocate adequate resources to sustain Joint Air and Space Power capabilities. This entails funding for the modernization of assets, ensuring a robust maintenance process, and providing adequate logistics support to guarantee the availability and readiness of operational resources. Furthermore, establishing efficient logistics networks and industrial supply capacity is crucial for the timely availability of necessary resources to sustain prolonged operations. Further, NATO members should foster collaboration and cooperation in the logistics of Joint Air and Space Power capabilities and forge partnerships with industry stakeholders, including defence contractors and technology providers to leverage their expertise and capabilities.

Article Synopses

This panel presents two articles that introduce various ideas and issues intended to inform the Sustaining NATO Joint Air and Space Power Panel discussion; the views expressed in these articles inspire critical thinking and prepare those attending the 2023 Joint Air and Space Power Conference.

The first article, written by Lieutenant Colonel Isaiah Oppelaar, US Air Force, JAPCC, is titled 'Organizing Logistics for Future Collective Defence.' It highlights the inadequacy of the current logistics systems in meeting the demands of future high-intensity, high-threat environments. The article emphasizes the urgent need for NATO logistics to evolve rapidly, leading the way in developing flexible and speedy systems that can support operations in such conflicts. The focus is on improving 'push logistics' rather than being reactive.

The second article, authored by Dr Michael Schoellhorn, CEO of Airbus Defence and Space, is titled 'Transparent Stakeholder and Multinational Collaboration: The Key to a Strong European Defence Industry'. It acknowledges the extraordinary times we live in and the need for extraordinary measures. The article emphasizes the evolving nature of the European defence system and its importance in ensuring effective, efficient, and sustainable air and space capabilities. It also highlights the shortcomings that have become apparent in Europe's defence, particularly in light of the conflict in Ukraine. The article suggests rethinking concepts such as modularity, scalability, Modular Open Systems Architecture (MOSA), agile development and procurement, interoperability, connectivity by design, defence budget increases, and strengthening the European defence industry and programs.

Organizing Logistics for Future Collective Defence

By Lieutenant Colonel Isaiah Oppelaar,
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The Challenge for Future Logistics

Logistics is the cornerstone of all NATO operations but is often a secondary planning discussion after the staff plans the execution portion of an operation. According to NATO doctrine (AJP-5), 'Logistics frequently shapes the design of operations.'[1] However, AJP-5 does not address logistics in operations planning until Course-of-Action (COA) analysis since 'nations have the ultimate responsibility for equipping their forces.'[2] Paraphrasing the doctrine, the staff will develop COAs to achieve the objective through operational art and design, determine if the Alliance possesses the correct capabilities to achieve the objective, adjust the plan if needed, and then the logistics planners attempt to estimate the time and quantity of resources required to get the needed capabilities in place and sustain the forces while in execution. However, without early logistics planning, this method can have dramatic negative impacts on operational plans when, after days or weeks of planning, the planning staff ascertains the nations cannot get all of the required capabilities to the locations the operators need or they can only sustain the operation for a fraction of the time required to achieve the objectives.

The ambiguity and complexity of logistical planning intensify when supporting future high-intensity, high-threat, and large-scale operations, to include Multi-Domain Operations (MDO). According to the definition released by Allied Command Transformation in March of 2023, MDO in

NATO is 'the orchestration of military activities, across all domains and environments, synchronized with non-military activities, to enable the Alliance to create converging effects at the speed of relevance.'[3] In the Joint Airpower Competence Centre pamphlet, 'All-Domain Operations in a Combined Environment,' the preeminent NATO Centre of Excellence describes a future where multiple NATO nations execute synchronized operations across domains utilizing state-of-the-art Machine Learning (ML) and Artificial Intelligence (AI) to reduce the fog of war, speed up the Find, Fix, Track, Target, Engage, Assess, (F2T2EA) kill chain, and achieve operational and strategic effects.[4] However, in every operation and especially highlighted by the initial failures of Russian Armed Forces attempting to seize the capital of Ukraine, Kyiv, in February and March of 2022, the logistics enterprise remains a critical component of operational concepts and must evolve and develop concurrently with the execution enterprise.

According to ACT, NATO and national logistics enterprises must be prepared to connect 'the systems and expertise of national and non-military stakeholders, and be agile enough to integrate emerging technology that support the delivery of MDO.'[5] However, the nature of logistics, being a mix of military, contracted, and civilian solutions presents very real difficulties in incorporating logistics into future military command and control and planning systems.

NATO Logistics as a National Capability

In 2014 and again in 2015, the North Atlantic Council (NAC) issued the Readiness Action Plan (RAP) and Political Guidance 2015 in response to the Russia-Ukraine conflict in Crimea. This guidance promoted, 'the pursuit of collective logistics and broadens the logistics vision to provide NATO commanders the greatest flexibility on current and future missions by providing effective and efficient logistic support.'[6]

Currently, NATO logistics is a function of and limited by the capabilities of the member nations and are, 'primarily a national (responsibility).' According to NATO doctrine, there are four primary methods of multi-national logistics support to an operation:

- Pre-planned mutual support, which are Mutual Support Agreements (MSAs) and cooperation between National Support Elements (NSEs) that are arranged bi- or multilaterally by NATO and/or nations.
- One nation formally provides the support and services to all or part of the multinational force as the Logistic Lead Nation (LLN) or the Logistic Role Specialist Nations (LRSN).
- One or more nations formally services all or part of the multinational force under the operational control of the joint force commander.
- One or more nations services all or part of the multinational force by forming a Multinational Logistic/Medical Unit (MLU/MMU).[7]

In all of these cases, either nations will supply and sustain with their own logistics or one or more member nations will provide the logistics capability, the nuances being who has command authority and under what agreement they will support. However, the limitations, and by extension the vulnerabilities, of the individual nations are ever present in NATO operations and may even be exaggerated by the increased stress of multinational operations.

The 'Triple Constraint' Challenge

Every commander desires fast, cheap, and abundant logistics when executing military operations. However, in the real world of trade-offs and compromises, a typical military logistics organization can achieve at most two of the three features and typically gets one. Compared to commercial air logistics such as FedEx or DHL, military logistics are much more

complicated and more limited by transportation capacity than funding, forcing a trade between speed and volume. In general, increasing the speed of logistics normally means switching the mode of travel from surface and sea transport to air, increasing the cost and reducing the volume and weight of the shipments.[8]

The logistics enterprise operates within the constraints of the 'Project Management Triangle', or triple constraint. In short, this theory of constraints contends:

- the quality of work is constrained by the project's budget, deadlines and scope (features);
- the project manager can trade between constraints;
- changes in one constraint necessitate changes in others to compensate, or quality will suffer.[9]

For military logistics, the first constraint can be modified to, 'The quality of the logistics is constrained by the nation's budget, delivery speed, and quantity.' On one end of the spectrum, the most cost-effective logistics deliver an immense amount of material very slowly, typically via rail and sealift. On the other end of the spectrum, logistics theoretically can move a tiny amount very quickly at high cost. A few years ago, the United States Transportation Command, the command responsible for global logistics for the United States, held a conference with more than forty commercial executives where the commanding general at the time, General Lyons, highlighted the future capability to, 'eventually move cargo through space to anywhere on the planet in an hour'.[10] Although this level of speed would be reserved only for the absolute pinnacle of priority cargo, it demonstrates the theoretical limit of the speed, cost, and volume triad.

The vision for NATO leadership is for the logistics enterprise to increase 'flexibility on current and future missions by providing effective and

efficient logistic support'. To have such a vision for improvement indicates that past operations were impaired, at least in part, by a rigidity in support or failure to provide effective and/or efficient solutions. Future solutions must be flexible to prioritize and reprioritize support to meet operational requirements. As the Alliance moves from conventional planning by traditional joint components to MDO, planned simultaneously across five domains, the complexity and stress on the logistics enterprise will only increase.

NATO Logistics in the Future

What impacts do future high-intensity, high-threat, and large-scale operations have on NATO logistics? The Alliance Concept reiterates that MDO-trained staffs will execute 'synchronized activities that create effects at scale and speed to produce collective results that are greater than the sum of their individual parts.' As NATO increases the speed of execution of the kinetic fight, reducing the time from target detection to employment of a weapon or force, and improving the operational and strategic impact of those decisions, the logistics side of the Alliance must be in place and capable to support.

In the future, national logistics support systems, using ML and AI, may be able to automatically and pre-emptively place an order for the required weapon or supporting equipment and match it with the necessary transportation method to achieve the required delivery date. This capability would function similarly to Amazon's Anticipatory Shipping.[11] According to Forbes Magazine, 'Amazon collects troves of valuable data about its customers' preferences and habits. With anticipatory shipping, the idea is to use that data to predict what customers want and then ship the products automatically.'[12] Specifically, the patent includes:

'Packaging one or more items as a package for eventual shipment to a delivery address, selecting a destination geographical area to which to ship the package, shipping the package to the destination geographical area without completely specifying the delivery address at the time of shipment, and while the package is in transit, completely specifying the delivery address for the package.'

For logistics in this environment, coupling future command and control systems with the required in-transit visibility capability will give commanders unprecedented flexibility to execute the operations necessary to achieve the desired strategic effects.

For military logistics, this means placing an order for forces or equipment to service a target or operation and simultaneously ordering replacement parts, expected maintenance support equipment, and/or follow-on weapons. Furthermore, if programmed with sufficient and correct historical execution data and logistics support plans, these national systems could theoretically anticipate operational changes as they are occurring and could then adjust the flow of personnel and equipment to meet the changing operational need.

Conclusion and Future of NATO Logistics

The current logistics systems of the Alliance's militaries are not designed for the necessary level of flexibility and speed to meet the needs of the future high-intensity, high-threat environment. Even if systems existed to receive logistics orders, check stock levels, identify a sourcing solution, and build multi-modal movement plans, NATO logistics would undoubtedly be faced with a lack of capacity or timeliness on the transportation side, even with a significant reliance on civilian or contract solutions.

NATO logistics must rapidly evolve to lead and develop the future of logistics in a way that enables operations in a high-intensity, high-threat conflict and provides new capabilities to improve 'push logistics' instead of being reactive. In an article on the Defence Visual Information Distribution Service (DVIDS), Gen. Joseph L. Votel, USA (ret.) stated, 'In a renewed era of great-power competition, logistics cannot be over-looked.'[13] As the Alliance seeks to transform integration across domains and simultaneously incorporate emerging technology, innovation must also occur within the logistics enterprise. From commercial integration with suppliers and transportation providers, to systems providing in-transit visibility, to multi-modal delivery of personnel and equipment, current obstacles to effective logistics may become barriers to successful future operations.

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Transparent Stakeholder and Multinational Collaboration

The Key to a Strong European Defence Industry

By Dr Michael Schoellhorn,
CEO Airbus Defence and Space

Introduction

The European defence system is finally evolving, accelerated by the growing need for effective, efficient, and sustainable air and space capabilities. At the same time, in light of the war against Ukraine, various shortcomings in Europe's defence, industrial and technological capabilities have suddenly become tangible. Simultaneously, a geopolitical power shift is happening that has the US increasingly focused on China as the 'pacing threat' and system rival and are expecting Europe to pull their weight by contributing to their own defence.

The Russian invasion of Ukraine has revealed these and other unpleasant truths for Europe. As political leaders across Europe acknowledged, we are indeed facing a 'Zeitenwende' (turn of the times). Europe is at a critical juncture that calls for a change of policy and processes.

Germany, France and Spain, economic strongholds and important NATO allies, have announced their plan to finally live up to the 2% NATO defence expenditure target. NATO has welcomed this as it sees

these members paying their defence dues and improving the operational readiness of their armed forces.

But it's a long way from rhetoric to reality: Unfortunately, even a full year after it was introduced with much fanfare, the 'Zeitenwende' is largely still awaiting its actual execution. The budgeted funds substantiating this policy change are excruciatingly slow to reach the European defence industry: Apart from purchasing F35 fighters and planned CH-47 helicopters, Germany, for example, has yet to spend the bulk of the funds. Even the restocking of ammunition and replacement of defence goods provided to Ukraine has not yet occurred.

But it is not just the allocation of funds the 'Zeitenwende' execution has failed on so far. The necessary overhaul of the procurement regulations, while, of course, remaining compliant with laws and regulations, has not happened in Germany. These rules, defined in peacetime and seemingly designed to ensure zero legal or contractual risk without improving throughput and implementation results, need to be revised and adapted to the realities of a defence landscape that has to brace for a decade of rising geopolitical risk including an ongoing hot war in Europe.

And finally, the industrial base has to be secured and overhauled as well: from a capacity to deliver to a technological and a mindset point of view.

We can only accomplish the three improvement needs mentioned in concert.

Devising a Collaborative, Resilient and Sustainable Defence Infrastructure for Europe

The key questions for European defence in the 21st century are simple: How can we achieve a collaborative, resilient, and sustainable defence

infrastructure for Europe? What should it look like? And how can the European defence industry play its part?

The answers are just as simple in principle, but their implementation is a mile-high, tall order for our generation: We need a different mindset. We need to let go of short-sighted comfort and business as usual. We need to look ahead and move swiftly. Europe needs sufficient strategic autonomy. We need a transparent, coordinated, integrated European industrial and technology strategy. This mindset is the basis for building and maintaining credible, sustainable, and well-equipped armed forces in Europe and for NATO.

From a defence industry perspective, we, our customers (governments and armed forces), and key partners (non-European suppliers, NATO) need to address the following action items:

- secure, utilize and leverage existing defence capabilities;
- facilitate the defragmentation and cohesion of the European defence landscape;
- promote and establish 'new and agile' ways of working;
- modernise procurement and optimise its processes;
- mature and standardise interoperability and modular open systems architecture for platforms;
- promote a European Space Strategy.

All this needs to be done and achieved together. It requires full collaborative transparency and the willingness of all stakeholders to rally behind a common purpose: Build a robust and sustainable European defence landscape that strengthens Europe's security and its reliability for NATO.

How to Leverage and Utilize Existing Defence Capabilities

Many significant challenges have been exposed in the light of the war against Ukraine. If we accept these 'lessons learned', we might have a great launch pad for moving by leveraging existing defence capabilities.

One example is the significance of localised defence maintenance hubs. The ability to maintain, repair, upgrade, and further develop combat systems on-site is strategically and economically prudent and a precondition for resilience. It is also time-efficient and guarantees the continuous mission-capable status of critical weapons systems. Airbus Defence and Space has long seen the advantages of such hubs.

Two proof point examples are:

- Getafe (Spain), which is home to the A400M, C295 and Eurofighter, also maintains the F/A18 Hornets. Airbus works closely with the Spanish Air Force to keep them mission ready until they age out in 2024.
- With Manching (Bavaria, Germany), we have built one of Europe's leading facilities for military aviation. This site is unique in more ways than one: In Manching, Airbus and our customers (German armed forces) work together closely and as equals. Its beginnings were primarily in repairing and maintaining American aircraft like the F-104 Starfighter and F4-Phantom, and to this day, we maintain externally produced aircraft such as the NATO AWACS aircraft. This site covers the entire value chain from R&D and design to production, maintenance and customer service of military aviation platforms. It also houses the Future Combat Air System's (FCAS) 'Remote Carrier' and 'Loyal Wingman' development and simulation. Accordingly, Manching would be a logical decision to maintain and keep operational the German Luftwaffe's recently purchased F35 fleet.

The various site capabilities Airbus successfully operates in its home nations ensure cost- and time-efficient military readiness and necessary working equipment to respond to threats effectively and offer a blueprint for industrial cooperation and end-to-end capabilities.

Co-working hubs such as these are critical in securing a reliable and sustainable European defence infrastructure, which today has become necessary in the face of war in Europe.

A robust and inclusive European defence industry is crucial for both NATO and its largest member, the US, as it promotes genuine burden sharing. It fosters joint innovation, inspiration, and interoperability, essential elements even for the US, which contributes to multiplying its military capabilities. Therefore, a strong European defence industry is necessary to address global security challenges and fulfil its responsibility, a precondition for making sovereign decisions in Europe. This becomes particularly significant since the US considers China as a 'pacing threat' and will shift its focus to the Indo-Pacific and China, reducing attention on European defence and security.

Facilitating Defragmentation: How to Create a More Cohesive European Defence Landscape

The European defence industry landscape is highly fragmented and cohesion is imperative. Consisting of many countries with diverse military and industrial capabilities, individual defence priorities and budget constraints make it challenging to align and coordinate: The European defence industry is significantly smaller in scale compared to the US, with a dilution factor of approximately 10. While the US focuses their budget on fewer platforms or weapon systems such as tanks, ships, and combat aircraft, Europe operates with roughly half the budget. Consequently,

this leads to duplicated efforts and inefficient utilisation of constrained resources in Europe.

There are two theoretical propositions on how to curb fragmentation:

The first option is that the European defence industry gets consolidated, and only the strongest players remain. However, this is hardly a feasible or likely scenario. Naturally, politicians are too invested in protecting their national interests and constituents' votes; and national defence players are trying to secure their profitable defence contracts and are not interested in close co-operation. Germany is a case in point: Its notorious 25 million Euro release process exacerbates structural fragmentation and under-scores the political influence and manoeuvring in constituencies.

The second option is multinational and industrial collaboration on large defence programmes. While this is not a new approach, it is most certainly the only viable option. Yes, some joint European programmes of the past have faced justified criticism: too expensive, too late, and not fit for purpose. However, let's look at and understand the root causes: The defence industry often has to deal with either last-minute changes in customer requirements or national specifications. These so-called 'gold-plated solutions', not aligned with other nations, prevent scaling, lead to an explosion of complexity through-out the life cycle of a product and strain already tight budgets further.

That said: The industry too is to blame and has frequently made mistakes. By over-promising, over-extending, and under-delivering on contracts the industry failed to meet expectations.

Despite these challenges, and based on our experience, we strongly believe that multinational programmes are the only key to Europe's success and de-fragmentation of the defence landscape – if they are sourced jointly, speci-fied realistically and developed collaboratively, transparently and iteratively

between customer and supplier. In recent programmes like Eurodrone, FCAS close discussions on requirements and expectations with project partners and customers have proven beneficial and were a lesson learned from the past. And for future endeavours, Airbus is taking the adoption of agile and Minimal Viable Product[1]-oriented (MVP) ways of working into consideration.

Promote and Establish 'New and Agile' Ways of Working

Industries are experiencing constant and unpredictable changes. While this permanent disruption known as VUCA[2] (Volatility, Uncertainty, Complexity and Ambiguity) presents challenges, it also provides opportunities to reform traditional leadership, management, and daily operations approaches.

Embracing new concepts like MVP and digital design can be game-changers for the defence industry. MVPs are the simplest product versions built to test their viability and value to customers. It validates assumptions and tests the product's value proposition, target audience, and business model. Digital design allows designers to create and test digital product prototypes before making them in real life. Companies can save resources and improve customer satisfaction by applying these approaches in a scaled, agile setup. This method is a framework for managing complex projects, breaking them down into smaller tasks and completing them in short sprints. Team collaboration, openness, and transparency are integral to the project's success. This all must be matched by a procurement process that allows for incremental and evolving steps.

To stay competitive, we need to change our operational thinking and practices. This is especially true for our space business. Small, well-funded start-ups are disrupting the costly space industry, driving innovation and democratising space.

Investor-funded companies like SpaceX, Blue Origin, Maxar, and Starlink have transformed the market with their agile and lean business practices, copied from Silicon Valley. Their approach to the space business is very customer-centric and has less of the red tape that comes with traditional, government-sponsored projects. As more companies like SpaceX enter the market and the battle for investment, talent and contracts becomes even tougher, the transformation of the defence industry is inevitable.

To achieve this, we must treat all procurement, contracting, R&D, and production stakeholders as part of a 'Sprint team'. This includes our customers (procurement representatives of and users from the armed forces and government officials) and (inter)national industry partners, who, ideally, fully commit to the process.

Transforming the defence industry's classical approach and adopting new ways of working is both imperative and challenging for our customers, our industrial partners and ourselves at Airbus. Letting go of the waterfall processes we hold dear requires persuasion in order to evolve. In the first pilots across several nations, we see promising results; however, we will inevitably experience setbacks that we need to consider as a source of improvement rather than defeat. We are convinced that this transformation will lead to reduced lead times to usage, and make the products more resilient and interoperable.

Modernize Procurement and Optimize its Process

The defence procurement process in Europe is, in many ways, outdated. Over decades an approach has become established that favoured special and national requirements – so-called 'gold-plate requirements' – over actual user needs (e.g. a turboprop aircraft flying at Mach 0.75 leads to costly and complex propulsion systems or a 100 % reliability expectation for

electronics equipment: it is beyond what even the automotive industry, with millions of products, would ask for).

This is not the result of European collaboration – aimed at overcoming national fragmentation in costly and complex systems – but of excessive nationally-driven requirements. A case in point is the Airbus NH90 helicopter. With over 22 distinctly different variants spread over approximately 600 aircraft, this leads to exploding costs of complexity. In order to produce time- and cost-efficiently, the defence industry – like most industries – depends on scale and serial production. That is not feasible with rampant, spread-out, and highly specialised individual variations. The result is a defence industry that, dependent on government contracts, is more or less knee-capped and forced to over-promise, fearing that they won't be able to deliver on time, cost, and quality.

We need to do away with the deliberate decoupling driven by the procurement office in the procurement process between the description of the requirements and the military-technical expertise the industry offers. This whole process flies in the face of industrial logic, with pages upon pages of detailed and high-flying gold-edge requirements produced by procurement offices. The industry is not allowed to negotiate or discuss these requirements but is expected to either take it or leave it. The effects are many times: The development journey is ten years with a fixed set of requirements that may – or may not – match what is actually needed once the product is available.

Reforming the procurement process and aligning it across all European Union member states is a necessary step forward. It needs to happen with all stakeholders involved from the very beginning, especially on large, multinational defence contracts. The main objective is to understand the different requirements of the diverse national armed forces and find common ground that delivers on their needs when on mission and in theatre.

Gold-edge requirements must be kept at an absolute minimum and always be weighed regarding actual user benefit, necessity, and cost-effectiveness. A streamlined, cost- and time-effective European procurement process will eventually lead to better interoperability and cooperation. The Ukraine war demonstrated the importance of the limitations of individual nations acting in isolation and the need for fast and joint development and acquisition of defence capabilities.

A New Paradigm:
Mature and Standardize Interoperability and
Modular Open Systems Architecture (MOSA)
for Combat Platforms

To address interoperability, our industry needs to incorporate modularity and open architecture from the beginning of any development process. Simply saying, we must stop hyper-diversification and the 'one product for one application' mentality that inherently complicates compatibility. Modern armed forces need systems that adapt to diverse needs, products with low operational complexity, are fit for combat and always mission ready. Interoperability and layered open architecture will be even more critical in the future: NATO has also stated that it is vital for allies to act efficiently together to achieve tactical, operational, and strategic objectives.

The extensive introduction of the F35 across European Air Forces is a case in point. The aircraft itself is just one part of the procurement. Its closed ecosystem comes with an additional hidden price tag: making the F35 interoperable with the rest of the fleet systems is a costly and herculean task, as a workaround needs to be found.

Furthermore, we must consider that in the coming decades, European and US forces will be operating mixed fleets of crewed and uncrewed 6th-,

5th- and 4th-generation aircraft, demanding new technological solutions to solve recurring interoperability issues. Therefore, we cannot afford to accept closed proprietary systems, as they lead to duplication and higher costs, reducing the combat value of a fleet with mixed assets and systems.

The future of warfare will be digital, and the global defence industry will only be able to meet the demands of a constantly evolving geo-political and defence landscape through the industry-wide adoption of interoperability and MOSA.

A Loyal Wingman-type drone can be a good example of why modularity and interoperability are so important. This uncrewed aircraft, equipped with Artificial Intelligence (AI), teams with crewed aircraft to support and enhance the latter's capabilities. The Wingman is a cost-efficient force multiplier that performs surveillance, reconnaissance, and even combat. To keep pace with the fast-changing nature of warfare, our armed forces need Loyal Wingmen with modular capabilities that are inter-operable with as many aircraft types as possible – regardless of their generation or manufacturer.

The modular and interoperable approach must define the future of our industry. The industry must accelerate its adoption to stay competitive and be considered an attractive partner to third-party suppliers and customers. Across the Atlantic, the US military first generation of Collaborative Combat Aircraft (CCA) has announced the delivery timeline by the end of this decade.

On the other hand, the delivery date for the European comparison project, FCAS, is currently planned for 2040 – a very late timeline for teaming manned and unmanned aircraft. We must speed up our lead time and bring FCAS pillars like 'Remote Carriers'[3] – ideally developed via an MVP-type approach to continuously add capabilities.

Our industry and customers must prioritise the benefits of MOSA and interoperability over proprietary interests and concerns.

Promote a European Space Defence Strategy: The Space Domain Paradox

Tomorrow's geopolitical challenges will take place across a fluid continuum of land, sea, air and space, cyber. Space will be the next combat theatre, which is still widely underestimated but needs to be addressed with a holistic and determined 21st century defence strategy.

While space has become increasingly important for military operations, such as satellite communications, intelligence gathering, and missile defence, the European approach to space has traditionally focused on civilian, commercial and environmental endeavours. As a result, the space domain has been kept separate from geo-strategic considerations. That mindset is changing now, but as more European countries develop national space capabilities, the fragmentation of the space industry subsequently increases. So does the risk of potential turf wars in space. Europe created its next paradox of multinational necessities and national interests.

To address this issue, the European Union must establish a strategic framework that promotes collaboration in countering space threats and identifying the main risks to space systems and the associated ground infrastructure. Developing shared strategies, policies, and regulations for space can serve as the framework for jointly addressing space challenges, and must include all players: The defence industry, armed services, and NATO. What is required are diverse critical functions with much greater resilience and shorter latency than Geostationary Orbit (GEO) can offer: earth observation, communication and intelligence gathering. Secure satellite constellations such as Infrastructure for Resilience,

Interconnectivity and Security by Satellite (IRIS)[2] and building up an active defence capability – will become strategically indispensable means of deterrence for both Europe and NATO.

Conclusion

Taken together, these are the key suggestions for the road ahead:

An honest and realistic definition of requirements. Instead of dream walking, we must keep it real. That means mandating products based on modularity, scalability, and MOSA, and co-designing the products and features with customers and industry partners.

Agile development and procurement: Our processes must be thoroughly revised and integrate MVP concepts to create and test products more quickly based on a tandem customer-operator feedback loop for continuous improvement.

Interoperability and connectivity by design: It should be mandated by NATO and must become second nature to us instead of continuing with individual, national solo efforts.

Defence budgets: The defence industry has to get real and finally deliver. That means NATO nations must spend at least 2 % of their GDP on national defence.

Think transatlantically: Let us pursue a tech-driven, European industrial strategy that doesn't position itself against the US but aims at serving as a strong pillar within NATO. This will create a force multiplier for Europe, building a resilient industrial base with higher visibility that will attract investment and much-needed talent.

European defence industry: A strong industrial base is also a pre-requisite for burden sharing while giving the US more flexibility in addressing global security challenges, such as China.

European programmes: The defence industry has to initiate and implement complex systems because of the above mentioned points and for all the above reasons.

As a big player in the European defence sector, Airbus Defence and Space will strive to help reshape European defence security with its nation partners and allies.

We live in extraordinary times and need to take extraordinary measures: Airbus Defence and Space has recently overhauled its strategy and is undergoing a profound transformation. At our core, we always put our customers first and constantly iterate our decision-making and operational execution process. We offer an interconnected product and service portfolio for capabilities in the strategic air, space and cyber domains, covering all key areas of 21st century defence.

With broad competencies in the aerospace sector, we can assist Europe in taking on a greater role in guaranteeing its security, increasing its strategic autonomy and strengthening NATO's collective power. All of this is fundamental to Airbus', Europe's, and global security. It is essential that Europe – policymakers, governments and the defence industry – take on the future of defence in the 21st century.

Airbus Defence and Space is in a great position to move ahead with our NATO partners, customers and allies. We offer our technological expertise, unique innovation spirit, valuable industry insights and experience.

We are ready to do our part.

Dr Michael Schoellhorn is the CEO of Airbus Defence and Space, responsible for the company's defence, space, unmanned air services, and connected intelligence activities. He previously served as Airbus' COO. Michael joined Airbus in February 2019 from BSH Home Appliances, where he was COO and a Board of Management member from 2015 until his departure. He has a background in the automotive sector and served in the German armed forces as an officer and helicopter pilot. He is the president of the German Aerospace Industries Association (BDLI) and is a member of several boards of directors. Michael holds a degree and a PhD in Mechanical Engineering and Control Engineering.

Endnotes

1. A Minimal Viable Product is the most basic version of a product or service that includes just enough features to satisfy early users and collect feedback.
2. VUCA is a concept that describes the unpredictable and rapidly changing nature of today's business and organisational environments.
3. Remote carriers are unmanned elements that collaborate with fighter jets, providing assistance in reconnaissance, electronic warfare, and operational efficiency. By leveraging these unmanned components, the mission risks to the combat aircraft and their pilots are minimized.

The Executive Director's Closing Remarks

Lieutenant General Thorsten Poschwatta,
GE Air Force,
Commander, German Air Operations Command,
Executive Director,
Joint Air Power Competence Centre

I hope that you have found the series of essays provided in our Conference Read Ahead informative and enlightening. Our desire is that these essays provoke and stimulate thoughtful discussion about the role of Joint Air Power in enhancing deterrence and defence in preparation for our upcoming conference.

I would like to take this opportunity to offer my perspective as the Executive Director of the Joint Air Power Competence Centre, highlighting four of the topics presented by our authors.

The first article from Franklin D. Kramer focuses on the conventional military threat from Russia. As the Russian Federation is the most significant and direct threat to Allies' security and peace and stability in the Euro-Atlantic area, the article proposed six priority actions that NATO should undertake to enhance its deterrence and defence posture. In this context, I would like to put emphasis on two of the six points. First, revise the two Joint Forces Command's command-and-control structures enabling their transition to regional commands capable of directing modern high-intensity warfare. Second, establish a sustainment initiative fostering NATO maintenance and replenishment of sufficient munitions to support an extended-duration conflict.

The second article I will highlight is Colonel de Angelis' essay on the topic of resilience, which relates to the aforementioned sustainment initiative. Resilience is not just an operational requirement; it is also a crucial element of strategic communications and, consequently, deterrence. The display of superior industrial and economic capacities, which in turn empower resilient military capabilities, sends a clear message to any potential adversary that they will face a credible and sustainable force if they initiate hostile actions against NATO and its Allies.

The third topic I would like to emphasize are the articles on superior technologies by the JAPCC's Combat Air Branch and Lieutenant Colonel Wartenberg's article on the relevance of quantity in modern conflict. The first article discusses the significant advantages superior technology provides in military operations when thoroughly integrated. Whereas the second article debates sufficient quantity of platforms and munitions enabling decisive battles versus superior technology. The ongoing war in Ukraine indicates that both arguments are valid and important to consider. Superior technology ensures gaining the initiative against an enemy, while the ability to augment and replace weapon systems is essential to sustain the duration of the conflict and maintain the initiative.

Finally, I would like to put emphasis on Dr Schoellhorn's article, which explores the role of a strong European defence industry and the necessity for multinational collaboration. The Russian invasion and our support to Ukraine illuminated multiple NATO shortcomings. Our defence spending has been insufficient to sustain major conflict, and our industrial capacity and assembly line throughput is insufficient to provide the required armament and munitions, which supports the first article that lists superior industrial and economic capacities as the foundation for resilience, sustainability, and thus, deterrence and defence.

I am really looking forward to discussing the role of Joint Air and Space Power in Enhancing Deterrence and Defence with you and our distinguished speakers and panellists this October. In closing, I hope you have enjoyed reading the articles and that they have piqued your interest. I firmly believe that your expertise will be required to successfully navigate the coming years, and your part in the discussion of ideas and solutions will ensure the continued success of the Alliance.

I sincerely hope to see you this fall in Essen.

Blue skies!

Thorsten Poschwatta
Lieutenant General, GE Air Force
Commander, German Air Operations Command
Executive Director, Joint Air Power Competence Centre
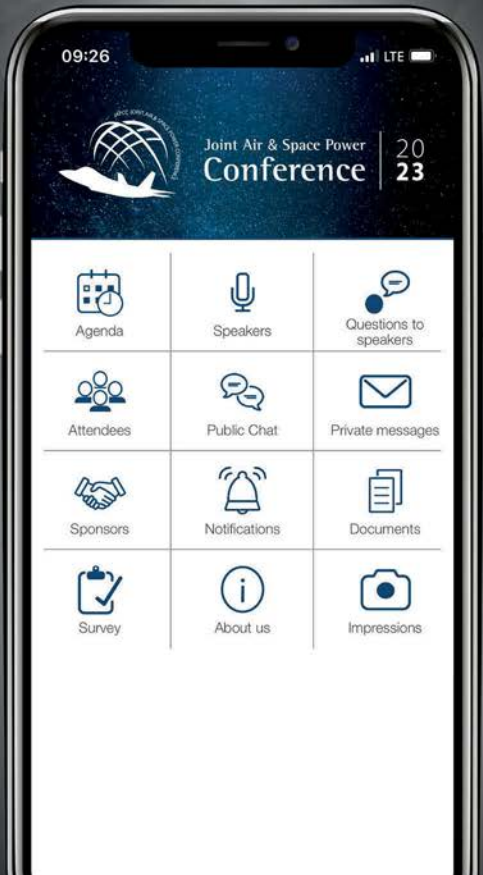
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