

Future Military Helicopters: Technological Innovation and Lessons Learned from Ukraine

edited by Alessandro Marrone and Giancarlo La Rocca

ABSTRACT

The Russian invasion of Ukraine highlighted the importance of helicopters in modern military operations, showing strengths and weaknesses of these assets in high-intensity scenarios. The preliminary lessons from the war come at a time in which most leading Western powers need to modernise their respective helicopters fleets, which until recently had experienced only limited technological leaps from the 1970s. Today, while the US is heavily invested in the Future Vertical Lift programme, European countries have shown a more cautious approach. Nevertheless, relevant EU and NATO collaborative projects show that there is widespread interest in the future of military helicopters. Italy, which is a leading country in the helicopter sector, finds itself at a crossroad and will need to carefully ponder its strategic options, both considering industrial and operational aspects inherent in the adoption of new rotorcraft technologies.

Helicopters | Ukraine | Russia | USA | Germany | France | Italy | NATO | European Union



keywords

Future Military Helicopters: Technological Innovation and Lessons Learned from Ukraine

edited by Alessandro Marrone and Giancarlo La Rocca*

Table of contents

1. Helicopters and war: Lessons learned from Ukraine	p. 3
by Karolina Muti	
2. United States	12
by Kevin Mangum	
3. France	18
by Léo Péria-Peigné and Elie Tenenbaum	
4. Germany	26
by Florian Schöne	
5. Italy	33
by Giancarlo La Rocca and Alessandro Marrone	
6. United Kingdom	38
by Justin Bronk	
7. NATO and EU initiatives	43
by Michelangelo Freyrie	
8. Conclusions	51
by Alessandro Marrone and Michele Nones	
Acronyms	57

* Alessandro Marrone is Head of the Defence Programme at the Istituto Affari Internazionali (IAI). Giancarlo La Rocca was a Junior Researcher in IAI's Defence and Security programmes.

1. Helicopters and war: Lessons learned from Ukraine

by Karolina Muti¹

The last qualitative leap in helicopters technology occurred during and right after the Vietnam war. Not surprisingly, this process of technological innovation was led by the United States, the major power directly involved in that conflict. It resulted in the procurement of the utility and multirole helicopter Black Hawk, operated by the US Army since 1976. After the Vietnam war and for almost five decades, the key characteristics of rotorcraft in use by Western armed forces remained mostly the same in terms of speed, range, endurance, with no major technological breakthroughs advancing their overall capability. Nonetheless, modernisation cycles helped to marginally adapt helicopter technologies to contemporary warfare after the so-called “revolution in military affairs”, adding for instance electronic countermeasures and extending operational lifetime to 50 years.² Washington is again leading the next significant advancement in rotorcraft technology, with military requirements of the Future Attack Reconnaissance Aircraft (FARA) and Future Long-Range Assault Aircraft (FLRAA) capabilities most likely thought for the Indo-Pacific theatre.

Against this backdrop, the invasion of Ukraine launched by the Russian Federation on 24 February 2022 represents a game-changer for the Europeans, with multi-faceted implications for the Euro-Atlantic area. The war is also a source of lessons to be learned by all NATO allies when it comes to helicopters and war. Even if the conflict is still ongoing and available information is far from complete and accurate, several preliminary, relevant indications can still be drawn from it.

1.1 Lessons to be learned from Ukraine: Helicopters survivability

While it is unlikely that the conflict will change the US strategic priority of a “pivot to Asia”, a large-scale, conventional, near-peer conflict in the European theatre will impact the strategy, doctrine, planning of forces and operations as well as procurement policy of all NATO allies. Therefore, the conflict will not only shape Western strategic posture, but also military requirements and procurement choices.

When it comes to next generation helicopters, there are some provisional yet ambiguous observations that can be made in Ukraine. The overall vulnerability and low survivability of Russian fleets, particularly of helicopters, together with Moscow’s failure to impose air superiority throughout the conflict, should be carefully analysed by NATO allies.

¹ Karolina Muti is Senior Fellow in the Security and Defence programmes at IAI.

² Center for Strategic and International Studies (CSIS), “The Future of Army Vertical Lift”, in *CSIS Events*, 24 August 2022, <https://www.csis.org/node/66525>.

The performance of Russian helicopters in Ukraine is intrinsically connected to tactics. Such performance cannot be separated from an assessment of the effectiveness of the counterpart's air defences. On the Ukrainian side, the role and effectiveness of short-range air defence, the lethality of man-portable systems (MANPADS), of anti-aircraft and anti-tank weapon systems and of unmanned aerial vehicles (UAVs), have proven crucial.

During the first eight months of combat, Russia's Armed Forces have lost a proportionally higher number of key attack helicopters compared to other weapon systems. Russian losses have been strikingly high, even if it has been noted that the majority of these platforms has been destroyed on the ground rather than in-flight.³ As of June 2023, total estimated aircraft losses suffered by Moscow included 90 helicopters, among which 79 destroyed, ten damaged and one captured, although real numbers are probably higher, thus determining a low aircraft survivability.⁴ The latter is a concept that encloses various elements, from range and speed to manoeuvrability, from noiselessness to protective devices.⁵ Non-technical elements, such as operating conditions and rules of engagement, determine survivability as well. As one observer noted, 80 per cent of a helicopter's survivability is determined when the engine is turned off.⁶

1.2 Use of helicopters during the conflict: The case of Russia

Such significant helicopter losses resulted in a gradual change of the tactics employed by the Russian Armed Forces during the conflict. Initially, in the period ranging from the start of the war to early March 2022, helicopters were more widely used to conduct hunter-killer missions, penetrating up to 50 km in depth of enemy-controlled territories.⁷ Afterwards, their use for penetration missions decreased significantly, and from April 2022 onwards attack helicopters were used very cautiously for combat, whereas after the summer they were mainly used to target Ukraine's critical infrastructures and non-military targets.⁸ As of spring 2023, the conflict has entered a new phase in which targeted attacks and sabotage operations on Russian soil have accompanied the preparation and the beginning of Ukraine's counteroffensive. Against this backdrop, on 13 May 2023 two Mi-8 helicopters have been reportedly shot down in an ambush in the Bryansk region, approximately 50 km northeast from the border with Ukraine and 370

³ Interview, 28 September 2022.

⁴ Stijn Mitzer et al., "Attack on Europe: Documenting Equipment Losses during the 2022 Russian Invasion of Ukraine", in *Oryx*, 24 February 2022 (last updated on 8 September 2023), <https://www.oryxspioenkop.com/2022/02/attack-on-europe-documenting-equipment.html>.

⁵ Interview, 13 January 2023.

⁶ *Ibid.*

⁷ Justin Bronk, Nick Reynolds and Jack Watling, "The Russian Air War and Ukrainian Requirements for Air Defence", in *RUSI Special Reports*, 7 November 2022, p. 21, <https://static.rusi.org/SR-Russian-Air-War-Ukraine-web-final.pdf>.

⁸ *Ibid.*, p. 22.

km from Moscow.⁹ From preliminary information it seems that Mi-8s were used as back-ups) for two Su-34 and Su-35 fighters that were directed towards targets in the Chernihiv region in Ukraine (including an eventual rescue mission for the Sukhoi's pilots).¹⁰

As of 20 June 2023, preliminary information from the latest phase of the war seems to indicate a shift by Russian Armed Forces towards a more intense use of their aviation and helicopters in particular, with the airspace becoming more permissive for Russia in Southern Ukraine.¹¹ It is still early to draw conclusions on this latest development, therefore considerations that follow refer to rotorcraft survivability as observed in the first 15 months of the conflict.

Evidence from the beginning of the invasion to May 2023, seems to show a significant level of vulnerability of heavily armoured hardware and current military rotorcraft defence capabilities when operating in contested airspace. This was caused by multiple factors. The effective and successful use of air defences, drones, MANPADS, anti-aircraft and anti-tank systems by the Ukrainian Armed Forces was key. Weapon systems provided by Western countries, such as the FGM-148 Javelin, the FIM-92 Stingers, but also longer-range National Advanced Surface-to-Air Missile System (NASAMS) and Aspide missile defence systems proved to be of extreme value for Ukraine's air and missile defence.

Several factors were recognised as facilitating Ukrainian action. First, the employment, at least in part, of rather obsolete capabilities by Russia.

Second, Russia implemented poor tactics, including terrain flight ones. For instance, the altitude of flights, day flights, and the inability to protect and hide platforms facilitated Ukraine's forces in shooting down enemy rotorcraft.¹² To perform attacks, Russian forces flew helicopters at high altitudes in broad daylight and without adequate survivability equipment, exposing them to Ukraine's air defence. Consequently, Russian pilots started flying lower to avoid Ukraine's air defence missiles but lacking appropriate protection and mission systems providing a strong battlefield situational awareness and fast target acquisition and engagement, they fell in the perimeter of highly effective, shorter range, portable systems operated by Ukrainian forces.

⁹ "Four Russian Military Aircraft Shot Down near Ukraine, Russian Daily Reports", in *Reuters*, 14 May 2023, <https://www.reuters.com/world/europe/videos-show-helicopter-apparently-shot-down-russia-near-ukrainian-border-2023-05-13>.

¹⁰ Ibid.

¹¹ UK Ministry of Defence, "The Russian Airforce has been unusually active over southern Ukraine", *Twitter*, 10 June 2023, <https://twitter.com/DefenceHQ/status/1667407596557328384>.

¹² Kevin W. Mangum and Ari Cicurel, "What Ukraine Teaches the US about Combat Helicopter Operations", in *The Defense Post*, 23 March 2023, <https://www.thedefensepost.com/2023/03/23/us-combat-helicopter-operations>.

Third, the adequacy of Russia's current force design¹³ and doctrine were also put into question,¹⁴ regardless of the ability of Russian armed forces to implement the latter since some observers noted that Russian troops were not following their own doctrine when in theatre.¹⁵ Moscow's doctrine differs from that of its Western European counterparts and stems from Soviet legacy. In the Russian doctrine, helicopters almost play the role of mobile artillery, rather than of a key air-based asset.¹⁶ Rotorcraft is employed for indirect strikes, engaging targets in an indiscriminate way, as opposed to the Western focus and investment on precision strikes to mitigate collateral damages, such as civilian deaths.¹⁷ Overall, such doctrine of employment substantially exposes the helicopter to enemy fire, which rises questions on its effectiveness, especially when facing a near-peer adversary rather than insurgents.

Fourth, the lack of adequate flight discipline, training and organisation among Russian personnel was also a factor.

Fifth, there were multiple problems related to logistics and supplies, as well as poor maintenance. Conditions of some downed Ka-52 prove this point, as aircraft were equipped with encrypted radio sets but lacked the encryption keys to use them, while radars and other sensors were put in stowed position or under covers, preventing them from working.¹⁸

As of June 2023, Russia has lost an overall of 90 helicopters: 79 were destroyed, ten damaged and one was captured.¹⁹ The highest number of destroyed platforms consists of Ka-52 Alligator attack helicopters (35 losses),²⁰ which is considered the key Russian attack helicopter developed by Kamov and the only one compatible with Russian VKHR anti-tank precision guided missiles. The Ka-52 Alligator operates by shooting a laser beam at the target and firing the missile, which follows the laser.²¹ Ka-52 uses mainly two types of anti-tank guided missiles: 9M120-1 Ataka-1, and the longer range 9A4172K Vikhr-1. A more advanced rotorcraft option available to Russia is the upgraded Ka-52M, which operates an advanced anti-armour LMUR missile with higher range (up to 9 miles), and greater standoff.²² Even if the LMUR has been launched from other platforms, as of 20

¹³ Michael Kofman and Rob Lee, "Not Built for Purpose: The Russian Military's Ill-Fated Force Design", in *War on the Rocks*, 2 June 2022, <https://warontherocks.com/?p=27074>.

¹⁴ Interview, 13 January 2023.

¹⁵ Interview, 9 November 2022.

¹⁶ Interview, 13 January 2023.

¹⁷ Ibid.

¹⁸ Justin Bronk, Nick Reynolds and Jack Watling, "The Russian Air War and Ukrainian Requirements for Air Defence", cit., p. 24.

¹⁹ Stijn Mitzer et al., "Attack on Europe", cit.

²⁰ Ibid.

²¹ Justin Bronk, Nick Reynolds and Jack Watling, "The Russian Air War and Ukrainian Requirements for Air Defence", cit., p. 23-24.

²² Thomas Newdick and Tyler Rogoway, "Ukraine's Armor Appears to Have a Russian Attack

June 2023 there is no public evidence of the deployment of this configuration of Ka-52M in Ukraine. In this case, low survivability could stem from (among other things) the Ka-52's own technological configuration: when firing the missile, the helicopter cannot move until it hits the target, as opposed to a "fire and forget" approach used for instance by US attack helicopters.²³ The Ka-52 hovers for tens of seconds to let the crew identify the target through laser designators before firing guided anti-tank missiles, and this time-lapse is often enough to allow Ukrainian air defences to shoot it down.²⁴ It has been estimated that the Ukrainian forces had destroyed 25 per cent of the overall Russian Ka-52 Alligator fleet by the end of October 2022.²⁵ As of June 2023, the 35 destroyed Ka-52 Alligator account for more than half of the attack helicopters lost by the Russian troops and for 44 per cent of the total helicopter losses.²⁶ Other destroyed rotorcraft include 20 Mi-8 transport helicopters, 12 Mi-28 attack helicopter, six Mi-24P/35M (helicopter gunship and troop transport) helicopters and two Mi-8MTPR-1 electronic warfare (EW) helicopters. 69 per cent of all the helicopters lost by Moscow are attack helicopters; 22 per cent are training platforms, whereas 7.5 per cent are of unknown type.²⁷ In the case of the Ka-52 Alligators, it is therefore clear how the technological features of the system could have contributed to the ineffectiveness of the tactics put in place by the Russian aviation, exposing aircraft to the counterpart's air defence.²⁸ In the very last weeks of the conflict, as of 20 June 2023, Russia's tactics changed regarding the use of helicopters, through an intensification of operations/activities, very close to the front lines, aimed at impeding Ukraine's advances. It seems that Russian helicopters, notably the Ka-52, are currently less vulnerable to Ukraine's air defences. One of the possible explanations is apparently the lack of forward-deployed mobile short range air defence (SHORAD) systems on Ukraine's side, leaving space for helicopters to operate, mainly at night and flying at a very low level, outside from the reach of the counterpart sensors and weapons, at a standoff distance adequate to effectively target Ukraine's armed forces vehicles in the open and not falling in SHORAD reach (or exploiting SHORAD absence).²⁹ In the area of the Berdiansk Airport (Southeast Ukraine) occupied by Russian troops, 20 helicopters were deployed, including five Ka-52 helicopters, 13 between Ka-27 and Ka-29 Helix naval helicopters, and nine between Mi-8 Hip and Mi-24 Hind

Helicopter Problem", in *The War Zone*, 15 June 2023, <https://www.thedrive.com/the-war-zone/ukraines-armor-appears-to-have-a-russian-attack-helicopter-problem>.

²³ David Axe, "Ukraine Has Shot Down a Quarter of Russia's Best Attack Helicopters", in *Forbes*, 26 October 2022, <https://www.forbes.com/sites/davidaxe/2022/10/26/ukraine-has-shot-down-a-quarter-of-russias-best-attack-helicopters>.

²⁴ Ibid.

²⁵ UK Ministry of Defence, "Latest Defence Intelligence update on the situation in Ukraine", *Twitter*, 25 October 2022, <https://twitter.com/DefenceHQ/status/1584783522040086531>.

²⁶ Stijn Mitzer et al., "Attack on Europe", cit.

²⁷ Author's elaboration based on Oryxspioenkop Data. See *ibid*.

²⁸ Justin Bronk, Nick Reynolds and Jack Watling, "The Russian Air War and Ukrainian Requirements for Air Defence", cit., p. 23-24.

²⁹ Thomas Newdick and Tyler Rogoway, "Ukraine's Armor Appears to Have a Russian Attack Helicopter Problem", cit.

platforms.³⁰

1.3 Use of helicopters during the conflict: The case of Ukraine

On the Ukrainian side, the use of helicopters during the conflict has been necessarily more restrained than that of Russia. Kyiv's Air Force is limited and the number of destroyed helicopters on their side amounted to 30, precisely one third of the helicopters lost by Russia. Similarly to Russia, Ukraine reduced the use of helicopters for deep penetration throughout the war to preserve their limited capacity. Ukrainian forces seemed to have avoided Russia's tactical mistake with regards to flight altitude and day flights and were actually able to fly at very low altitudes with appropriate flight discipline, especially at night, to disable or destroy high-value targets.³¹ Still, the relative number of Ukrainian helicopters that were shot down is far from low and was in fact deemed unacceptably high. Ukraine suffered from 25 destroyed, three captured, and two damaged platforms.³² Unlike Russia, most of the destroyed helicopters (66 per cent) were Mi-8 transport platforms, and only 13 per cent were Mi-24/P multi-role attack-troop transport attack platforms, whereas a sizeable percentage (17 per cent) accounted for Mi-2 training helicopters.³³ On paper, low altitude/night flights should have had the benefit of preventing interception by Russian air defences. However, Ukraine's evacuation and resupply missions in Mariupol during the siege ended with the loss of three Mi-8 helicopters. In the end, Russian air defence proved to be successful enough to discourage Ukraine from extensively using helicopters.³⁴

Overall, penetrating the frontlines with helicopters seemed to be considered by both sides a very risky tactic, viable only in very specific circumstances.³⁵ Some intrinsic difficulties remain even when penetration succeeds, due to increasing risk on the return flight when defences have been alerted and successful routes cannot be repeated.³⁶ Additionally, exposure to enemy fire increases dramatically when defensive aid suites are depleted, as traditional countermeasures can only be carried in a limited number.

1.4 The dilemmas on the future of next generation helicopters

The dilemma for Western armed forces pertains an underlying question: to what degree is the vulnerability and low survivability bore by helicopters in the Russia-

³⁰ Ibid.

³¹ Kevin W. Mangum and Ari Cicurel, "What Ukraine Teaches the US about Combat Helicopter Operations", cit.

³² Stijn Mitzer et al., "Attack on Europe", cit.

³³ Author's elaboration of Oryxspioenkop Data. See Stijn Mitzer et al., "Attack on Europe", cit.

³⁴ Pavel Aksenov, "Guerre Ukraine - Russie : Pourquoi l'aviation ne joue-t-elle pas un rôle important dans la guerre en Ukraine et peut-elle inverser la tendance ?", in *BBC News Afrique*, 30 March 2023, <https://www.bbc.com/afrique/monde-65064520>.

³⁵ Interview, November 2022.

³⁶ Ibid.

Ukraine conflict the result of gross tactical and force design errors,³⁷ inadequate doctrine, personnel, logistical and organisational limits, or technological issues related to poor maintenance and modernisation?

Conversely, how much of those losses are instead due to certain types of heavy-duty hardware, such as helicopters, reaching their operational limits in specific scenarios of contemporary warfare,³⁸ to the advantage of more precise, lethal and expendable air defences or weapon systems such as UAVs, unmanned ground systems (UGSs) and loitering munitions?³⁹

In certain high-intensity, near-peer or peer-to-peer conventional scenarios, the role of helicopters could be transformed, especially in situations where air superiority (let alone air dominance) is not granted.

Therefore, the debate on the future of next generation helicopters seems to oppose two sides. The first argues that operational requirements for future, technologically advanced rotary wing platforms will push suppliers to develop aircraft capable of overcoming current vulnerabilities. According to Major General Walter Rugen, the director of the US Army's Future Vertical Lift (FVL) cross-functional team, his procurement programme will consider the following elements based on the lessons from Ukraine:

- higher speed, beyond air domain and extended to cyber and AI, contributing to provide air and decision-dominance;
- longer range to stay outside the reach of surface-to-surface fires and increase survivability;
- improved safety in low altitude flight, and taking better advantage of clutter;
- standoff in excess of 30 km for better manoeuvrability, as anticipated by the Nagorno-Karabakh conflict.⁴⁰

This stance implies that the limits associated with rotary wings as observed in Ukraine would not be linked to the family or type of platform *per se*, but would rather stem from doctrinal, operational and tactical errors and obsolete or poorly maintained equipment, as in the case of Russia and resulting both in low effectiveness of helicopters deployments and low survivability.

Even still, the main lessons from Ukraine would also underline the relevance of other elements, such as noiselessness, infra-red countermeasures, and the ability of intercepting and disturbing enemy drones and missiles, together with the ability

³⁷ Michael Kofman and Rob Lee, "Not Built for Purpose: The Russian Military's Ill-Fated Force Design", cit.

³⁸ Stavros Atlamazoglou, "The Fighting in Ukraine Shows the Vulnerability of One of Modern Militaries' Most Important Weapons", in *Business Insider*, 22 June 2022, <https://www.businessinsider.com/fighting-in-ukraine-shows-growing-vulnerability-of-helicopters-2022-6>.

³⁹ David Barno and Nora Bensahel, "The Other Big Lessons that the U.S. Army Should Learn from Ukraine", in *War on the Rocks*, 27 June 2022, <https://warontherocks.com/?p=27193>.

⁴⁰ CSIS, "The Future of Army Vertical Lift", cit.

of low altitude (night) flight.⁴¹

The second, opposing vision is more pessimistic and suggests that rotary wing aviation will remain too vulnerable on the future battlefield, and that the conflict in Ukraine is providing ample demonstration in this sense. Observers from this side of the debate suggest that investments in next generation helicopters, including the FVL programme, should be rather directed to more expendable systems such as UAVs and loitering munition, coupled with heavier reliance on armoured vehicles for manoeuvre, as well as Air Force and Navy jets.⁴²

Overall, elements from both these visions seem to be valid, and it is too early to draw a definite conclusion on the basis of an ongoing war and with limited amounts of accurate information. It is likely that the role of helicopters on future battlefields will be reshaped, in line with a system-of-systems approach prioritising coordination and connectivity between different types of platforms: crewed and uncrewed, autonomous and semi-autonomous, precision-guided and not. Future helicopters will be even more complex, versatile and modular platforms. In a system-of-systems approach implementation, they would still play a role by virtue of being a key part of the system; in high-intensity scenarios, they can act for instance as communication/connectivity hubs for a swarm of unmanned systems in the air and on the ground. Nevertheless, in high-intensity near-peer or peer-to-peer scenarios, they may/could prove less central due to their limited expendability if compared to other weapon systems.⁴³ In any case, the doctrinal basis for rotorcraft employment should consider it as being part of a combined arms solution. As the Ukraine case showed, helicopters, if employed on their own, suffer unsustainable losses.⁴⁴

1.5 What convergence among NATO allies?

Rotary wing aviation has been an essential component not only for military and combat-heavy missions, but in many cases an asset for dual-use and civilian tasks of the armed forces and for civilian first responders thanks to its versatility and flexibility, for example in search and rescue operations. Helicopters can be employed in a wider range of missions than fixed wing aircraft and are on average less expensive,⁴⁵ making them attractive for institutional buyers in the Euro-Atlantic area. Their future employment will largely depend on Allied priority operational scenarios. Allies should avoid a situation in which versatility and flexibility, which makes helicopters fit for various operational scenarios, end up hindering the definition of clear requirements for next generation helicopters.

⁴¹ Interview, 13 January 2023.

⁴² David Barno and Nora Bensahel, "The Other Big Lessons that the U.S. Army Should Learn from Ukraine", cit.

⁴³ Interview, 9 November 2022.

⁴⁴ Interview, November 2022.

⁴⁵ Interview, 13 January 2023.

This is particularly important if considering that the “exquisite vs. mass” trap affects rotary aviation sector as any other. In this sense, mass and interoperability will be crucial to defend Europe in the future. The Russian invasion of Ukraine is a game changer for NATO, and it pushes Allies towards convergence when it comes to preparing for certain types of conventional, heavy-armoured land warfare to defend the Alliance’s border to the East. Yet, some relevant differences in deployment priorities and strategic interests persist among Allies.⁴⁶ This is strictly related to the future employment of helicopters, their operational requirements and related procurement programmes. By learning from the Ukrainian conflict, a similar high-intensity operational scenario in Europe could see the employment of the majority of current helicopters’ fleets more for support missions – providing tactical lift, transport of troops and equipment and support to intelligence, surveillance and reconnaissance (ISR) – rather than for hunter-killer operations. In terms of military requirements, the United States is currently planning for a peer-to-peer conflict scenario in the Indo-Pacific through the FVL programme, as shown for instance by the requirement to achieve longer ranges than those taken into consideration for Europe until now.

Other NATO allies, such as France, Italy, Spain, but also the UK prioritise the European continent as well as North Africa and Middle East as their main area of interest and engagement. This translates into the fact that future helicopters may require less improvements in term of range, while affordability will play a more relevant role if compared to the US. Therefore, compatibility and interoperability among Allies will also have to be considered as key issues. Still, some observers note that longer range, higher autonomy and faster speed will be important for the Europeans as well.⁴⁷ Such view considers the vastness of the border regions towards Belarus and Russia, consisting in a vast plain, but also Europe’s new stakes in the High North or the Mediterranean, where autonomy, speed and range would be useful to rapidly reach North Africa and the Middle East without needing to stop to refuel.⁴⁸

⁴⁶ See also Chapter 7 of this study.

⁴⁷ Interview, 28 February 2023.

⁴⁸ Ibid.

2. United States

by Kevin Mangum¹

The United States Army is modernising and transforming its vertical lift capability to meet operational needs and capitalise on 21st century technologies. The unique convergence of near-peer threat capability and new available technology are catalysts driving the Army to field game-changing capability. Helicopter capability is a defining, asymmetric advantage, integral to the American way of war.² The ability to operate in the third dimension, free from the constraints of terrain, continues to allow US forces to strike at a time and place of their choosing, swiftly and decisively. While competitors are focused on efforts to counter American forces, the latest technologies offer the opportunity for vertical lift to remain an advantage for US, their partners and allies.

The conflict in Ukraine serves as an illustrative example of why future vertical lift aircraft are necessary and reinforce the attributes necessary to ensure these capabilities are effective. While various commentators assert that operations in Ukraine demonstrate that helicopters (and tanks) are obsolete,³ it is essential to learn the correct lessons and critically determine the drivers for Russian failures on the battlefield and causes of their helicopter (and armoured vehicle) losses. Aging and inferior Russian equipment as well as poor leadership, tactics, training and discipline exhibited by Russia led to staggering tactical and operational losses that merit some attention.⁴ Indeed, a committed and better trained, equipped and led force can fight, survive and win as Ukraine's forces continue to prove. While Kyiv has not taken credit for the operations, reports of Ukrainian night helicopter attacks in Russian-held territory indicate the efficacy of vertical lift capability when wielded skilfully.⁵ This demonstrates that vertical lift capability with the speed, range and manoeuvrability to fly very low and fast can fight and survive during deep range penetrations of enemy territory.

2.1 Evolution of the vertical lift requirements

The US Army launched on its journey to field modernised vertical lift aircraft in the early 2000s. Initially, the focus was on leveraging the latest technology to increase the speed, range and payload of its helicopter fleet. With an eye on aging UH-60 and

¹ Lt. Gen. (ret.) Kevin Mangum is former Deputy Commanding General of the US Army Training and Doctrine Command.

² See, among others, Kevin W. Mangum and Ari Cicurel, "What Ukraine Teaches the US about Combat Helicopter Operations", cit.

³ David Barno and Nora Bensahel, "The Other Big Lessons that the U.S. Army Should Learn from Ukraine", cit.

⁴ See in this regards Chapter 1 of this study.

⁵ Robyn Dixon, Miriam Berger and David Stern, "Russia Accuses Ukraine of Helicopter Strike on Belgorod Fuel Depot", in *The Washington Post*, 1 April 2022, <https://www.washingtonpost.com/world/2022/04/01/russia-belgorod-fire-helicopter-ukraine>.

AH-64 fleets, Army leaders were keenly interested in what was in the realm of the possible to overcome the physics limiting helicopter speed and performance.⁶ At the core, the commitment was to determine if innovative designs, breakthroughs in material science, propulsion and manufacturing would allow industry to build a new clean sheet, vertical lift platform capable to bend the performance curve.

The Army, as part of the Department of Defense's Joint Multi-Role Technology Demonstration (JMR-TD), sought to identify innovative designs and allow select industry partners to build and demonstrate a modern capability. The Army aimed to double the improvement in performance – twice the speed and range with similar payloads as existing platforms. The desired airspeed (230 knots) and range (450 nautical miles, 833 km) were determined by emerging doctrine, specifying the dimensions of both brigade and division tactical and operational footprints. The payload (12 combat-equipped troops) is based on an infantry squad reinforced with command and control and enablers. Army leaders initially hoped to develop a common design that could be used for both assault and attack roles. After preliminary design work, the realities of how large a vertical lift aircraft needed to be to achieve the range and speed with desired payloads became more apparent. As a result, it was clear a common design was not really feasible and separate configurations were necessary to optimise aircraft for their respective role, attack and assault.⁷

The result was the creation of two programmes within the Future Vertical Lift (FVL) ecosystem: the Future Long Range Assault Aircraft (FLRAA) and Future Attack Reconnaissance Aircraft (FARA).

Operational analyses for FLRAA as well as government and industry configurations were carried out between 2011 and 2013. In 2013, four companies were chosen for the initial JMR-TD Phase 1 design, and the following year the Army selected Bell and Sikorski-Boeing to build actual flying demonstrators.⁸ Competitive demonstrations and risk-reduction efforts ended in 2021, and in late 2022 the Department of Defense (DoD) finally selected the V-280 to provide the FLRAA capabilities.⁹ It has been reported that the Army will decide whether to transition FLRAA into a programme of record (i.e. ready for an appropriation of funds by Congress) in mid-2024.¹⁰ FARA underwent an analogous process, although at a slower pace. Four

⁶ Marv Broke, "Army Announces Technology Investment Agreements for its Joint Multi-Role technology Demonstrator", in *U.S. Army Articles*, 4 October 2013, <https://www.army.mil/article/112611>.

⁷ Kevin Hunter, "Joint Multi-Role, On a Roll", in *Armor and Mobility*, May 2015, p. 3-5, https://issuu.com/tacticaldefensemedia/docs/2015_am_may_web/5.

⁸ Mike Hirschberg, "Army Decides on FARA and FLRAA", in *Vertiflite*, May/June 2020, p. 30-32, https://vtol.org/files/dmfile/fvl_v_may-jun_2020.pdf.

⁹ Jen Judson, "US Army Makes Largest Helicopter Award in 40 Years", in *DefenseNews*, 5 December 2022, <https://www.defensenews.com/industry/2022/12/05/us-army-makes-largest-helicopter-award-in-40-years>.

¹⁰ Ashley Roque, "Timeline Revealed: Army, Bell Flying towards FLRAA Program of Record in 2024",

out of the seven companies that submitted bids to build competitive prototypes in 2018 were selected by the US Army in 2019.¹¹ However, prototype flights have yet to take place due to delays in the delivery of a new engine developed by General Electric Aerospace under the Improved Turbine Engine Programme. The first tests will take place in late 2024 at the earliest.¹²

While the JMR-TD programme evolved, it became more and more apparent that strategic competitors were bolstering their ability to counter US forces. The ability for US and Allies to stage and project the force to penetrate opponents' areas of influence is increasingly contested. Long range precision weapons, improved integrated air defence networks and a more transparent battlefield with layered sensors make it much more difficult for friendly forces to operate from sanctuary, fight at stand-off ranges and achieve stand-in effects.

The necessity to operate from relative sanctuary to strike objectives and targets reinforces the need to significantly increase the speed and range of Army air assault and attack aviation capability. That increased capability not only enhances the ability to operate from stand-off ranges but to provide stand-in effects at a vastly increased tempo. Augmented reach and tempo present the opposing force with multiple dilemmas simultaneously and divert their focus over a much wider front when confronted with US and allied forces. Tactical and operational tempo provided, in part, by vertical lift aircraft will remain integral to the American way of war and continue to be the asymmetrical difference in US and combined warfighting concepts.

As the US DoD and Military Services develop the concepts and doctrine to conduct Joint All-Domain Operations (JADO), future vertical lift capabilities will certainly play an important role. The JADO concept "integrates air, land, maritime, cyberspace, and space domains, plus the electromagnetic spectrum and is comprised of actions by the joint force in multiple domains, integrated in planning and synchronised in execution, at the speed and scale needed to gain advantage and accomplish the mission".¹³ The goal of JADO is to compete in all domains to present adversaries with multiple dilemmas simultaneously to allow the Joint force to gain and exploit positions of advantage – spatially, geographically, temporally, and informationally – to present national leaders multiple options to compete with, deter and ultimately defeat competitors, when necessary.

in *Breaking Defense*, 28 April 2023, <https://breakingdefense.com/?p=283848>.

¹¹ Mike Hirschberg, "Army Decides on FARA and FLRAA", cit.

¹² Jen Judson, "US Army Preps Mission Tech for Future Helicopter, Despite Engine Delay", in *DefenseNews*, 24 April 2023, <https://www.defensenews.com/industry/techwatch/2023/04/24/us-army-preps-mission-tech-for-future-helicopter-despite-engine-delay>.

¹³ US Air Force, *The Department of the Air Force Role in Joint All-Domain Operations*, Air Force Doctrine Publication 3-99 / Space Doctrine Publication 3-99, 19 November 2021, p. 4, <https://www.dctrine.af.mil/Doctrine-Publications/AFDP-3-99-DAF-Role-in-Jt-All-Domain-Ops-JADO>.

While the Army is leading development of US future vertical lift capability, both the Navy and Marine Corps are developing their own requirements to leverage the potential of significant improvements in speed, range and manoeuvrability to contend with the tyranny of distance in the maritime environment, particularly in the Indo-Pacific Command area of responsibility. In 2021, the US Navy announced their ambition to begin development of a Maritime Strike vertical lift capability to replace existing MH-60 R/S Seahawk helicopters and MQ-8 Firescout unmanned aircraft systems.¹⁴ The Navy envisions a vertical lift capability that can operate from various ships with an airspeed between 170 and 270 knots, 300 to 437 nautical mile (555–810 km) range, an internal payload of 5,000 pounds (~ 2,300 kg) and external payload of 8,000 pounds (~ 3,600 kg).¹⁵

The Marine Corps seeks a similar capability with as many common requirements and capabilities as the Navy as possible – but with a couple of twists. The Marines seek a capability with an airspeed between 275 to 295 knots with even higher sprint speeds; 365–450 unrefuelled nautical mile range (590-725 km), able to carry 10 combat equipped Marines.¹⁶ The Marine Corps also desires an attack variant, capability for air-to-air refuel and the ability to operate from amphibious ships.

While it is unclear how the requirements for these various service capabilities will flush out, it is obvious there is potential and great benefit from a family of systems, as originally envisioned by the DoD in their Joint Multi-Role concept. Common platforms with similar mission systems have the potential to provide efficiencies and economies of scale. Regardless of platform capabilities and commonality, mission systems must be able to “plug in” into the targeting, sensor, shooter network to meet Joint All-Domain situational awareness, goals and requirements.

2.2 Mission optimisation and tactical objectives

US Army planners build their tactical plans at the objective, whether terrain or enemy oriented. That location in time and space drives all activity from planning, preparation to sequential execution. Tactical relevance is predicated by the force’s ability to reach and close on the objective. Payload, speed of action on and around the objective, ability to land and rapidly mass the force or deliver lethal and non-lethal effects on the objective, and the ability to survive *enroute* are all critical operational and design considerations. The United States enjoys the luxury of fielding capability optimised to perform a specific mission set. As the Army learned when considering multi-mission future vertical lift platforms, a common design was not practical.¹⁷ Resulting designs were either too big to be a viable attack

¹⁴ Mike Hirschberg, “Commentary: The Need for FARA”, in *Vertiflite*, November/December 2021, p. 4-5, <https://vtol.org/news/commentary-the-need-for-fara>.

¹⁵ Ibid.

¹⁶ Sydney J. Freedberg, “FVL: Army, Marines, SOCOM Release Ambitious Specs for Future Aircraft”, in *Breaking Defense*, 5 April 2019, <https://breakingdefense.com/?p=55316>.

¹⁷ Dan Parsons, “Navy Launches FVL Maritime Strike Replacement for MH-60 Seahawk”, in *Vertical*,

aircraft or too small to carry the necessary air assault payloads to distant objectives.

The bottom line is that it is extremely difficult to build an aircraft that can be everything to everybody. Clearly identifying the primary mission, purpose and function of the capability is absolutely critical. The history of military procurement has proven that failure to do so results in aircraft incapable of effectively executing any of the multiple missions originally envisioned. While some partners may pursue multi-mission future vertical lift platforms, because of budgetary, force structure and/or political considerations, it is crucial to remain clear eyed on the operational effects they desire to achieve. Rapidly configurable, multi-mission designs are achievable but have to be focused on the objective and the primary, and perhaps, most likely mission they must execute. Finding the right balance on how much of the secondary and additional missions can be accomplished is key.

2.3 Transformational capabilities and industrial rationale

While the physical attributes of next generation platforms will be game changing, other state of the art technologies, capabilities and concepts are truly transformational. Fielding new aircraft allows the Army to introduce three new approaches which significantly improve the platforms' flexibility, reliability, and lethality. The first transformational concept is known as a modular open systems approach (MOSA). MOSA establishes common interface standards between platforms, systems and components providing a plug and play ability to add and rapidly integrate components and systems.¹⁸ MOSA offers a number of distinct advantages to the current business model. Designers can more rapidly upgrade and modify existing platforms to leap ahead of emerging threats. Force developers can reduce the number of systems necessary to outfit the force with common plug and play components that can be moved between different aircraft and platforms. Commanders can more rapidly equip and configure aircraft to fight and win in a particular theatre and for a specific mission.

Second, mature predictive and prognostic maintenance systems provide commanders and crews a better understanding of what is happening with their platform. Aircraft will "communicate" the wear of, and stress on, key components and remaining operational life. The depth of knowledge and understanding allows the US Army to realise their historical goal of conditions-based maintenance,¹⁹ changing components based on actual stress, usage and remaining life. Commanders and crews can use this knowledge to determine when they must maintain or replace aircraft systems instead of relying on predetermined maintenance schedules. They can then predict how long and how hard they can

29 January 2021, <https://verticalmag.com/?p=360771>.

¹⁸ US Defense Standardization Program (DSP) website: *Modular Open Systems Approach (MOSA)*, <https://www.dsp.dla.mil/Programs/MOSA>.

¹⁹ Andy Bellocchio and Danny Parker, "The Maintenance Forecast", in *Army ALT Magazine*, 17 March 2022, <https://asc.army.mil/web/?p=51254>.

drive their aircraft and fleets to meet combat needs. This deeper understanding of aircraft systems and components will further enable maintenance free operating periods. These extended periods allow units, aircraft and commanders to operate in a more dispersed and survivable manner, free from vulnerable operating bases and assembly areas. Planners can also forecast maintenance and parts needs more effectively, reducing parts inventories which must be moved and warehoused in forward operating locations. Last, but certainly not least, improved diagnostics and prognostic capability will increase aircraft availability and reduce operating costs.

The third significant transformational capability is launched effects – and in the case of future vertical lift platforms, air launched effects (ALE). ALE aim to transform vertical lift platforms into a sensor-shooter capability able to deliver stand-in lethal and non-lethal effects, from survivable, stand-off ranges.²⁰ The combination of these autonomous and semi-autonomous systems, launched from super-fast, highly survivable vertical lift platforms, are meant to allow US forces to operate from relative sanctuary and enhance situational understanding, targeting and lethality at the distant objective to assure mission success. In a nutshell, future vertical lift platforms will likely give commanders and crews the means to sense, surveil and strike targets at range, allowing these aircraft to operate with the reach and tempo to significantly change the current American concept of battlefield geometry. Connected to the Joint All-Domain Command and Control architecture, these platforms extend the commander's "eyes and ears," his communications reach, and provide critical stand-in precision fires over the horizon and at range.

Current technology both enable and dictate the need to field modernised and transformational vertical lift platforms as soon as possible. The same modern technologies that allow these platforms to realise transformational speed, range, manoeuvrability, survivability and lethality enable competitors' ability to contest US and allies' ability to close with and defeat their forces. To stay a step ahead of potential adversaries, it necessary to collectively act now. To remain an interoperable and cohesive combined force within NATO, it is imperative for US partners to develop and field modernised vertical lift capability. Western military asymmetric advantage is dependent on doing so. Competitors' aggression and aggressive actions in both Europe and the Indo-Pacific drive US and allies to not only compete but to be prepared to fight and win.

²⁰ US Department of the Army Office, *Air Launched Effects (ALE)*, 14 August 2020, <https://www.army.mil/article/238407>; and *Air Launched Effects (ALE) Architect Request for Information (RFI)*, 3 February 2022, https://imlive.s3.amazonaws.com/Federal%20Government/ID161616779419613215068532021442332995231/220203%20-%20ALE%20Architect%20RFI%20-%2003_February_2022_FINAL.pdf.

3. France

by Léo Péria-Peigné and Elie Tenenbaum¹

A historical pioneer in the field of rotary wings, France has always kept a significant military helicopter capability in its armed forces. However, years of doctrinal hesitation and of pushing back long overdue modernisation have put its rotorcraft fleet at the crossroads in a time of dramatic strategic paradigm shifts. As the era of stability and counterterrorist operations seems to be yielding to a new world of hybrid threats and high intensity conflicts, the exact role of French military helicopters remains to be defined. This questioning comes at a time when the national helicopter capability is undergoing a major renewal, moving from a heterogeneous 12-model fleet to a rationalised 3-model fleet: the EC665 Tiger as the main combat one, the NH90 as the main manoeuvre one and the H-160 Guépard as a light utility and attack one. The convergence of these two dynamics invites to compare the current doctrinal and operational outlook with the projected capability format projected by 2030 and beyond.

3.1 Doctrine and operational outlook

3.1.1 Army helicopters

Out of the 430 helicopters currently in the French Armed Forces, two thirds come under the Army's Light Aviation branch (*Aviation légère de l'armée de terre* – ALAT). Created in the aftermath of World War II, it proved an especially innovative service in the 1950s introducing new air assault tactics in post-colonial wars like Algeria. In the later Cold War era, Army helicopters assumed an antitank purpose to counter a potential heavy mechanised Warsaw Pact assault on West Germany. Such task was assigned to the 4th *Division Aéromobile* (DAM) which, in case war ever broke out, was supposed to swiftly penetrate 350 km deep into Germany in less than 12 hours to counter any aggression. Unlike the US Army though, France lacked a proper attack helicopter and relied for this mission on light reconnaissance and attack helicopters Alouette II and Gazelle, while medium utility aircraft Puma and SuperPuma ensured air assault mobility missions. It was not until 2005 that ALAT finally equipped itself with the long-awaited Franco-German EC665 Tiger attack helicopter, which had been designed in the Cold War for antitank warfare along similar lines as the US AH-64 Apache or the Italian A129 Mangusta, but 15 to 20 years later.²

¹ Léo Péria-Peigné is a Research Fellow at the Institut Français des Relations Internationales (IFRI)'s Security Studies Center. Elie Tenenbaum is the Director of IFRI's Security Studies Center.

² Etienne de Durand, Benoît Michel and Elie Tenenbaum, "Helicopter Warfare. The Future of Airmobility and Rotary Wing Combat", in *Focus stratégique*, No. 32 bis (January 2012), <https://www.ifri.org/en/node/6168>.

By the time the Tiger came in, the end of the Cold War had deprived ALAT from its main tactical purpose bringing along severe cuts in the 1990s and 2000s (from around 700 to less than 300 aircraft). The need was no longer to perform manoeuvre warfare, but to carry out stability and counterinsurgency operations. Whether in the Balkans, Afghanistan or in the Sahel, the demand for Army rotary wings was high and the fielding of the new NH90 Caiman by 2011 was here again a long-awaited relief to improve air mobility. Somehow reviving the approach from the 1950s, Tiger, Gazelle and NH90s were used as unique force multipliers in terms of mobility and fire support.

The capability pattern remained incomplete though, due to the absence of heavy vertical lift capabilities, which has been a recurring issue. While main European allies (UK, Italy, Spain) could rely on an, albeit limited, fleet of CH-47 Chinooks or EH101 Merlins, French tactical lift tended to be underweighted with NH90s maximum payload (4.2 t) still a third of that of CH-47s (12 t). The outstanding performance of the British Chinooks and the Danish Merlins lent out to France for operation Barkhane has raised once more questions regarding the opportunity to acquire such aircraft. But a look at purchase and maintenance costs quickly closed the debate, even more so because adding a new model would run against the ongoing effort toward a more homogeneous rotorcraft fleet.³

In 2011, French intervention in Libya gave ALAT a new opportunity to prove its relevance in mid- to high intensity warfare. Embarked aboard Navy amphibious assault ships, Army attack helicopters were used as genuine manoeuvre units. Unlike their British counterparts (AH-64 Apache), strictly used for fire support, French Tigers and Gazelles were given larger autonomy on a wider zone in a mission-style command. The Libyan experience gave rise to a new operating ALAT concept called “*Aérocombat*”, ingrained in the notion of an autonomous aviation manoeuvre. It envisions rotary wings as “contact units” in their own right, with larger leeway regarding tactical course of action, target identification, and ammunition use.⁴

As the “intervention era” is now winding down for the Army, ALAT finds itself once again at a crossroad, as it was at the end of the Cold War. Rotorcrafts were an invaluable asset in the largely unopposed African and Middle Eastern skies, but the current conflict in Ukraine shows how vulnerable they are in a high intensity conflict – each side having lost up to 70 aircraft in the first six months of combat.⁵ With only 67 Tigers and a mission capable rate below 40 per cent in 2021, ALAT can hardly endure severe losses. Even if every Tiger had the firepower of 6 legacy

³ Jean-Pierre Cubertafon and Jean-Jacques Ferrara, *Mission flash sur les hélicoptères des armées*, Rapport à l'Assemblée nationale, 15 July 2020, https://www2.assemblee-nationale.fr/content/download/312248/3032575/version/2/file/200715_MI_he%CC%81licopte%CC%80res_JPC_JFF.pdf.

⁴ Centre de doctrine et d'enseignement du commandement (CDEC), *Concept d'emploi des forces terrestres (CEFT) 2020-2035 (RFT 3.2.0)*, September 2021, <https://www.terre.defense.gouv.fr/node/236>.

⁵ Stijn Mitzer et al., “Attack on Europe”, cit.

attack helicopters, replacing inevitable losses in a reasonable timeframe would also be very hard, as production time between order and delivery could be superior to a year. Training a Tiger crew is also both much costlier and lengthier than the ones from previous generations, and the French ALAT would not be able to handle substantial crew casualties before losing most of its combat capability.

3.1.2 Air Force helicopters

With more than 70 aircraft, the Air Force is the second rotary wing user in the French armed forces. Air Force helicopters are employed for a wide range of missions. The 23 Pumas and SuperPumas medium utility aircraft are used for cargo, medical evacuation (MEDEVAC), search & rescue (SAR) as well as Personnel Recovery missions. After four decades of service, mission capable rate is low (30–50 per cent) and operational maintenance costs are high, making their replacement with the more recent H225 Caracals is now a long overdue priority. The latter model is already used by the Air Force for SAR, but mainly also for special operations. Finally, the Air Force keeps a rather large fleet of about 40 H125 Fennec, which are widely used for Air Policing and Security – with a renewed interest in anti-drone warfare, as well as occasional fire support, SAR and even combat SAR.⁶

3.1.3 Navy helicopters

The French Navy too is a sizeable user of military helicopters, even though it has been struggling with an ageing fleet. It still maintains the old Alouette III, designed during the Algerian war, as well as 27 Dauphin/Panther medium weight multirole aircraft. Their mission scope is wide enough for such a small fleet. Maritime SAR, counter-trafficking (of narcotics, arms, humans) in the Mediterranean Sea and counter-piracy operations along the African coasts (Gulf of Aden and Gulf of Guinea) have been a demanding effort over the last decade, especially as it added up to the more essential mission of surface fleet protection and anti-submarine warfare (ASW). The naval version of the NH90 Caiman has been especially efficient at ASW, with its fully electrical command system, low frequency FLASH (Folding Light Acoustic System for Helicopters) dipping sonar, electronic warfare suite and MU90 torpedoes.⁷

3.2 The 2030 horizon: A renewal in process

3.2.1 An ageing fleet struggling with low availability

The current French helicopter fleet faces two main issues: ageing aircraft see their maintenance costs rising very fast reducing availability, and the more recent ones suffer from low availability due to complex maintenance activities. Most of the

⁶ Jean-Pierre Cubertaon and Jean-Jacques Ferrara, *Mission flash sur les hélicoptères des armées*, cit.

⁷ Frédéric Barbe, "Les tribulations du bourdon : l'hélicoptère dans la Marine", in *Études marines*, No. 20 (November 2021), p. 36-55, <https://www.defense.gouv.fr/node/2148>.

Future Military Helicopters: Technological Innovation and Lessons Learned from Ukraine

French military helicopters' mission capable rate is under 50 per cent, even if the ones used in operations usually have a higher rate.⁸

Table 1 | The French helicopter fleet in 2022

Helicopter	Purpose	Fleet	Introduc- tion date	Average age	Note
French Army (283 aircraft)					
Tiger	Attack helicopter	67	2003	10	To be upgraded to HAD variant and maintained beyond 2030
NH90 Caiman	Medium multirole	48	2007	6	To be maintained beyond 2030
Caracal		8	2005	17	To be replaced by NH90 by 2030
Cougar		24	1978	32	
Puma		32	1968	48	
Gazelle	Light recon- naissance and attack	86	1973	36	To be replaced by HIL by 2030
Fennec	Light multirole / training	18	1990	28	
French Air Force (73 aircraft)					
Fennec	Light multirole	40	1990	31	To be replaced by HIL
Caracal	Medium multirole	10	2005	16	To be upgraded after 2026
Puma / SuperPuma			1968	45	To be replaced by Caracals by 2030
French Navy (62 aircraft)					
NH90 Caiman	Medium multirole	26	2007	8	To be maintained beyond 2030
Panther		16	1986	30	To be replaced by HIL by 2030
Dauphin		11	1978	39	
Alouette III	Light multirole	9	1961	47	

In 2018, the 30-year-old Cougars hit a low 27 per cent, the much younger Tigers was barely reaching 30 per cent, while the 40-year-old Gazelles had a mission capable rate of 46 per cent, with an improvement from 2017 and 2016. Such a low availability can be explained by four big factors. First, fleet heterogeneity makes maintenance operations extremely complex, with some spare parts being difficult

⁸ Sébastien Meurs, "L'inquiétant taux de disponibilité de nos hélicoptères militaires", in *Capital*, 7 March 2019, <https://www.capital.fr/economie-politique/linquietant-taux-de-disponibilite-de-nos-helicopteres-militaires-1343800>.

to come by. Second, maintenance is hampered by a chronic shortage in skilled personnel, with logistics suffering from a low priority given within the military human resources policy. Third, over the last decades operational conditions have been exceptionally hard for the aircraft due to particularly hot and sandy theatres. Fourth, maintenance contracting policy towards the private sector has been unsatisfactory, with loopholes in specifications and cases of not-fulfilment. A dire consequence of low availability is degraded training levels. With most of the maintenance effort going to actual operations (resulting in a mission capable rate twice higher than the rest of the fleet), training has suffered from serious shortfalls. For years now, the rotary wings branches from the three services have not been able to meet the NATO standard requirement of 200 flight hours per year, as French helicopter crews have only flown 148 hours.⁹

3.2.2 Towards a 3-model format

In the coming years, the whole French helicopter fleet will be going through a strong rationalisation process, moving from 12 different models (Dauphin, Alouette, Panther, Lynx, NH90, Fennec, Caracal, Puma/Super Puma/Cougar, Gazelle, Tiger) to only 3 with several specialised versions: the Tiger, the NH90 and the H-160 Guépard.

Table 2 | Projected French helicopter fleet by 2030

Tigers	67
NH90 Caiman / Caracals	111
HIL H160 Guépard	169

3.2.3 The future of the Tiger

With the first Tigers soon reaching 20 years of operational service, a large midlife update process has been launched in 2022, adding new features to extend their operational life expectancy until 2050. As Germany eventually refused to join France and Spain in this modernisation effort (in spite of Paris' efforts to convince Berlin to get onboard), the update has turned out to be too costly. After several months of hesitation on whether France and Spain should still upgrade part of their fleets by their own, the head of the French Army confirmed during a parliamentary hearing that the whole upgrade programme would be postponed, even if there were still discussions with his Spanish counterpart.¹⁰ He also added that the experience of

⁹ François Cormier-Bouligeon, "Préparation et emploi des forces: forces terrestres", *Avis à l'Assemblée nationale*, No. 369 (19 October 2022), p. 24, https://www.assemblee-nationale.fr/dyn/16/rapports/cion_def/l16b0369-tiv_rapport-avis.

¹⁰ Anne Bauer, "Paris et Madrid lancent la modernisation de l'hélicoptère de combat Tigre sans attendre Berlin", in *Les Echos*, 3 March 2022, <https://www.lesechos.fr/industrie-services/air-defense/paris-et-madrid-lancent-la-modernisation-de-lhelicoptere-de-combat-tigre-sans-attendre-berlin-1390850>.

Ukraine was not questioning the French combat helicopter capability but that it would be a decisive point to develop the next rotorcraft, and its possible UAV nature.¹¹ Faster, more manoeuvrable and with a better situational awareness than most of its Russian or Ukrainian counterparts, the Tiger is also a fragile machine with lighter firepower compared, for instance, to the Ka-52. Operating on a battlefield saturated with low and medium range surface-to-air systems, its room for manoeuvre would be greatly limited, questioning the relevance of maintaining such a costly capability.

3.2.4 H160 Guépard: A new workhorse

In 2017, the French Ministry of Defence (MoD) announced that Airbus' H160 Guépard was selected to be the next Joint Light Helicopter (*Hélicoptère Interarmées Léger – HIL*) in view of replacing five ageing models: Fennecs, Gazelles, Panther, Dolphin and Alouettes. An order of 169 aircraft has been approved to replace 174 old ones: 80 will go to the Army for combat reconnaissance, special operations, fire support and command and control; 49 will go the Navy to perform ASW, maritime SAR, and fleet protection missions; 40 to the Air Force for air policing missions, SAR and intelligence, surveillance and reconnaissance (ISR). Still, the new military budget law announced a strong spread of the deliveries, with only 20 aircraft delivered by 2030 and 70 by 2035, even if the final target, beyond 2035, is said to be kept at 169.

3.2.5 Utility aircraft

France ordered 81 NH90s to be delivered by 2024, and 27 more in their naval version named Caiman Marine, which have been fully delivered in 2021. Used as "utility and assault" helicopters by the ALAT together with EC 665 Tigers, it has been praised for its speed and manoeuvrability,¹² even if at the beginning of 2022 the French Ministry of Defence (MoD) criticised its low availability as only 4 Caiman Marine (over a fleet of 27) were actually available and massive corrosion issues had been detected.¹³ Still, the new military budget law planned the purchase of 8 more NH90 with specific modification for the French special forces.

3.2.6 The pending issue of rotary-wings UAVs

For years, the French armed forces have been lagging behind in the adoption of unmanned air vehicles (UAVs), both fixed and rotary wings. They are now in the process of catching up. It is especially true for the Army, which should go from only 160 UAVs of various types in 2019¹⁴ to around 3,000 unmanned aircraft by

¹¹ Laurent Lagneau, "ALAT : Le chef d'état-major de l'armée de Terre confirme la suspension du programme Tigre Mk3", in *Zone militaire*, 6 May 2023, <https://www.opex360.com/?p=70190>.

¹² Interview with French armed forces officers, 2023.

¹³ Laurent Lagneau, "La Marine nationale ne dispose que de 4 hélicoptères NH-90 Caiman disponibles sur... 27", in *Zone militaire*, 15 November 2021, <https://www.opex360.com/?p=64073>.

¹⁴ French senate, *Projet de loi de finances pour 2020 - Audition du général Thierry Burkhard*,

2023. Most of these will be small or even micro-UAVs for ISR purposes, such as Black Hornet 3 or Anafi USA from French manufacturer Parrot. However, the Army does not appear to have immediate plans for larger rotary wing UAVs, even though such expendable systems may prove a useful solution in high intensity warfare scenarios to limit crew exposure and balance the need for mass. The French Navy has been more active in this field, with the purchase in 2019 and 2020 of 6 Australian-made Camcopter S-100s embarked onboard each of its three Mistral-class amphibious assault ships. S-100s are but an interim solution before the fielding of an Airbus VSR700, a remotely piloted helicopter with a 250 kg payload which will not be delivered before 2030. The new budget law expects “at least 15” of them by 2035.

3.3 Beyond 2040

Without any strictly national rotorcraft industry requirement, any future French helicopter will likely be developed at the European level, most probably through its champion, Airbus Helicopter. The company’s German and, to a lesser extent, Spanish and British participation and production sites are expected to matter in any sizeable development project.

Currently, France is involved in two main international groupings: the NATO-led Next-Generation Rotorcraft Capability (NGRC) and the EU-led Next Generation Rotorcraft Technologies (NGRT).¹⁵ Launched in 2021, NGRC primarily seeks to establish a common basis of needs and specifications for a future joint utility helicopter and intends to develop a multirole aircraft by 2040 combining efforts from France, Germany, Greece, Italy, the Netherlands and UK, with Spain, the US and possibly Canada as observer nations.¹⁶ NGRT, on the other hand, is a European Defence Fund (EDF) project, also launched in 2021 with a 40 million euro tender to develop the first technical elements for a future common military helicopter, be it utility or combat. Leonardo and Airbus Helicopters have been assigned co-leadership on this programme, which should also be determining to a possible successor to either Tigers or Guépards models. While both NGRT and NGRC are still in their infancy, they should have made significant inroads by 2026.

For France, the main project for a future military helicopter is the Next Generation Utility Helicopter, intended to replace by 2040 the French Puma, Caracal and Cougar, and maybe even the NH90. Mentioned for the first time in October 2018, this programme remains at a very early stage. Only a limited budget has been allocated, with most available resources prioritised for the acquisition of H-160 and the modernisation programme Tiger Mk III. A few studies have been funded,

chef d'état-major de l'armée de terre, 16 October 2020, <https://www.senat.fr/compte-rendu-commissions/20191014/etr.html#toc6>.

¹⁵ See Chapter 7 of this study.

¹⁶ Jen Judson and Vivienne Machi, “Six NATO Countries Sign Agreement to Collaborate on Next-Gen Helo”, in *DefenseNews*, 16 June 2022, <https://www.defensenews.com/global/2022/06/16/six-nato-countries-sign-agreement-to-collaborate-on-next-gen-helo>.

mainly to support the aeronautic sector during the Covid pandemic, and very little data will be available before 2025 on the potential industrial partnership the project would require.¹⁷

3.4 Conclusions

Questions about the French vision of future helicopters cannot be separated from a wider analysis of the French vision for its overall armed forces. When presenting the future Military Programming Law (*Loi de programmation militaire*) in early January 2023, President Macron clearly pointed at the challenges of what he called “a pivot towards high intensity”, shifting away from an expeditionary warfare posture that had shaped rotary wings doctrine and capabilities over the last thirty years. But what exactly does “high intensity” mean and how will this translate into military requirements, and more widely in concepts of employment for helicopters? According to the new budget law for 2024–2030, total military spending should undergo a significant increase (+40 per cent) and only a few amounts will actually be used to expand immediate capabilities. Instead, most will go for infrastructure renovation, long term new capability development based on new technologies or increasing ammunition stockpiles. Considering costs inflation, and the competing priorities among capability and capacity gaps to be filled, the future of French rotary wings remains uncertain and the budget law is still very blurry on it.

¹⁷ Nathan Gain, “Le programme ‘Hélicoptère de manœuvre NG’ sort partiellement de l’ombre”, in *FOB - Forces Operations Blog*, 26 October 2020, <https://www.forcesoperations.com/?p=20991>.

4. Germany

by Florian Schöne¹

4.1 Political-strategic rationale

The goal of military procurement is to have armed forces that can defend the Federal Republic of Germany as well as its allies and that can be deployed in missions within the framework of NATO, the EU or the United Nations. Berlin procures its defence equipment primarily in Europe, while at times prioritising its own industrial base when specific so-called key technologies are produced to sustain a certain level of strategic industrial independence. Germany wants to be a reliable ally in NATO and the EU and to increase the EU's defence capability. A major part of that is the development of industrial capacities within the Union by investing either in joint multinational programmes with other member states, for example within the framework of the Permanent Structured Cooperation (PESCO), or in bilateral programmes with individual partners.² This strategy serves to maximise independence from non-European suppliers.

For technical and financial reasons, the specification of procurement in Europe increasingly requires intra-European armament policy cooperation. The consolidation of the defence industrial base in the EU through cooperation is a particular concern of France, Germany's closest partner in Europe. Joint European projects are meant to increase integration between participating states and can be seen as a starting point for closer military cooperation among them. However, the individual interests of the participants, such as the will to invest their taxpayer's money in their own industry, or the industry's refusal to share intellectual property rights, make agreements difficult. Moreover, the procurement of armaments within the EU is not always the most financially advantageous option, as capabilities are not always readily available and must be developed. This can prove to be extremely costly and time intensive.

In its coalition agreement, the current German government – consisting of the Social Democrats, the Greens and the Liberals – affirms the intention to prioritise replacement purchases and the procurement of market-available (military “off-the-shelf”) systems in order to avoid capability gaps.³ The drive for cooperative procurements (at least at a European level) and the need to complete the timely acquisition of replacement systems with off-the-shelf solutions are – as stated above – sometimes mutually exclusive.⁴ The procurement of military helicopters

¹ Florian Schöne is Bundeswehr General Staff Officer.

² SPD, Greens, FDP, *Mehr Fortschritt wagen. Bündnis für Freiheit, Gerechtigkeit und Nachhaltigkeit. Koalitionsvertrag 2021-2025*, November 2021, <https://www.spd.de/koalitionsvertrag2021>.

³ *Ibid.*

⁴ The procurement of F35 jets is an example. The European market does not offer 5th generation fighter jets nor jets certified to carry US nuclear weapons.

in Europe, especially attack and heavy-lift models, is an example of the difficulties posed by this approach. The additional financial resources promised during the special parliamentary session of 27 February 2022 (the so-called 100 billion euro “special fund” for the Bundeswehr) do not allow for unnecessary duplications of capabilities. The additional money primarily enables the implementation of existing plans, aiming to make the Bundeswehr fully equipped. Parts of this additional money will be invested to replace the medium lift capabilities of the CH-53 fleet with the heavy lift capabilities provided by the CH-47F, built by the US company Boeing.⁵ Furthermore, more light utility helicopters (LUH) are to be procured at a later date.⁶ It is likely that those will come from the European company Airbus, as the German armed forces already operate Airbus’ H145 and H145M LUHs, respectively for search and rescue and in supporting roles for special operation forces. These two examples already show how the German government is trying to balance the necessity to buy what is needed with the political will to invest in European industry.

Helicopters are a scarce international resource⁷ and are therefore of strategic value to the Federal Republic of Germany in terms of security policy. For instance, of 30 NATO partners (in 2021) only 15 have attack helicopters,⁸ and merely six of them (Germany, France, Italy, Turkey, the United Kingdom, the United States) have a fleet of more than 30 aircraft. The rest have between six and 28 combat helicopters, including obsolete systems of Russian origin. Helicopters, and especially attack helicopters, will remain an important asset on the battlefield and in more dangerous missions such as the UN stabilisation mission in Mali, MINUSMA. It is therefore also the responsibility of economically stronger nations like Germany to provide NATO primarily (but also the United Nations) with rotary wing (air attack) capabilities.

For the Bundeswehr, keeping its attack helicopters capabilities is not an easy feat. The German-French-Spanish attack helicopter project Tiger is another example of the conflicting goals in German armament policy.⁹ The Federal Government must weigh divergent interests and decide where the priorities lie between political goals, financial challenges and industrial priorities¹⁰ while trying to at

⁵ German Federal Government, *Bundeshaushaltsplan 2023 - Einzelplan 14. Bundesministerium der Verteidigung*, November 2022, p. 74, <https://www.bundeshaushalt.de/static/daten/2023/soll/epl14.pdf>.

⁶ *Ibid.*, p. 73.

⁷ The need to deploy MD500 from El Salvador as “attack helicopters” to MINUSMA after the withdrawal of the French forces from Mali to bridge the gap till Mi24 from Bangladesh could be deployed can serve as an example in this regard. See Thomas Wiegold, “Merkposten Mali: Deutsche Verstärkung komplett, Kampfhubschrauber aus El Salvador, Kontakte nach Russland und Iran”, in *Augen geradeaus!*, 26 August 2022, <https://augengeradeaus.net/?p=61622>.

⁸ Sven Arnold and Florian Schöne, “Der deutsche Kampfhubschrauber »Tiger« steht vor dem Aus”, in *SWP-Aktuell*, No. 6 (January 2022), <https://doi.org/10.18449/2022A06>.

⁹ *Ibid.*

¹⁰ There is very little competition within the European market when it comes to producing helicopters. Germany focuses on Airbus which is the biggest European aviation company and

least maintain current military capabilities. The future of the attack helicopter fleet has now been decided, and the last Tiger is scheduled to leave the force in 2038.¹¹ Germany will not participate in the Mk III upgrade, as the financial risk has been deemed too high. France and Spain had previously agreed to continue the programme and invited Germany to join. The option to procure a US machine such as the AH-64E Apache or the AH-1Z Viper will not be pursued. With the final year of the programme being 2038, the goal could be to stretch the lifetime of the Tiger through obsolescence management, while only doing the most urgent maintenance until the next generation of rotary wing aircraft become available in the 2030s. The development of the Future Attack Reconnaissance Aircraft (FARA) and the Future Long-Range Assault Aircraft (FLRAA) should therefore be keenly observed in Germany. The option to equip the German army with the H145M, possibly in a light attack configuration, seems still to be on the table. There is still quite a bit of time to find a genuine attack helicopter to replace the Tiger. Solely depending on light attack helicopters puts a genuine attack helicopter capability at risk, as they will not be able to carry as much weaponry and reconnaissance means without sacrificing flight endurance.

With the Tiger helicopter still in service after 2035, there is now the opportunity to replace both systems, Tiger and NH90, using a holistic approach. The US FVL project might offer a way to replace both types with a new helicopter “ecosystem”, consisting of an integrated fleet that uses the same (digital) architecture and drones in a manned-unmanned teaming approach.¹² The CH-47 Chinook now being procured by the German air force could later be replaced by the heavy lift FVL system,¹³ which should ease the system’s integration into the German armed forces. Looking at the German political approach of trying to buy European (or at least to balance spending between extra- and intra-European markets), this eventual solution would need a great deal of domestic persuasion.

Although conflicts of interest as well as capability gaps in European industrial capacity are likely to remain, and available funds remain too scarce, the usefulness of military helicopters is not being questioned politically.¹⁴ This might change in the future, as remotely piloted aircraft might be able to take over more and more tasks from current helicopter fleets. At the same time, two projects with the goal to develop next generation technology – namely, the Future Combat Aircraft System

essential for keeping know-how and production capabilities in Europe. It has various European facilities, several of those sites are in Germany.

¹¹ “Bundeswehr will Tiger-Kampfhubschrauber langfrisitg ersetzen”, in *Spiegel Politik*, 13 May 2023, <https://www.spiegel.de/politik/deutschland/a-40e6f557-7451-4789-ada4-cc91c7d18a62>.

¹² See in this regards Chapter 7 of this study.

¹³ A heavy lift option is not currently pursued but might follow. See John R. Hoehn, “Army Future Vertical Lift (FVL) Program”, in *CRS In Focus*, No. IF11367 (13 July 2021), <https://crsreports.congress.gov/product/details?prodcode=IF11367>.

¹⁴ Essential tasks are for example air assault and close aerial support (CAS), armed reconnaissance, combat search-and-rescue (CSAR), medical evacuation (MEDEVAC). Furthermore NATO (NGRC) and the EU (EDF 2021 NGRT) still work on future vertical lift options.

(FCAS) and the Main Ground Combat System (MGCS) – are likely to take substantial investment, and Germany's will to spearhead rotary wing projects might be diminished. This notwithstanding, Berlin will continue to explore multilateral options. For example, within NATO Germany is part of the Next Generation Rotorcraft Capability programme,¹⁵ with the aim to deliver a (European) medium multi-role helicopter.¹⁶ As the NGRC project seems to focus on lifting capabilities, two possibilities come to mind: (1) a newly developed system to supersede the NH90, or (2) an update for existing systems like the NH90. If the lifetime of the NH90 TTH was not to be extended, it would reach its end in the middle to late 2030s.

Another project with the aim to provide next generation capabilities is the EU's Next Generation Rotorcraft Technologies project. The provided project description assesses that "The scope of this topic concerns research on future technologies and the future operating environment (FOE) and future operating concepts (FOC) of military [Vertical Take-off and Landing] VTOL-systems".¹⁷ NGRT is spearheaded by Airbus and Leonardo and aims to deliver future military helicopter capabilities.¹⁸ As a European research project, NGRT is of interest to Germany, but since the project has only recently started (2022), it is hard to predict where it might lead and what exact militarily useful capabilities it might deliver. It is, therefore, equally hard to say whether the German military will develop a deeper interest for the project. There is no one-size-fits-all solution to operational military problems, and the project might in the end primarily benefit dual-use capabilities rather than fulfil specific military needs.

4.2 The military rationale (including threat assessment)

The capability to conduct air mobile operations by using rotary wing assets remains important in the future in state-on-state warfighting (which in Germany is perceived as being primarily national and allied defence in a NATO context), as well as in crisis management scenarios. Berlin will continue to focus on these two scenarios, with national and allied defence (*Landes- und Bündnisverteidigung – LV/BV*) determining capability development.

The ongoing Russian war against Ukraine has underlined the need to focus on interstate wars. There is too little openly available information to judge the effect of rotary wing assets on the battlefield, yet both countries still operate helicopters,

¹⁵ NATO, *Factsheet - Next Generation Rotorcraft Capability (NGRC)*, June 2023, <https://www.nato.int/topics/mcc/Factsheet-NGRC.pdf>.

¹⁶ See Chapter 7 of this study.

¹⁷ European Commission Funding & Tenders Portal: *Next Generation Rotorcraft Technologies*, <https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/opportunities/topic-details/edf-2021-air-r-ngrt>.

¹⁸ Gareth Jennings, "Airbus, Leonardo to Co-lead EU Next Gen Rotorcraft Technologies Project", in *Janes Defence News*, 26 July 2022, <https://www.janes.com/defence-news/news-detail/airbus-leonardo-to-co-lead-eu-next-gen-rotorcraft-technologies-project>.

showing their specific purpose. The fact that helicopters are downed should not cast doubts on their usefulness since multiple elements, from doctrine to training to maintenance, are possible explanations for such losses.¹⁹ Furthermore, air mobile tasks – especially air assault operations – remain high risk/high rewards options, and losses of aircraft are generally more common in state-on-state war. There are multiple (albeit not new) threats visible in the war in Ukraine, such as MANPADS, small arms fire and different ground and air based anti-air systems and/or weapons. The answer to these threats still lies in a mix of measures, reaching from awareness and training to technical systems and operational planning.

Victory on today's as well as tomorrow's battlefield will rely on the ability to perform multi-domain operations (MDO),²⁰ where all systems mitigate each other's shortfalls as frictionless as possible, while exploiting the enemy's weaknesses. Speed will remain of great importance. The ability to get to a point quicker and being able to close the chain going from identifying a target to delivering an effect will remain vital. Germany has subscribed to the US conceptualisation of MDO, beginning a conceptual shift from services to domains.²¹ An open and common systems architecture connecting all participants jointly (as well as in a combined manner) will be necessary to achieve a full implementation of the MDO approach. Since international integration will remain at the heart of Western warfare, operating the same aircraft as partners could prove beneficial. For future aircraft, breaking or eluding the enemy's anti-access/area denial (A2/AD) capabilities will be essential for survival. In these scenarios, the ability to move fast will be helpful, but aircraft will also have to fly low using the environment to hide, be harder to find by radar and either deliver effects to suppress the enemy's air defences or target information to other systems. In this respect, manned-unmanned teaming will be crucial. Although it is very likely that piloted aircraft will remain the backbone of the fleet, integration with remotely piloted aircraft (possibly piloted from a rotary wing asset) and autonomous weapons will become more important. Human control will remain vital in Western militaries, limiting the reach of weapon systems since they will need to maintain a connection to their operator. Furthermore, connections between systems will be targeted and with longer distances these connections become harder to maintain. To have a piloted system nearby would greatly reduce distance, making connections harder to disrupt. Helicopter could take over this role. Having said that, the approach towards a future vertical lift ecosystem must not focus only on technical solutions alone. A holistic approach, reaching from

¹⁹ See in this regards Chapter 1 of this study.

²⁰ The term is still missing a commonly agreed definition (see: Heiner Grest and Henry Heren, "What Is a Multi-Domain Operation?", in *Joint Air & Space Power Conference 2019 Read Ahead*, June 2019, p. 1-4, <https://www.japcc.org/?p=14944>), the US Army offers its own concept (US Army, *The U.S. Army in Multi-domain Operations 2028*, 6 December 2018, <https://www.army.mil/article/243754>) which essentially is a descendent of air-land-battle. See also: US Army, *2019 Modernization Strategy: Investing in the Future*, October 2019, https://www.army.mil/e2/downloads/rv7/2019_army_modernization_strategy_final.pdf.

²¹ Florian Schöne, "The Key Elements Paper on the Bundeswehr of the Future: Necessary Adaptations to Security Policy Challenges", in Günther Maihold et al. (eds), "German Foreign Policy in Transition", in *SWP Research Papers*, No. 10 (December 2021), p. 36-39, <https://doi.org/10.18449/2021RP10>.

doctrine and training to infrastructure and organisational structures, is necessary to prevail on the future battlefield.

The German armed forces remain willing to maintain a mix of different aircraft necessary to conduct air mobile operations, such as heavy and light transport helicopters as well as combat helicopters. The helicopters in Germany's armed forces are divided between the three main services. Four distinct types of helicopters are in service within the Bundeswehr: light utility helicopters (LUH), light transport helicopters (LTH),²² medium transport helicopters (MTH) and attack helicopters (AH).²³ Each of the services is responsible for specific tasks and, therefore, plays a decisive part in the decision on what kind of helicopter to operate and how it should be fitted to the task. Although the procurement and the responsibility for keeping all rotary wing aircraft operational are centralised within the Federal Office of Bundeswehr Equipment, Information Technology and In-Service Support (*Bundesamt für Ausrüstung, Informationstechnik und Nutzung der Bundeswehr* – BAAINBw) there is no centralised command managing the use of all aircraft within the armed forces, as it is for example the case with the British Joint Helicopter Command.²⁴ Nonetheless, the German army has put into service a brigade-level helicopter command to manage their capabilities more efficiently. This is part of developing German corps troops, but it is also integrated into the German air mobile division (*Division Schnelle Kräfte* – DSK) which also leads the German airborne and special operation forces, as well as the Dutch 11th Air mobile brigade. The Bundeswehr will, of course, remain committed to international integration.

4.3 Technological and industrial rationale

European purpose-built military helicopter models have, as of now, hardly been huge international successes. Australia left the Tiger and is in the process of leaving the NH90 programme,²⁵ Norway and Sweden left the NH90 programme,²⁶ while Belgium is considering doing the same.²⁷ The gathered experiences with newer, European-built helicopters seem to have been too negative. Fewer customers will

²² The NH90 TTH has superseded the Bell UH-1D Huey which was a light transport helicopter. The NH90 is strictly speaking an MTH. To avoid confusion between the NH90 and the CH-53, which have a higher payload, the NH90 is classified as LTH in this text.

²³ Florian Schöne, "Zur Notwendigkeit der Zentralisierung von Hubschraubern in der Bundeswehr", in *SWP-Arbeitspapier*, No. 1 (March 2022), <https://www.doi.org/10.18449/2022AP02>.

²⁴ See Chapter 6 of this study.

²⁵ Clement Charpentreau, "Australia to Replace European NH90 Helicopters with US-made UH-60 Black Hawks", in *AeroTime*, 13 December 2021, <https://www.aerotime.aero/articles/29675>.

²⁶ Stefano D'Urso, "Norway Permanently Terminates NH90 Operations And Contract", in *The Aviatorist*, 19 June 2022, <https://theaviationist.com/?p=79850>; Tim Martin, "Sweden Follows Norwegian Lead and Axes NH90 Helicopter Fleet", in *Breaking Defense*, 2 November 2022, <https://breakingdefense.com/?p=252226>.

²⁷ Patrick Zwerger, "Auch Belgien sortiert die NH90 (zum Teil) wieder aus", in *Flug Revue*, 14 January 2022, <https://www.flugrevue.de/zu-teuer-und-unzuverlaessig-auch-belgien-sortiert-die-nh90-zum-teil-wieder-aus>.

in the end mean higher prices. From a German national perspective, the availability of the Tiger helicopter never reached a satisfactory level. The German path to reach satisfactory availability of the NH90 was long and there are still relevant problems. The obvious need to buy European to keep a cutting edge industry and some much needed autonomy on one hand and the necessity to quickly and cheaply equip the armed forces to strengthen European defence on the other seem, at the moment, mutually exclusive.²⁸ When buying European means buying more expensive, while not significantly increasing defence spending, it means smaller fleets and harder to replace losses, and therefore weakening defence capabilities.²⁹ European economies of scale for military helicopters are unlikely to develop anytime soon, and costs will continue to matter especially when it comes to cost intensive projects like those dealing with helicopters. Without continuously and significantly rising defence budgets and a unified defence industry, Europe will not be able to escape this vicious circle.

Leaving European armament projects will adversely affect the German national industry. Possible effects on the German industrial basis can be shown using the Tiger example.³⁰ It is not clear what will happen to Germany's domestic industrial capabilities in the field of combat helicopter production after 2038. Not only is the final assembly line in Donauwörth in Bavaria going to be affected, but the decision will probably also have an impact on the engine developer MTR in Hallbergmoos.

Against this backdrop and with US companies leading the field in developing military aircraft, it seems unlikely that German/European companies will take more risks in the attack helicopter segment. It seems to have proved more efficient to design helicopters for dual-uses or develop them for civilian use and subsequently adapt them for military purposes. Both ways are more cost effective, since, for example, parts can be produced for a much larger market and are therefore cheaper. Most recent example for a "conversion" is the light utility approach by Airbus, largely using the H145 model and adjusting it for military purposes. This approach is very similar to what Messerschmitt-Bölkow-Blohm (MBB) successfully did with the BO105. The machines were fitted with performance-enhancements and anti-tank missiles in the 1970s and remained the backbone of the German anti-tank capabilities through the rest of the Cold War. Refitted helicopters, however, cannot deliver what purpose-built attack helicopters can do and remain a much poorer substitute, except for mass since they are cheaper to procure. Larger opportunities for European industry could lie with the development of remotely piloted vehicles and manned-unmanned teaming, as well as by becoming a leader in the field of autonomous weapons and so-called air launched effects.

²⁸ Poland buying Korean and US tanks and thereby opting for non-European equipment can be taken as an example.

²⁹ Sven Arnold and Florian Schöne, "Der deutsche Kampfhubschrauber »Tiger« steht vor dem Aus", cit.

³⁰ Ibid.

5. Italy

by Giancarlo La Rocca and Alessandro Marrone¹

Italy retains one of the largest helicopter fleets in Europe and among NATO countries. Rome currently fields 436 total rotorcraft, the majority of which is deployed by the Army (235), followed by the Air Force (111) and the Navy (90). It also holds a global leadership role thanks to its national industry, driven by Leonardo.²

Table 3 | The Italian helicopter fleet in 2022

Italian Air Force	Italian Navy	Italian Army
Bell 212		
29	9	26
AW101		AW129
11	58	58
AW139/M	NH90 (NFH/TTH)	
32	53 + 3*	56 + 3*
MD500		
39		Bell 205
		51
		Bell 206
		30
		AW 169M
		2
		CH-47C/F
		22

Note: *Ordered platforms.

Source: Flight International, *2023 World Air Forces Directory*, 2022, p. 21, <https://www.flightglobal.com/download?ac=90688>.

Rome has maintained a peculiar approach with regards to the rotary wing component of the armed forces, built on a balance between high and low intensity scenarios as well as on an effective exploitation of the commonality of basic dual-use components, also utilised for civil security platforms.³ Italy plays a strong role in the most significant programmes in this sector. Leonardo co-leads together with Airbus the EDF Next Generation Rotorcraft Technologies project – with a budget

¹ Giancarlo La Rocca was a Junior Researcher in IAI's Defence and Security programmes. Alessandro Marrone is Head of IAI's Defence Programme.

² In particular the Leonardo Helicopters Division built on the former AgustaWestland subsidiary.

³ Alessandro Marrone and Michele Nones (eds), *The Role of Dual-Use Helicopters in the Security and Defence Field*, Rome, Nuova Cultura, July 2015, <https://www.iai.it/en/node/4431>.

of 40 million euro⁴ – and participates in the newly launched Permanent Structured Cooperation (PESCO) initiative on a Next Generation Medium Helicopter.⁵ Rome is also central in the NATO framework, thanks to the joint NH90 platform – largely acquired at international level albeit with mixed fortunes – and now to the Next Generation Rotorcraft Capability framework launched in 2022 together with France, Germany, Greece, the Netherlands, and the UK as leader.⁶

5.1 Political-strategic rationale

The Italian defence stakeholders recognise that to invest in next generation helicopters is necessary and in the interest of the national ecosystem at large. The recognition of a watershed in this field raises awareness on the potential impacts in military terms, but also from the point of view of dual-use applications, especially with regards to the generation of know-how. More generally, there is a strong interconnection between the actors within the national ecosystem, a vision put forward also by the 2022 Chief of Defence Strategic Concept which states that “a country’s defence potential is proportional to the level of technology and production capabilities expressed by its industrial system”.⁷

The Multi-year Planning Document (*Documento programmatico pluriennale* – DPP) of the Ministry of Defence for the triennium 2021–2023 clearly states that, being a leader in the sector, Italy should benefit from anticipated, significant innovations in this field, also through synergies at the international level.⁸ The DPP also foresees the initiation of studies to explore the matter,⁹ for instance the joint study by Leonardo and Lockheed Martin within the Next Generation Fast Helicopter (NGFH) initiative for a fifth generation helicopter based on X2TM Technology, focused on requirements, capabilities and market opportunities. Such outlook is reiterated by the 2022–2024 DPP, which defines a second round of studies for the NGFH to outline Italian interests and involvement in the transformational leap.¹⁰ The latter include a follow-up joint study by Leonardo and Lockheed Martin, envisaged for 2023.

⁴ Gareth Jennings, “Airbus, Leonardo to Co-lead EU Next Gen Rotorcraft Technologies Project”, cit.

⁵ European Defence Agency, 11 New PESCO Projects Focus on Critical Defence Capabilities and Interoperability, 23 May 2023, <https://eda.europa.eu/news-and-events/news/2023/05/23/11-new-pesco-projects-to-focus-on-critical-defence-capabilities-and-interoperability>.

⁶ NATO, *Six Allies to Explore Innovative Solutions for Their Future Helicopters*, 16 June 2022, https://www.nato.int/cps/en/natohq/news_196492.htm.

⁷ Italian Defence General Staff, *The Chief of Defence Strategic Concept 2022*, September 2022, p. 21, https://www.difesa.it/SMD_/CaSMD/Concetto_strategico_del_Capo_di_SMD/Documents/CS_22/Chief_of_Defence_Strategic_Concept_2022_.pdf.

⁸ Italian Ministry of Defence, *Documento programmatico pluriennale della difesa per il triennio 2021-2023*, 2021, p. 59, <https://www.difesa.it/Content/Documents/20210804%20DPP%202021-2023%20per%20pubblicazione.pdf>.

⁹ *Ibid.*, p. 47.

¹⁰ Italian Ministry of Defence, *Documento programmatico pluriennale della difesa per il triennio 2022-2024*, 2022, p. 62, https://www.difesa.it/Il_Ministro/Documents/DPP_2022_2024.pdf.

Overall, there is a high-level shared understanding on the strategic nature of investments in the next generation helicopters.¹¹ This understanding is based on the need to safeguard the leadership of the national industrial base and the position of the country as a whole with international partners vis-à-vis FVL technologies. The impact of the very large US investments devoted to the FVL is perceived to bring a turning point, challenging the defence industrial status quo in this sector at global level. Such perception is particularly important considering that helicopters are among the few sectors where Italy plays a leading international role.

5.2 Military rationale

In recent years, a modernisation and rationalisation effort has been launched concerning the military helicopters fleet, centred on both the new attack helicopter AW249,¹² and on the new light utility helicopter (LUH) based on the multirole AW169. The two platforms are relevant components of the vision outlined by *Esercito 4.0*, the 2022 strategic document of the Italian Army outlining the key areas of investment and development,¹³ and respond to NATO interoperability requirements. The new helicopters will respectively replace the AW129 Mangusta and as many as five legacy platforms (AB205 and 206, A109, AB212 and AB412). Notably, the AW169 LUH is also a key part of a government-to-government (G2G) agreement signed by Italy and Austria in 2022.¹⁴

The AW249 *Nuovo Elicottero da Esplorazione e Scorta* (NEES) would increase the cruise speed by approximately 30 km/h (16 knots) – from 124 to 140 knots¹⁵ – compared to older platforms introduced in the 1990s, such as the AW129 Mangusta, widely employed by the Italian Army. The new rotorcraft would also double both take-off weight and anti-tank weapon capabilities compared to the Mangusta

¹¹ The awareness related to the potentially revolutionary impact of the FVL technologies is frequently expressed in interviews with national institutions conducted by IAI. It was acknowledged already in 2020 by the former Air Force Chief Alberto Rosso (Stefano Pioppi, “La sfida del futuro è tecnologica. L’aerospazio secondo il gen. Rosso”, in *Formiche*, 11 November 2020, <https://formiche.net/?p=1342280>) as well as by the Defence Committee of the Italian Chamber of Deputies (Italian Chamber of Deputies, *Resoconto stenografico*, 10 December 2020, http://documenti.camera.it/leg18/resoconti/commissioni/stenografici/pdf/04/indag/c04_difesa/2020/12/10/leg.18.stencomm.data20201210.U1.com04.indag.c04_difesa.0010.pdf).

¹² The Italian name is *Nuovo Elicottero da Esplorazione e Scorta* (NEES), whose translation in English “New Exploration and Escort Helicopter” may be misleading since it is a truly attack helicopter.

¹³ General Staff of the Italian Army, *I 5 assi di sviluppo capacitivo per lo strumento militare terrestre*, 14 September 2022, <https://www.esercito.difesa.it/comunicazione/Pagine/Esercito-4-0-prepararsi-alle-sfide-del-futuro-220914.aspx>.

¹⁴ Leonardo, *Leonardo and the Italian Secretariat General of Defence/National Armaments Directorate Sign AW169M LUH Helicopter Acquisition Contract for Austria*, 13 January 2022, <https://www.leonardo.com/en/press-release-detail/-/detail/13-01-2022-leonardo-and-the-italian-secretariat-general-of-defence-national-armaments-directorate-sign-aw169m-luh-helicopter-acquisition-contract-for-austria>.

¹⁵ In August 2022, a AW249 prototype completed its first flight. Stefano D’Urso, “The New AW249 Attack Helicopter Flies for the First Time”, in *The Aviationist*, 23 August 2022, <https://wp.me/p2TYIs-kV4>.

and make a step forward with regards to Manned-Unmanned Teaming (MUM-T) capabilities. Overall, the NEES will possibly be introduced from 2025 onwards, will be designed for a life cycle of 30 years – similarly to the operational lifetime of its predecessor – and will yield an architecture which could guarantee upgrades and maintenance opportunities. Its development will benefit from Leonardo's work on recent rotary wings platforms such as AW139 and AW169. This timing matches well with the urgent need of the Army to replace the Mangusta, since the latter has been introduced to the service, for instance, prior to the Tiger.

The Air Force is in a different position, given that it opted for the HH-139 as an interim solution in view of future developments and thus received the first platforms in 2012. Besides aging rotorcrafts to be replaced by the new models, the overall fleet of the Army, the Navy and the Air Force encompasses 22 CH-47 (C and F), 105 NH90 and 25 AW(HH)101.

To improve the future operational use of military helicopters, a new *Scuola Elicotteri Interforze* (Joint Helicopter Academy) will be constituted at the Viterbo Army Aviation base, which will see an important role for Air Force instructors and is expected to be operational by 2025.

Against this backdrop, the Russian invasion of Ukraine is widely perceived as a wake-up call and a primary source of lessons from such a crucial operational theatre.¹⁶ From a military perspective, there is a widely shared position centred on some lessons identified, highlighting that helicopters employed in Ukraine suffered major losses because of their low speed, low manoeuvrability low battlefield situational awareness, and high vulnerability to surface-to-air missiles and MANPADS, coupled with failures in training and tactics.¹⁷ More broadly, the 2022 invasion of Ukraine caused a relative shift towards the needs of peer-to-peer conflict scenarios. From an Italian perspective, the evolving threat assessment and international security environment, the long-anticipated US pivot to Asia, together with the disruptive effects of new technologies have a direct or indirect impact on future helicopters. In addition, the ongoing war underlines the need for cooperation at the operational level, given the importance of interoperability, the distributed location of bases and logistics as well as supply chains.

In this context, as also reported by the *Esercito 4.0* document, the key aspects of the future operating environment draw maximum attention towards speed, manoeuvrability and extended range in a low altitude regime, pointing to the overall strategic nature of next generation military helicopters rather than to incremental

¹⁶ Interviews conducted by IAI, October and November 2022.

¹⁷ Tom Kington, "Italy Air Force Chief Wants in on US Next-Gen Helicopter Tech – Pronto", in *DefenseNews*, 7 October 2022, <https://www.defensenews.com/global/europe/2022/10/07/italy-air-force-chief-wants-in-on-us-next-gen-helicopter-tech-pronto>. On the lessons from Russia-Ukraine war see also Chapter 1 of this study.

upgrades.¹⁸ Interestingly, some stakeholders also underlined the importance of the next generation helicopters in reducing the workload and overall burden carried by pilots and operators, as well as in maintaining key capacities in contested environments where reliance on crucial communication is at risk. Moreover, improvements concerning onboard active and passive protection systems should not be neglected.

In military terms, the specific role and nature of the NEES compared to next generation helicopters should not be configured as an overlap.¹⁹ Likewise, in the US the selected FVL technology will coexist with upgrades to the Apache AH-64E and with the Black Hawk UH-60. Essentially, there could be different platforms for specific missions, also based on cost-effectiveness and specific conditions inherent in each operation or faced threat. This will imply the exploitation of older generation machines, while at the same time already having laid the groundwork for the long-term technological leap.

5.3 Technological and industrial rationale

A participation to early developments of next generation rotorcraft clearly requires large efforts in terms of investments. Thus, both the Italian political and military rationales have to necessarily resonate with the technological and industrial context and vice versa.

In general, to trust the eventual dominance of the forthcoming leap in military helicopters would also mean to bank on future returns on investments. Moreover, the R&D necessary for this leap is expected by many national interlocutors to bring know-how spill-overs relevant in other fields and in the civilian sector, a traditionally important trait for the Italian context.²⁰ Additionally, space and cyber represent novel domains to which next generation helicopters should be connected by design: the new platforms have to be born digital. In particular, the ability to team with UAVs and to control them from the cockpit would maximise the impact of the command and control of the aerial dimension in several scenarios. Finally, from a technological standpoint, the leap towards open architecture platforms with modular systems, advanced maintenance and upgrade possibilities unleashes a promising long-term future to today's leap for helicopters.

¹⁸ General Staff of the Italian Army, *I 5 assi di sviluppo capacitivo per lo strumento militare terrestre*, cit.

¹⁹ Tom Kington, "Italy Air Force Chief Wants in on US Next-Gen Helicopter Tech – Pronto", cit.

²⁰ Interviews conducted by IAI, October and November 2022.

6. United Kingdom

by Justin Bronk¹

6.1 The strategic and military rationale

Alongside France, the United Kingdom has traditionally been one of the most expeditionary military powers in Europe, with a strategic focus on defeating potential threats to national security at reach, before they can become a direct threat to the homeland. This focus on deployed operations overseas continued to be evident in the 2021 Integrated Review of Defence and Security, which specified that whilst the Euro-Atlantic area remained the most critical theatre, the Armed Forces would also increase their global presence.² As a result of this strategic outlook, the UK Armed Forces have traditionally relied heavily on helicopters to provide military units with rapid mobility, logistics support and medical evacuation (MEDEVAC) capabilities when deployed overseas.

The UK's current rotary mobility fleets were largely shaped by the demands of Afghanistan and Iraq, which put a premium on high reliability, fleet capacity and adequate performance in hot and high conditions. In addition to the mobility fleets, the AH-64 Apache is the mainstay of the British Army's mobile anti-tank capability, with 50 of the latest AH-64E standard having been ordered to replace the older AH-64D fleet.³ With the return of Russia as a dominant force planning consideration since 2015, the British Army has decided to move away from the model where Joint Helicopter Command assets were attached as supporting assets to ground formations in small numbers according to local needs. Instead, the British Army's AH-64E and the AH-1 Wildcat fleets have been reorganised under a new formation called 1 Aviation Brigade, with the intention of being deployed as a single manoeuvre unit for large scale battlefield effects rather than being spread out across the force in small supporting detachments. The logic is that the modern battlefield against near-peer or peer countries such as Russia or Iran will be sufficiently lethal for helicopters that their use will need to be carefully planned, risk managed and supported by aviation specialists at a Brigade level to be survivable.⁴ The recent purchase of the AH-64E fleet also means that alongside

¹ Justin Bronk is the Senior Research Fellow for Airpower and Technology in the Military Sciences team at the Royal United Services Institute (RUSI).

² UK Government, *Global Britain in a Competitive Age. The Integrated Review of Security, Defence, Development and Foreign Policy*, March 2021, p. 71-72, <https://www.gov.uk/government/publications/global-britain-in-a-competitive-age-the-integrated-review-of-security-defence-development-and-foreign-policy>.

³ Gareth Jennings, "British Army Showcases New AH-64E Apache", in *Janes Defence News*, 21 January 2022, <https://www.janes.com/defence-news/news-detail/british-army-showcases-new-ah-64e-apache>.

⁴ Jack Watling and Justin Bronk, "Maximising the Utility of the British Army's Combat Aviation", in *RUSI Occasional Papers*, April 2021, https://static.rusi.org/236_op_uk_aviation_capabilities_final_web_version.pdf.

the relatively new AH-1 Wildcat, both the attack and reconnaissance rotary fleets have been successfully modernised in recent years.

On the Royal Air Force (RAF) and Royal Navy helicopter picture things have been somewhat more complicated, with consolidation of fleets taking place alongside modernisation efforts. The RAF's Merlin HC3 medium lift fleet was transferred to the Commando Force and upgraded to HC4 standard between 2014 and 2016, to join the Royal Navy's own maritime Merlin HMA2 fleet.⁵ This left the Royal Navy as the sole UK operator of the Merlin and enabled the Commando Force to retire their long-serving Sea King HC4 helicopters in 2016.⁶ The replacement of the Sea King with the Merlin for both the Royal Navy and Commando Force, therefore, meant a contraction in overall helicopter numbers due to the RAF giving up its Merlin HC3s.

Similarly, the RAF's Chinook heavy lift helicopter fleet is currently being modernised, which involves 23 of the oldest Mk4/6a models being retired and 14 new build 'Extended Range' models that are broadly analogous to the US MH-47G Block 2 standard purchased by 2030.⁷ The result will be a significantly enhanced heavy lift fleet from a capability point of view, but a decrease in airframe numbers from the current 60 to 51. The RAF's 23 remaining medium lift Puma HC2 fleet have also been scheduled for early retirement in 2025 as part of the Defence Command Paper that accompanied the 2021 Integrated Review.⁸ The plan is to procure up to 44 new medium helicopters in the mid-late 2020s to replace not only the Puma fleet, but also the Army Air Corps' Gazelle and Bell 212 light helicopters, as well as the RAF Griffin HAR.2s in Cyprus.⁹ Once again, the likely result will be an increase in platform capability, but a contraction in overall helicopter numbers.

There is a notable thread of continuity throughout these modernisation plans for UK military helicopter capabilities. The replacement of Lynx with Wildcat and of Sea King with Merlin, modernisation of the Chinook and Apache fleets and the new medium helicopter programme are all examples of incremental improvement rather than the pursuit of transformative innovation. There has so far been little serious UK military interest shown in tilt-rotor or other novel configurations for next-generation rotorcraft.

⁵ "Last Merlin Helicopter Leaves RAF Benson", in *BBC News*, 16 June 2016, <https://www.bbc.co.uk/news/uk-england-oxfordshire-36552982>.

⁶ "Sea King Mk4 Bids Farewell to the Royal Navy with Flypast", in *BBC News*, 21 March 2016, <https://www.bbc.co.uk/news/uk-england-somerset-35855631>.

⁷ Gareth Jennings, "Retirement of 'Bravo November' Heralds Transfer of Older UK Chinooks", in *Janes Defence News*, 22 March 2022, <https://www.janes.com/defence-news/news-detail/retirement-of-bravo-november-heralds-transfer-of-older-uk-chinooks>.

⁸ UK Ministry of Defence, *Defence in a Competitive Age*, March 2021, p. 54, <https://www.gov.uk/government/publications/defence-in-a-competitive-age>.

⁹ George Allison, "UK Begins £1bn Project for New Medium Helicopters", in *UK Defence Journal*, 19 May 2022, <https://ukdefencejournal.org.uk/?p=40306>.

There is a solid military rationale behind this approach, which is that none of the UK's core requirements for future military helicopters require a transformative shift in platform capabilities. The US Military, which is gearing up for a major Chinese challenge in the Indo-Pacific and has a truly global footprint, has invested heavily over several decades in the V-22 Osprey family of tilt-rotor aircraft, and has selected the Bell V-280 Valor as its Future Long-Range Assault Aircraft, due to the significant increases in range and cruise speed that it can offer compared to traditional helicopters. The US Army's Future Vertical Lift (FVL) programme as a whole is prompting manufacturers to explore a range of novel configurations that promise to significantly increase the range and cruise speed, driven primarily by the likely demands of the Indo-Pacific theatre.¹⁰ This is because for various US Army, US Navy and US Air Force mission sets, range and transit speeds were identified as critical performance bottlenecks, meriting significant investment in novel designs to operate alongside extensive traditional helicopter fleets.

For the UK, however, this is not necessarily an attractive model to follow since multi-rotor pusher or tilt-rotor designs generally involve significantly increased mechanical complexity, higher unit cost and reduced payload capacity within each weight class compared to more traditional helicopters. This is especially true for tilt-rotor designs due to the fact that the wing that allows for efficient cruise in forward flight is dead weight in the hover. Furthermore, the complex gearbox, tilt-mechanisms and transmission arrangements to enable one engine to power both rotors in an emergency add further weight and mechanical complexity. This means that the cost of much greater speed and range is significantly reduced payload in terms of cargo, personnel, weapons and/or armour protection for a given weight class of tilt-rotor or hybrid design compared to a traditional helicopter. Britain's primary security interests are in the Euro-Atlantic area and the Middle East, and the MoD is already having to accept significant reductions in the total size of its helicopter fleets in exchange for modernisation. In this context, the trade-offs for tilt-rotors and other hybrid rotary configurations have not proven sufficiently attractive to warrant serious consideration so far. The range and cruise speed of existing designs is generally considered adequate, and instead improvements to fuel efficiency, reliability, payload, avionics and communications equipment have been prioritised.

On the other hand, US experiments with manned-unmanned teaming and future air-launched effects in the rotary space are of significant interest to the UK, and are the primary driving force behind a US–UK agreement on information sharing on Future Vertical Lift.¹¹ The potential gains in survivability and organic situational awareness being sought by the US as part of FVL in the air-launched effects space are something that the UK is also hoping to leverage with conventional helicopters, especially in light of lessons from the war in Ukraine.

¹⁰ John R. Hoehn, "Army Future Vertical Lift (FVL) Program", cit.

¹¹ Andrew White, "New US, UK Agreement on Helicopters Gives Brits Unique FVL Access", in *Breaking Defense*, 17 February 2022, <https://breakingdefense.com/?p=205612>.

6.2 A British perspective on the war in Ukraine and military helicopters

As a result of the links established between the British Armed Forces and the Armed Forces of Ukraine under Operation ORBITAL since 2014, the consistent flow of weapons and other aid, and the training programme established for Ukrainian troops in the UK, the lessons learned from both Russian and Ukrainian rotary operations during the war in 2022 have been rapidly passed on to the UK.¹² These are likely to inform UK rotary force planning and tactics in the coming years.

An early example was the disastrous Russian helicopter assault on Hostomel Airport near Kyiv on the 24 February 2022. Elite Russian Airborne Forces (*Vozdushno-desantnye voyska* – VDV) units were successfully inserted onto the airport in a daring low-altitude helicopter insertion enabled by the effective suppression of Ukrainian surface-to-air missile (SAM) systems in the area north of Kyiv by Russian electronic warfare.¹³ However, Russian ground forces were unable to rapidly link up with the VDV forces, and Ukrainian rapid reaction forces moved quickly to isolate and then overwhelm the lightly equipped VDV troops.¹⁴ Russian attempts to conduct a second wave resulted in significant helicopter losses to MANPADS and Javelin anti-tank missiles.¹⁵ Ultimately the battle for the suburb of Hostomel would last for forty days and end with a Ukrainian victory. The initial helicopter assault not only failed to secure the airport for reinforcements to be flown in, but the operation as a whole resulted in significant helicopter losses and the virtual annihilation of the VDV units involved.

Ukraine has itself conducted helicopter infiltration deep into enemy held territory during the war, with the most notable example being seven Mi-8 resupply and casualty evacuation flights into the besieged city of Mariupol.¹⁶ All the flights had to be performed at exceptionally low altitudes of 30 feet or below, at night or in bad weather, to avoid being shot down by Russian SAMs and fighter patrols.¹⁷ In spite of these extremely low flying tactics, at least two of the flights were shot down while attempting to extract from Mariupol for the return trip, and a third

¹² UK Government, *UK to Offer Major Training Programme for Ukrainian Forces as Prime Minister Hails Their Victorious Determination*, 17 June 2022, <https://www.gov.uk/government/news/uk-to-offer-major-training-programme-for-ukrainian-forces-as-prime-minister-hails-their-victorious-determination>.

¹³ RUSI researcher discussions with Ukrainian military intelligence and general staff officers in Kyiv, April 2022.

¹⁴ Sebastien Roblin, "Pictures: In Battle for Hostomel, Ukraine Drove Back Russia's Attack Helicopters and Elite Paratroopers", in *19FortyFive*, 25 February 2022, <https://www.19fortyfive.com/?p=39777>.

¹⁵ RUSI researcher discussions with Ukrainian military intelligence and general staff officers in Kyiv, April 2022.

¹⁶ Howard Altman, "Inside Ukraine's Daring Helicopter Missions into Russian-Occupied Mariupol", in *The War Zone*, 25 May 2022, <https://www.thedrive.com/the-war-zone/exclusive-details-of-ukraines-daring-helicopter-missions-into-russian-occupied-mariupol>.

¹⁷ Valius Venckunas, "Ukrainian Pilot Details Daring Mi-8 Rescue Flight to Russian-occupied Mariupol", in *AeroTime*, 7 June 2022, <https://www.aerotime.aero/?p=46209>.

helicopter was lost when attempting to offer support to one of these.¹⁸ Ultimately the flights were abandoned as the loss rate was considered unacceptable due to the critical need to preserve Ukraine's limited number of support helicopters for other missions, despite the desperate need of the Mariupol defenders for more supplies and reinforcements.

Overall, both Ukrainian and Russian forces seem to have concluded that penetrating the frontlines with helicopters against state adversaries is a very high-risk tactic that is only viable in very specific circumstances, and with a great deal of shaping activity such as electronic warfare and mapping enemy air defence laydowns. In some cases, it is possible to penetrate enemy lines successfully, but the risk increases on the return flight once defences have been alerted, and even successful routes cannot be repeated. Defensive aid suites including modern missile-approach warning systems and flares have proven fairly effective on both sides in reducing losses to MANPADS, but only a finite number can be carried, and once they have been used then helicopters are highly exposed even if they fly low and fast.¹⁹ This is a significant limitation if penetrations of enemy lines occur for more than a minute or two in a given sortie. Furthermore, if exposed to radar-guided SAMs, imaging seeker missiles such as Javelin, or Semi-Active Command Line-of-Sight (SACLOS) weapons like the British Starstreak then helicopter losses have been consistently heavy.²⁰ Consequently, most helicopter sorties on both sides in Ukraine have remained behind the first line of enemy troops, conducting support tasks including moving critical specialists and supplies rapidly around the more than 1,000 km of frontlines, and conducting stand-off suppression strikes with unguided rocket pods.

For the UK, the early lessons from Ukraine suggest that in future of rotary operations in high-intensity conflict scenarios in the Euro-Atlantic area are likely to be dominated by support operations behind the frontlines rather than massed air assaults or hunter killer operations behind enemy lines. Providing operational and tactical lift, as well as ISR support, are likely to remain the most critical mission sets for helicopters in the UK armed forces, whether that is at sea or over land, and the distances involved in Europe and the Middle East do not require revolutionary increases to speed or range so much as they require the greatest possible payload, cost-effectiveness and reliability from each class. Thus, future UK helicopter procurement is likely to continue to prioritise increases in efficiency via new conventional designs that exploit modern manufacturing techniques, efficient engines and state-of-the-art avionics to deliver incremental improvements in

¹⁸ Howard Altman, "Inside Ukraine's Daring Helicopter Missions into Russian-Occupied Mariupol", cit.

¹⁹ For example, see a Russian Mi-8 shot down by MANPADS after expending all 192 flares carried: "Ukraine Shoots Down a Low-Flying Russian Mi-8 Attack Helicopter Using a Surface-to-Air Missile", in *YouTube*, 23 April 2022, <https://youtu.be/kfxnABnihho>.

²⁰ RUSI researcher discussions with Ukrainian military intelligence and air defence officers in Kyiv, April, June and July 2022. See also Stijn Mitzer et al., "List of Aircraft Losses during the 2022 Russian Invasion of Ukraine", cit.

capability and cost-effectiveness.

6.3 The industrial outlook for rotary technologies

Given the emphasis on multirole efficiency gains, national industrial benefits and consolidation around fewer types of distinct helicopter in the UK approach to the new medium helicopter requirement, it is perhaps unsurprising that all the proposals from industry so far have been adaptations of existing helicopters such as the AW149 and S-70 Blackhawk rather than novel designs.²¹ It is somewhat unclear where this leaves the UK lead within the NATO Next-Generation Rotorcraft programme that was announced in early 2021.²² There is little chance of the British Army or Ministry of Defence more widely having the money or the requirement to purchase a common European helicopter type beyond the New Medium Helicopter and the Chinook Extended Range and AH-64E Apache Guardian that are already on order. In fact, the Integrated Review committed to extending the service life of the Merlin HM2 and HC4 fleets to 2040 rather than their previously intended out-of-service dates of 2029 and 2030.²³ Therefore, if the UK is indeed still leading on the NATO NGRC project, then it is setting a lead for industry that looks very much like incremental improvement of existing medium helicopter types, rather than technological revolution.

On the other hand, the UK decision to make an agreement with the US to share research on the Future Vertical Lift programme points to an intent to bring innovative air-launched effects, manned-unmanned teaming options and new-generation defensive aids suites across to these more traditional helicopter platforms. The goal for industry, therefore, is to find a way of making the most of novel technologies like these, coupled with more generous onshore industrial manufacturing provisions, to make new versions of traditional helicopters as competitive as possible for those countries which, like the UK, don't want to pay the cost, payload and operating footprint burden of following the US down the tilt-rotor/multi rotor development route.

²¹ George Allison, "Britain's 'New Medium Helicopter' Project Continuing", in *UK Defence Journal*, 17 January 2023, <https://ukdefencejournal.org.uk/?p=43054>.

²² UK Army, *British Army Leads the Way for NATO's Next Generation Rotorcraft*, 23 February 2021, <https://www.army.mod.uk/news-and-events/news/2021/02/nato-rotorcraft-development>. See also Chapter 7 of this study.

²³ Dominic Perry, "UK Extends Merlin Operations until 2040", in *FlightGlobal*, 11 June 2021, <https://www.flightglobal.com/144123.article>.

7. NATO and EU initiatives

by Michelangelo Freyrie¹

Both NATO and the European Union have sought to boost efforts for the development of next generation helicopters. To better understand the objectives pursued by the two organisations, it is important to highlight what kind of operational requirements and doctrines are at play when defining R&D agendas and multinational coordination in Brussels.

7.1 NATO and rotary wings aircraft

7.1.1 NATO doctrine

Until 2022, NATO reasoning on the battlefield use of rotary wings (RW) aircraft largely derived from the experience earned by member states both in the Gulf Wars as well as in counter-insurgency operations in Iraq and Afghanistan. Russia's invasion of Ukraine constitutes a watershed in this regard and will likely provide a number of lessons to be learned. Additionally, the Alliance's 2022 Strategic Concept and its focus on collective defence and deterrence, and to a lesser extent its portrayal of China in line with the US pivot to Asia, is also expected to influence allied military posture concerning rotary wings platforms.

Despite air units of the Alliance being deeply engaged in the framework of the Allied Air Command in Ramstein, the main coordination and planning hub for this operational domain, helicopter operations are not as strictly harmonised the way fixed wings assets are. RW vehicles are often distributed across different branches of the armed forces, with a preminent role played by army aviation, which currently lacks a specific form of NATO oversight.² As a rule of thumb helicopters are usually considered organic to specific land units.³

This decentralisation means that allied operational doctrines, tactics and standards are looser for rotary wings aircraft when compared to other NATO assets, weakening the implementation of Standardization Agreements (STANAGs). A partial exception to this is rotary wings aircraft employed by special operation forces (SOFs). In this realm, deployment tactics are somewhat harmonised by NATO SOF Headquarters due to the sheer complexity of such missions, which "are inherently joint and will usually require support, close coordination, and shared interoperability among other SOF and the conventional components of a joint force".⁴ This has also been

¹ Michelangelo Freyrie is Junior Researcher in the Security and Defence programmes at IAI.

² Interview, 16 November 2022.

³ Joint Air Power Competence Centre (JAPCC), *Enhancing NATO's Operational Helicopter Capabilities. The Need for International Standardisation*, Kalkar, JAPCC, August 2012, <https://www.japcc.org/?p=1805>.

⁴ Maurizio Modesto, *Future Battlefield Rotorcraft Capability. Anno 2035 and Beyond*, Kalkar, JAPCC,

amplified by exchanges of best practices and SOF joint trainings.⁵

Even still, it is possible to identify some minimum standards within the Alliance's rotary wings operational practice, which may be informing the requirements currently at the base of NATO's Next Generation Rotorcraft Capability (NGCR) project. The 2019 Allied Tactical Publication on Close Air Support (ATP-3.3.2.1) identifies altitudes between 500 and 3,000 feet as a "danger zone" for helicopters because of the overlapping threats it attracts, including other longer-range weapons.⁶ While ATP-3.3.2.1 lists multiple tactics that can be employed by supporting helicopters, most emphasise the need for high manoeuvrability and speed. Similar indications are given by ATP-49(C)⁷ on the use of RW assets in land operations. Air assault is often the only available entry point for troops employed in military operations other than war (MOOTW), be it for logistical, political or geographical reasons. As such, it is important that the employed RW aircraft has enough lift capability and range to be essentially self-deployable in an operational theatre, while still retaining enough agility underpinning the principles of an air assault: velocity, precision and the ability to reach a target from unexpected directions.

7.1.2 NATO Next Generation Rotorcraft Capability (NGRC)

NATO's Next Generation Rotorcraft Capability is born out of the necessities of an aging allied RW fleet, as well as a changing strategic environment for the Alliance. The project mainly aims to substitute both NH Industries' NH90 Medium utility helicopter, who took its first flight in 1995, and AgustaWestland's AW101, which entered service in 1987. Despite the effectiveness of these models, military and industrial planners have long pointed out that upgrades to current generation vehicles have become exceedingly expensive, also due to their close systems architecture, and that newly developed designs could harness the potential of new technologies, such as manned-unmanned teaming (MUM-T).⁸

November 2018, p. 15, <https://www.japcc.org/?p=1722>.

⁵ Interview, 9 November 2022.

⁶ NATO, *Tactics, Techniques and Procedures for Close Air Support and Air Interdiction* (ATP-63/AJP-3.3.2.1), April 2019.

⁷ More recent updates to this ATP are still classified.

⁸ See, for example, Etienne de Durand, Benoît Michel and Élie Tenenbaum, "Helicopter Warfare", cit.

Table 4 | Comparison between NGRC specifications and exiting models

Indicators	NH90 ⁹	AW101 ¹⁰	NGRC ¹¹
Max. range (w/o refuelling)	982 km	1,500 km ¹²	1,650 km
Max. endurance	5 hours	6 hours 50 minutes	5 hours ¹³
Max. cruise speed	~ 162 knots	150 knots	220 knots
Max. gross weight	11,000 kg	15,600 kg	10,000-17,000 kg
Cost-per-flight-hour (euro) ¹⁴	15,000-19,500 ¹⁵	14,000-16,000 ¹⁶	5,000-10,000

As such, it is not at all surprising that this key capability area has led to the development of a NATO High Visibility Project such as NGRC. With most medium multi-role RW systems reaching the end of their life cycles in between 2030 and 2040, NGRC should be suitable “for a wide range of missions, including tactical operations such as: insertion and extraction of Special Operation Forces [...]; transport of small and medium sized cargo and troops into, out of, and within operational theaters”.

These necessities are largely shared by most NATO member states, particularly the Europeans. The Memorandum of Understanding (MoU) foresees seven participating states (Canada, France, Germany, Greece, Italy, The Netherlands and with the United Kingdom as leader) allocating 26.7 million euro to the project’s concept phase, which will hash out the military requirements for a new medium-multi role helicopter. If the project continues, the objective will be to eventually deploy the new model from the mid-2030s onwards.¹⁷ Despite having showed some interest in the initiative and having signed the Letters of Intent in 2020, Spain and the US have ultimately joined the project only as observers.¹⁸

Discussions seem to have crystallised on some key interim features expected to be found in the NGRC. These are mostly in line with the existing (loose) NATO operational standards. NGRC will be required to fly for 1,650 km without refuelling

⁹ Airbus website: *NH90 Technical Information*, <https://www.airbus.com/en/products-services/helicopters/military-helicopters/nh90/nh90-technical-information>.

¹⁰ AW 101 is a tree engine helicopter. Leonardo website: *AW101*, <https://helicopters.leonardo.com/en/products/aw101>.

¹¹ Inder Sing Bisht, “NATO Allies Launch Next-Gen Rotorcraft Concept Phase”, in *The Defense Post*, 17 June 2022, <https://www.thedefensepost.com/2022/06/17/nato-next-gen-rotorcraft>.

¹² Twin engine cruise.

¹³ 8 hours with range tanks.

¹⁴ Approximate value might vary due to model and fuel cost.

¹⁵ “Of Helicopters and High Costs”, in *Corporal Frisk*, 3 March 2018, <https://wp.me/p4gvDN-2qo>.

¹⁶ Interview, 28 June 2023.

¹⁷ Harry Lye, “Eurosatory 2022: NATO Allies Sign up for Next Generation Rotorcraft Capability Concept Phase”, in *Shepard News*, 20 June 2022, <https://www.shephardmedia.com/news/defence-helicopter/nato-allies-sign-up-for-next-generation-rotorcraft-capability-concept-phase>.

¹⁸ Christina Mackenzie, “Six NATO Nations Team up to Launch Helicopter Program Eyed by Euro, US Industry”, in *Breaking Defense*, 16 June 2022, <https://breakingdefense.com/?p=229370>.

(using range tanks) and to have a lifting capacity of 4,000 kg.¹⁹ It is also expected to have an endurance of up to 8 hours and to reach cruise speeds of 220 knots (407 km/h). Fly-away costs need to stay below 35 million euro, while the cost-per-flight-hour should range between 5,000 and 10,000 euro.²⁰ Finally, like for other High Visibility Projects, NGRC should be based on an Open System Architecture in order to ensure modularity and interoperability with other assets. This will be ensured by the NATO Support and Procurement Agency, which has been put at the helm of the concept phase.²¹

The industrial implications of this project are not trivial, especially because of the interplay between this initiative and the US FVL programmes. Airbus and Leonardo, which together make up almost 70 per cent of the global market share in the field of helicopters,²² are cast to be two major players in the possible development of NGRC.²³

Notably, Airbus has long advocated for a European-built solution calibrated on “European needs”,²⁴ with the aim of safeguarding industrial sovereignty. It remains to be seen how this ambition will be fulfilled within NGRC, also given Airbus’ objections with current key requirements. On the whole, it seems to be that participation in NGRC has been mostly driven by the imperative for participating states to keep track of relevant technologies and industrial capabilities, rather than an urgent operational need expressed by the respective armed forces.²⁵

7.2 European Union projects

The European Union has also launched R&D initiatives pertaining a new generation of rotorcrafts, with requirements not unlike those of NGRC. This is not surprising considering the large (and increasing) overlap between NATO and EU membership, including that of the European Defence Agency (EDA). EDA participating member states possess close to 20 per cent of the global stock of multi-role helicopters, and 53 per cent of their current fleet has been produced in the 1960s and 1970s.²⁶

¹⁹ Dawn Zoldi, “NATO Gives Industry Aim Points for Next-Gen Rotorcraft”, in *Vertical*, 13 May 2021, <https://verticalmag.com/?p=364623>.

²⁰ Inder Singh Bisht, “NATO Allies Launch Next-Gen Rotorcraft Concept Phase”, cit.

²¹ NATO Support and Procurement Agency, *NSPA to Manage the Concept Stage of the Next Generation Rotorcraft Capability*, 16 June 2022, <https://www.nspa.nato.int/news/2022/nspa-to-manage-the-concept-stage-of-the-next-generation-rotorcraft-capability>.

²² Statista, *Market Share of the Leading Helicopter Manufacturers Worldwide in 2020*, January 2021, <https://www.statista.com/statistics/1117531>.

²³ Gareth Jennings, “Airbus Touts European Alignment on NATO Next Generation Rotorcraft Capability”, in *Janes Defence News*, 22 January 2021, <https://www.janes.com/defence-news/news-detail/airbus-touts-european-alignment-on-nato-next-generation-rotorcraft-capability>.

²⁴ Ibid.

²⁵ Interviews, 13 January 2023 and 21 November 2022.

²⁶ Marta Kepe, Richard Flint and Julia Muravska, *Future Collaboration Opportunities for Light and Medium Multirole Helicopters in Europe*, Santa Monica, RAND, 2019, https://www.rand.org/pubs/research_reports/RR3034.html.

Moreover, the well-known issue of European stockpile fragmentation also concerns RW aircraft, with EDA participating member states fielding 30 different helicopter models.²⁷

Despite this, efforts to develop common rotorcraft designs has not always been successful. In this regard, the difficulties encountered in the development of the Franco-Spanish-German Tiger Mk III combat helicopter is telling.²⁸ In the end, Berlin has decided to drop the project and opt for available off-the-shelf solutions, while Madrid and Paris have decided to go ahead²⁹ within the PESCO framework and with the support of the Organisation for Joint Armament Cooperation (OCCAR).³⁰

7.2.1 European Union Next Generation Rotorcraft Technologies (NGRT)

At the same time, more innovative technologies for the post-2035 period³¹ will be pursued within the European Union Next Generation Rotorcraft Technologies (NGRT) project, financed by the 2021 European Defence Fund Work Programme. Unlike NGRC, which has been described as “scenario-driven”, NGRT is more akin to a survey of available next-generation rotorcraft technologies.³²

Table 5 | Comparison between NGRC and NGRT

	NATO NGRC	EU NGRT
Budget	26.7 million euro	40 million euro
Participating countries	France, Germany, Greece, Italy, Netherlands, UK*	Finland, France*, Germany, Greece, Italy, Spain, Netherlands
Launch date	November 2020 (LoIs signed)	December 2021 (EDF 2021 decision)
Timeframe	2035-40+	2035-40+

Note: * Leading nation.

As in its NATO counterpart, NGRT sees a major participation from Airbus and Leonardo, which were awarded a 40-million-euro contribution as co-leaders. Other notable members of the consortium led by Airbus Helicopters and Leonardo include the Italian Elettronica Spa, Indra Sistemas (Spain), MBDA France and both

²⁷ Ibid.

²⁸ See Chapters 3 and 4 of this study.

²⁹ Airbus, *France and Spain Launch Tiger MkIII Programme*, 2 March 2022, <https://www.airbus.com/en/newsroom/press-releases/2022-03-france-and-spain-launch-tiger-mkiii-programme>.

³⁰ Permanent Structured Cooperation (PESCO) website: *Tiger MkIII*, <https://www.pesco.europa.eu/project/european-attack-helicopters-tiger-mark-iii>.

³¹ Gareth Jennings, “Airbus, Leonardo to Co-lead EU Next Gen Rotorcraft Technologies Project”, cit.

³² Interview, 13 January 2023.

the French and German subsidiaries of Hensoldt. The group prevailed over a competing project by the Lithuanians from PB Group, German company Cortesa and the Spanish subsidiary of Safran, whose proposal was for a small and more agile concept.³³

The main objective of NGRT is the development of a roadmap for military rotorcraft technology and the identification of key future rotorcraft features and capabilities. Crucially, the project will not necessarily result in the launch of a next generation RW aircraft.³⁴ Unlike NGRC, no specific requirements in terms of range or velocity have been publicly made available *ex ante*, preferring a more open-ended approach to pursue technologies and modes of operation relevant for a future RW system. This is due to the fact that NGRT also aims at establishing the future operational environment and operational concept of RW systems, which will need to be informed by a set of general guidelines such as “operability and operational flexibility; affordability both in procurement and life cycle cost; survivability, up to potential peer nations high intensity conflict; sustainability and operational readiness; interoperability for joint and combined operations and collaborative combat; resilience, with reduced dependency on critical installation and materials”.³⁵ When it comes to interactions with NATO’s NGRC, French representatives have been especially adamant about avoiding what they have dubbed a “H-35”, meaning having multiple European users opting for a US-centric solution as the same way they did with the F-35.³⁶

7.2.2 Other EU projects

NGRT is not the only RW-related advanced research currently being pursued by EU Member States. There are currently three projects that are immediately relevant for RW systems: Rotorcraft Docking Station for Drones,³⁷ Development of a generic European Manned unManned Teaming system (MUSHER)³⁸ and Future European Self Protection System for Fixed Wing and Rotary Wing airborne platforms (CARMENTA).³⁹ Noticeably, Italy and France are the only participating member states present in all these initiatives, one of which – Rotorcraft Docking Station for Drones – is an exclusively Franco-Italian cooperation.

³³ Nathan Gain, “WDS 22 : Jetcopter, ce projet d’ADAV européen venu de Lituanie”, in *FOB - Forces Operations Blog*, 10 March 2022, <https://www.forcesoperations.com/?p=24607>.

³⁴ Interview, 13 January 2023.

³⁵ European Commission Funding & Tenders Portal: *Next Generation Rotorcraft Technologies*, <https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/opportunities/topic-details/edf-2021-air-r-ngrt>.

³⁶ Ibid.

³⁷ Matthias Monroy, “Unmanned Supersaturation Attacks”, in *Security Architectures in the EU (Blog)*, 5 October 2021, <https://digit.site36.net/?p=3780>.

³⁸ European Commission, *MUSHER Factsheet*, 30 June 2021, https://defence-industry-space.ec.europa.eu/musher_en.

³⁹ European Commission, *CARMENTA Factsheet*, 30 June 2021, https://defence-industry-space.ec.europa.eu/carmenta_en.

Two of these projects have been funded through the European Defence Industrial Development Programme (EDIDP), one of the precursors of EDF. The largest of the two is MUSHER, whose objective is to improve human-machine interfaces and to guarantee interoperability between rotorcraft and UAVs. Total costs are just shy of 14 million euro, with participating entities (among which Leonardo, Airbus and Indra coordinated by Thales) hailing from Belgium, France, Italy and Spain. The other relevant European Defence Industrial Development Programme (EDIDP) project, CARMENTA, is coordinated by Italy's Elettronica and again sees the participation of Airbus, Indra, Leonardo and Thales (together with MBDA France, Hensoldt Sensors and others). This initiative aims at the design of a self-protection system (SPS) to defend both legacy and next generation platforms from enemy anti-aircraft systems.

Finally, a new programme has been launched within the PESCO framework in order to harmonise the operational requirements of EU countries and ensure the effectiveness of legacy RW capabilities until 2040. The so-called Next Generation Medium Helicopter (NGMH) will see the participation of France, Italy Finland and Sweden and is designed to also facilitate the preparation of NGRT.⁴⁰

⁴⁰ European Defence Agency, *11 New PESCO Projects Focus on Critical Defence Capabilities and Interoperability*, cit.

8. Conclusions

by Alessandro Marrone and Michele Nones¹

8.1 Operational and technological factors for a qualitative leap

The last qualitative leap in helicopters technology occurred during and right after the Vietnam war. Not surprisingly, this process of technological innovation was led by the United States, the major power directly involved in that conflict. Afterwards and for almost five decades, the key characteristics of rotorcraft in use by Western armed forces remained mostly the same in terms of speed, range and endurance, with gradual, significant improvements but no technological breakthroughs. Most of this technological evolution has focussed on advanced digital avionics maximising situational awareness and human-machine interface, mission system integration – including weapons – and integration of aircraft survivability equipment.

Against this backdrop, the 2022 Russian invasion of Ukraine represents a game-changer for the Europeans, presents multi-faced security implications for the Euro-Atlantic area and is a source of lessons to be learned by NATO allies when it comes to helicopters and war.² Even if the conflict is still ongoing and information on it is far from complete and accurate, it is sensible to state that penetrating the enemy's frontlines with helicopters turned out to be a very high-risk tactic to both Russia and Ukraine, viable only in specific circumstances. Beyond the poor training, maintenance, doctrine, tactics, and discipline demonstrated by the Russians, in fact the saturation of the Ukrainian operational theatre by a variety of air defence assets sharply decreases the survivability of current helicopter models in similar operational scenarios. This conflict is a turning point with respect to the Western operational experience over thirty years of operations marked by air dominance, or at least air superiority, from Iraq and Somalia to the Balkans, Afghanistan and Libya.

At the same time, the role of helicopters on the future battlefield will likely be reshaped in line with a system-of-systems approach, prioritising coordination and connectivity among different types of platforms: crewed and uncrewed, precision-guided and not, stand-off and stand-in, with helicopters being an important part of the overall equation. In any case, the doctrinal basis for rotorcrafts' employment in high-intensity, large-scale, near-to-peer conflict scenarios is going to be reassessed in light of both lessons learned in Ukraine and technological innovation. Among the latter, FVL technology is set to play a revolutionary role in terms of speed and range for next generation helicopters, as well as connectivity within a system-of-systems on which helicopters interact effectively with a number of assets.

¹ Alessandro Marrone is Head of IAI's Defence Programme. Michele Nones is Vice-President of IAI.

² See Chapter 1 of this study.

8.2 The underpinning military rationale of the US

It is not by chance that once again the US is transforming its vertical lift capability in order to meet operational needs and capitalise on 21st century technologies.³ The unique convergence of near-peer threats and new available technology are the catalysts driving the US Army to field game-changing capabilities. The necessity to operate from relative sanctuaries to strike targets reinforces the need to significantly increase speed and range of army air assault and attack aviation capabilities. This not only enhances the ability to operate from stand-off ranges, but to provide stand-in effects at a vastly increased tempo. Augmented reach and tempo present the opposing force with multiple simultaneous dilemmas and divert their focus over a much wider front when confronted with US and allied forces.

Notably, US Army planners build their tactical plans thinking in terms of objectives, whether these are terrain- or enemy-oriented. That location in time and space drives all activity from planning and preparation to sequential execution. Tactical relevance is predicated by the force's ability to reach and close on the objective, to land and rapidly amass forces or deliver lethal and non-lethal effects maintaining standoff distance while mastering drones and other air launched effectors. Payload, high manoeuvrability, high speed, high performance electronic warfare, robust connectivity and enhanced survivability in contested environment with high threat levels are all critical operational considerations.

As the Army learned when considering multi-mission future vertical lift platforms, a common design was not practical for FVL. Resulting designs were either too big to be a viable attack helicopter or too small to carry the necessary air assault payloads to distant objectives. The bottom line is that it is extremely difficult to build a platform that can be everything to everybody. Clearly identifying the primary mission, purpose and function of the capability is absolutely critical.

8.3 Europe's cautious approach: France, Germany and the UK

Among NATO members, only 15 have attack helicopters, and mere six of them (France, Germany, Italy, Turkey, the UK and the US) have a fleet of more than 30 aircraft. Within these major players, for a variety of reasons Paris, Berlin and London approach next generation helicopters with a certain degree of cautiousness. France has always maintained a significant military helicopter capability in its armed forces. However, years of doctrinal hesitation and pushing back long overdue modernisation have put its rotorcraft fleet at the crossroads in a time of strategic paradigm shifts, as the era of stability and counterterrorist operations seems turn into a new one of high intensity conflicts. Meanwhile, the national helicopter capability is undergoing a major renewal, moving from a heterogeneous 12-models fleet to a rationalised three-models fleet: the Tiger as the main combat one, the NH90 as the main manoeuvre one and the H-160 Guépard as a light utility and

³ See Chapter 2 of this study.

attack one. Any future French helicopter will likely be developed at the European level, most probably through Airbus Helicopter. From the French perspective, the EU NGRT project – led by Paris – should also be decisive concerning a possible successor to either Tigers or Guépards.⁴

Berlin procures its defence equipment primarily in Europe, but at the same time the current German government affirmed its intention to prioritise the procurement of replacements and market-available systems in order to avoid capability gaps. When it comes to helicopters, part of the 2022 extra defence budget will be invested in replacing the medium lift capabilities of the CH-53 fleet into a heavy lift capability provided by the CH-47F. Germany recently abandoned the Tiger upgrade project pursued by France and Spain. With the final year of the German Tiger being 2038, Berlin could stretch its lifetime through obsolescence management until the next generation of rotorcraft become available in the 2030s. The development of FARA and FLRAA should therefore be keenly observed in Germany. At the same time, by participating in the Future Combat Aircraft System and the Main Ground Combat System – two projects with the goal to develop next generation technology and likely to take substantial investment – Berlin's will to spearhead rotary wing projects might be diminished. Notwithstanding, it will continue to explore multilateral options such as NGRC with the aim to deliver a new European medium multi-role helicopter to supersede the NH90.⁵

London has traditionally been one of the most expeditionary military powers in Europe, and the current British helicopter fleet is largely shaped by the demands of the Afghanistan and Iraqi interventions. With the return of Russia as a dominant force planning consideration since 2015, the British Army has decided to move away from the model which saw helicopters attached in small numbers as supporting assets to ground formations. Instead, the AH-64E and the AW159 Wildcat fleets have been reorganised under a new formation called 1 Aviation Brigade, with the intention of being deployed as a single manoeuvre unit for large-scale battlefield effects. The logic is that modern conflicts against near-peer or peer countries such as Russia or Iran will be sufficiently lethal for helicopters that their use will need to be carefully planned and risk-managed. Meanwhile, the replacement of the Lynx model with the Wildcat and of the Sea King with the Merlin, the modernisation of the Chinook and Apache fleets and finally the new medium helicopter programme are all examples of incremental improvement rather than the pursuit of transformative innovation, such as tilt-rotors. Still, US experiments with manned-unmanned teaming and future air-launched effects in the rotary space are of significant interest to the UK and are the primary drivers behind a US–UK agreement on information sharing on FVL.⁶

⁴ See Chapter 3 of this study.

⁵ See Chapter 4 of this study.

⁶ See Chapter 6 of this study.

8.4 The outlook for Italy: Five key elements

Italy fields one of the largest helicopter fleets in Europe, and its national industry is driven by Leonardo to hold a global leadership role. Rome has maintained a peculiar approach with regards to the rotary-wing component of the armed forces, built on a balance between high and low intensity scenarios as well as on an effective exploitation of the commonality of basic dual-use components utilised also for civil security platforms. In recent years, a modernisation and rationalisation effort has been launched concerning the military helicopters fleet, centred on both the new attack helicopter through the AW249 programme, and on the new light utility platform based on the multirole AW169. The MoD has also launched a new joint helicopter academy to combine army and air force approaches into a more effective use of this capability. Against this backdrop, the Russian invasion of Ukraine is widely perceived as a wake-up call and a primary source of lessons, fuelling an overall military shift towards high-intensity scenarios in comparison with the three-decades long Italian experience in counterinsurgency and stabilisation operations in Somalia, Balkans, Afghanistan, Iraq and Lebanon.

The Italian defence stakeholders recognise the necessity to invest in next generation helicopters. The 2021 MoD Multi-year Planning Document stated that Italy should benefit from the anticipated significant innovations in this field, also through synergies at the international level. In 2022, the Italian army strategic document *Esercito 4.0* made clear that key aspects of the future operating environment draw maximum attention towards speed, manoeuvrability and extended range in a low altitude regime – pointing to the overall strategic nature of military helicopters and the ensuing demand for radically innovative air vehicles rather than to incremental upgrades. In military terms, the specific role and nature of the new attack helicopters compared to next generation ones should not be configured as an overlap. There could well be different platforms for specific missions, also based on cost-effectiveness and specific conditions of each operation, and this will imply the exploitation of older generation assets while laying the ground for a long-term qualitative leap.⁷

Recent MoD strategic documents, such as the aforementioned Multi-year Planning Document, highlight the importance of the wider Mediterranean region, which is more and more central in the Italian political discourse. It encompasses North Africa, the Sahel, the Horn of Africa and the Middle East. This resonates with the expanding range of the NATO's eastern flank in Europe after the accession of Finland, which is today far larger than the West German plateau of the Cold War era: a vast *limes* of more than 5,000 km along which to implement collective deterrence and defence, with a greater military burden shared by Europeans – including Italians – as the US continue to shift their strategic focus towards China and the Indo-Pacific. As a result, range, speed, endurance and being able to connect in a system of systems are needed in the wider Mediterranean as well as on the whole

⁷ See Chapter 5 of this study.

European continent to fulfil Italian military level of ambition.

Moreover, next generation helicopters may well change how the rotor-wing component is integrated in Multi-Domain Operations, by reducing the overall exposure of forces on the field to steeply increase survivability. This applies to different types of missions, from combat search and rescue to casualties and medical evacuation, in which time is the most relevant factor. The next generation rotorcraft would then ensure fast responses to emerging threats, thus increasing their overall flexibility, situational awareness and thus survivability. Breakthroughs in terms of sensors, connectivity and data fusion are key in this regard,⁸ together with an open system architecture. Next generation helicopters would create new opportunities to react quickly, raising the impact of the so-called “golden hour”, but also enabling to rethink a lighter logistical footprint as well as troop positioning. Most importantly, the key military requirements at the base of this leap forward would allow to penetrate defence and A2/AD systems and have versatile platforms deployable in a variety of scenarios, from south to east, interoperable with other advanced capabilities as well as with major allies.

In conclusions, five elements are key for the future Italian outlook on next generation helicopters.

First, as discussed in previous paragraphs, there is a robust military rationale for seriously working on this qualitative leap. A leap which should achieve a next generation platform digital by design, interoperable and fit for multi-domain operations, bearing in mind that for certain missions is not possible to militarise civilian helicopters. The ability to master drones and other air-launched effectors will be key in this regard.

Second, the abovementioned technology is moving forward, and Italian industrial base cannot afford to lag behind if it wants to maintain its technological edge in the production of helicopters. Italy has to drive rather than to follow technological innovation in this sector.

Third, the US is already undertaking such a leap, and this will have a two-fold impact at the global level, as it has happened with previous major procurement programmes launched by Washington. On the one hand, it will influence not only American requirements but their interoperability with allies in Europe and beyond, as well as NATO posture and doctrines with a significant impact on Italy. On the other hand, US investments are going to change the current status quo on the international defence markets in terms of both supply and demand, as next generation helicopters will play a central role in future international markets alongside legacy platforms. In the long term, both types of FVL – compound and tilt rotor – are likely to co-exist in the US in a complimentary way.

⁸ See Gregory Alegi, “Elicotteri di quinta generazione? Le sfide dell’industria secondo Alegi”, in Formiche, 14 May 2023, <https://formiche.net/?p=1553279>.

A *fourth* key element is that no single European country can afford to undertake such qualitative leap on its own, as demonstrated over the last couple of years *inter alia* by the launch of the aforementioned initiatives within NATO, EDF and PESCO.⁹ International cooperation is clearly necessary for Italy. But such a cooperation should go beyond the paradigm of workshare applied to single elements of the platform, as Italy should maintain a relevant role in system design and all major technological components. There is also an interesting window of opportunity: since other major European countries are quite cautious on FVL, as discussed in previous paragraphs, Rome can be at the forefront of this qualitative leap in Europe.

Last but not least, time is of essence for Italy. Postponing the choice on FVL entails the risk to be a follower rather than a leader on rotorcraft technological innovation. It also weakens the Italian position vis-à-vis possible international partners or competitors, in the US as well as in Europe. In contrast, a timely choice in terms of requirements backed by a tangible commitment of resources from the short to the mid- and long term would enable both the Italian military and industry to play a strong role in the shaping of FVL technologies and assets. Moreover, a timely decision would enhance Italian ability to influence ongoing NATO and EU initiatives in a synergic way, to retain the operational and technological sovereignty of next generation helicopters, reduce the time-to-market and lay the ground for future exports.

Altogether, these five elements should make the FVL qualitative leap one of the top defence priorities for Italy.

Updated 29 August 2023

⁹ See Chapter 7 of this study.

Acronyms

A2/AD	Anti-Access/Area Denial
ALAT	Aviation légère de l'armée de terre
ALE	air launched effects
ASW	anti-submarine warfare
ATP	Allied Tactical Publication
BAAINBw	Bundesamt für Ausrüstung, Informationstechnik und Nutzung der Bundeswehr
C2	Command and Control
CARMENTA	Future European Self Protection System for Fixed Wing and Rotary Wing airborne platforms
CAS	Close Air Support
CSAR	Combat Search-and-rescue
DAM	Division Aériomobile
DPP	Documento programmatico pluriennale
DSK	Division Schnelle Kräfte
EDA	European Defence Agency
EDF	European Defence Fund
EDIDP	European Defence Industrial Development Programme
EU	European Union
EW	Electronic Warfare
FARA	Future Attack Reconnaissance Aircraft
FCAS	Future Combat Aircraft System
FLASH	Folding Light Acoustic System for Helicopters
FLRAA	Future Long-Range Assault Aircraft
FOC	Future Operating Concept
FOE	Future Operating Environment
FVL	Future Vertical Lift
G2G	Government to Government
HIL	Hélicoptère Interarmées Léger
ISR	Intelligence, Surveillance, Reconnaissance
JADO	Joint All-Domains Operation
JMR-TD	Joint Multi-Role Technology Demonstration
LTH	Light Transport Helicopter
LUH	Light Utility Helicopter
LV/BV	Landes- und Bündnisverteidigung
MANPADS	Man-Portable Air Defence System
MBB	Messerschmitt-Bölkow-Blohm

MDO	Multi-Domain Operation
MEDEVAC	Medical Evacuation
MGCS	Main Ground Combat System
MINUSMA	UN Multidimensional Stabilisation Mission in Mali
MoD	Ministry of Defence
MOOTW	Military operations other than war
MOSA	Modular Open Systems Approach
MoU	Memorandum of Understanding
MTH	Medium Transport Helicopter
MUM-T	Manned-Unmanned Teaming
MUSHER	European Manned unManned Teaming system
NASAMS	National Advanced Surface-to-Air Missile System
NATO	North Atlantic Treaty Organisation
NEES	Nuovo Elicottero da Esplorazione e Scorta
NGFH	Next Generation Fast Helicopter
NGMH	Next Generation Medium Helicopter
NGRC	Next Generation Rotorcraft Capability
NGRT	Next Generation Rotorcraft Technology
OCCAR	Organisation for Joint Armament Cooperation
PESCO	Permanent Structured Cooperation
RAF	Royal Air Force
R&D	Research and Development
RW	Rotary Wing
SAM	Surface-Air Missiles
SAR	Search and rescue
SHORAD	Short range air defence
SOF	Special Operation Forces
SPS	Self-Protection System
STANAG	Standardization Agreements
UAV	Unmanned Aerial Vehicle
UGS	Unmanned Ground System
UN	United Nations
VDV	Vozdushno-desantnye voyska
VTOL	Vertical Take-off and Landing

Future Military Helicopters: Technological Innovation and Lessons Learned from Ukraine

Istituto Affari Internazionali (IAI)

The Istituto Affari Internazionali (IAI) is a private, independent non-profit think tank, founded in 1965 on the initiative of Altiero Spinelli. IAI seeks to promote awareness of international politics and to contribute to the advancement of European integration and multilateral cooperation. Its focus embraces topics of strategic relevance such as European integration, security and defence, international economics and global governance, energy, climate and Italian foreign policy; as well as the dynamics of cooperation and conflict in key geographical regions such as the Mediterranean and Middle East, Asia, Eurasia, Africa and the Americas. IAI publishes an English-language quarterly (*The International Spectator*), an online webzine (*AffarInternazionali*), two book series (*Global Politics and Security* and *IAI Research Studies*) and some papers' series related to IAI research projects (*Documenti IAI*, *IAI Papers*, etc.).

Via dei Montecatini, 17 - I-00186 Rome, Italy

T +39 06 6976831

iai@iai.it

www.iai.it

Latest DOCUMENTI IAI

Director: Alessandro Marrone (a.marrone@iai.it)

- 23 | 19 Alessandro Marrone and Giancarlo La Rocca (eds), *Future Military Helicopters: Technological Innovation and Lessons Learned from Ukraine*
- 23 | 18 Miriam Zenobio, *Reframing EU–Tunisia Relations: Democracy, Governance, Migration*
- 23 | 17 Federico Castiglioni, *Van Wittel/Vanvitelli Dialogue Policy Roundtable*
- 23 | 16 Silvia Colombo and Dario Cristiani, *European Think Tanks Contact Group on Libya: Towards a New Common European Narrative on Libya*
- 23 | 15 Karolina Muti, Ottavia Credi e Giancarlo La Rocca, *Il sistema-Paese Italia di fronte alle sfide dello spazio: tra space economy, cooperazioni internazionali e cybersecurity*
- 23 | 14 Michelangelo Freyrie, *Industrial Production in Support of European and Transatlantic Defence*
- 23 | 13 Elio Calcagno and Alessandro Marrone (eds), *The Underwater Environment and Europe's Defence and Security*
- 23 | 12 Federico Castiglioni, *A Stronger Italian-German Partnership: Closer Cooperation in Time of Energy Crisis*
- 23 | 11 Akram Ezzamouri and Miriam Zenobio, *EU–Tunisia Relations: Unpacking the Conundrum*
- 23 | 10 Matteo Bonomi, Luisa Chiodi and Irene Rusconi, *New Visions for the Western Balkans: EU Accession and Regional Security*