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Helicopter Warfare

The Future of Airmobility and Rotary Wing Combat

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Abstract

Military helicopters have evolved into technologically sophisticated weapon systems. Originally designed to counter Soviet armor, attack helicopters now have to cope with a wide spectrum of threats, some of them bringing them back to their counterinsurgency roots. In this new context, direct fire support of ground forces has superseded airmobile maneuvers and autonomous helicopter forces. Nonetheless, helicopters remain essential for their combat and tactical mobility roles. However, the high cost of these sophisticated platforms and major cuts in defense budgets call into question the ability to provide such tools. Accommodating strong demand in helicopters with present budget constraints requires the adaptation of fleets, since technological advances alone will not provide an answer to this problem. The time of homogenous fleets made up of same-generation, single-use platforms, appears to belong to the past.

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Les évolutions successives de l'hélicoptère militaire ont abouti à un système d'armes très sophistiqué technologiquement. Pensé à l'origine pour contrer les blindés soviétiques, l'hélicoptère d'attaque est désormais confronté à un large spectre de menaces qui le ramène aux fondamentaux développés dans des contextes de contre-insurrection. Les manœuvres aéromobiles dans la profondeur et les forces héliportées autonomes ont ainsi laissé place à l'appui direct des forces. L'hélicoptère n'en demeure pas moins indispensable comme plateforme de combat et comme vecteur de mobilité tactique. Toutefois, le prix élevé de ces plateformes sophistiquées constitue un véritable défi pour des budgets de défense en diminution. Concilier la forte sollicitation en hélicoptères et les contraintes budgétaires actuelles impose désormais une adaptation des parcs à laquelle les évolutions technologiques ne sauraient seules apporter une réponse. Dans ces conditions, le temps des parcs homogènes composés de plateformes de même génération et dédiées à un seul type de tâche semble révolu.

Introduction

Cavalry, and I don't mean horses

General James M. Gavin, 1954

Mobility sets the tempo of war. Not only does it provide the capacity to move and support a military force; it also allows he who possesses it to seek out the enemy, pursue him and surprise him by applying fires and a volume of force at the place and time of his choosing. Thanks to its ability to restore the balance of force and destabilize the adversary, mobility exerts a dual effect, both physical and psychological, in what remains a "dialectic of two opposing wills". This, without doubt, explains the crucial role played historically by cavalry and, later, by the battle tank.

It was not until the second part of the 20th century that advances in technology enabled the gradual emergence of a new form of flying cavalry. Because of its characteristics and its unique flight capabilities, the helicopter initially provided ground troops with an unprecedented ability to free themselves from terrain barriers and from the reliance on major infrastructures. In a second phase, rotary wing aircraft became actual combat systems, even forming autonomous airmobile forces. In parallel with continuous platform improvements thanks to the considerable technical advances of the past 30 years, the helicopter has been able to adapt and learn lessons from the various conflicts that have marked its existence. On occasion it has become the emblematic representation of the conflict, whether in the Vietnam War or in the failed raid of October 3, 1993 in Somalia. These different operational engagements have highlighted its utility in modern conflicts, as well as its vulnerabilities.

Today the helicopter is omnipresent across a large spectrum of defense missions, as well as in public security roles. In Western forces, this reality translates into intensive use of rotary wing aircraft, leading to premature ageing of fleets and substantial maintenance costs. At the same time, the dual heritage of the Cold War and "military transformation" has favored the development of sophisticated new-generation systems that are costly to produce and operate. Although these types of helicopter undoubtedly offer unprecedented technical and tactical capabilities in airmobile and *aérocombat*[1] operations, the current

[1] The French doctrinal and operational concept of *aérocombat* covers the idea of "an integration of airmobile tactics and missions within the air-land maneuver". It

political and budgetary context is raising serious questions as to the viability of this model.

Thus, recalling the lessons of past conflicts and their impact on force structures helps to analyze and understand current engagements, their influence on employment doctrine, as well as problems related to fleet management. However, since economic and budget constraints have a profound influence on political choices, there is no doubt that cost issues, at least in Europe, will play a key role in defining future airmobile forces. For that reason, it appears likely that the objective of a drastic reduction in the variety of platforms will prove impossible to achieve and that most Western forces will tend to operate hybrid fleets combining upgraded equipment with new-generation helicopters.

In spite of this incomplete modernization, airmobile forces will probably remain one of the criteria discriminating modern armed forces from the rest, if only because of their adaptability. It is therefore essential that European forces, already facing major reductions, succeed in retaining significant airmobile capabilities.

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explicitly dissociates itself from the US concept of Close Combat Attack (CCA) which is included in the “support function” whereas *aérocombat* is broader than support and denotes the capability of helicopter forces to engage the enemy in depth. Accordingly, it fits in the “contact function”, next to mounted combat and dismounted combat. Nevertheless, *aérocombat* does not imply an independent force, as “the employment of helicopter units can only be understood in close coordination with the two other components of the contact function”. Due to this very specific and somewhat convoluted meaning, the editors have decided not to translate it and to keep the French term in the text. Note that the official translation is likely to be "Army Aviation Combat Operations". Cf. Centre de Doctrine et d’Emploi des Forces (CDEF), FT-04, *Les fondamentaux de la manoeuvre interarmes*, June 2011.

From Support to Maneuver: the Helicopter Century

Even though armed forces have only started to use it recently, the helicopter has been with us for about as long as the fixed wing aircraft. The first rotary wing aircraft took to the air in 1907[2], three years after the Wright brothers' exploit. However, the pace of technical innovation of fixed wing aircraft rapidly outstripped that of rotary wing designs, so that, by the time of World War I, the former had already achieved a degree of maturity allowing them to be engaged in combat. It was not until 1939 that the first helicopter featuring a conventional configuration, with a vertical anti-torque tail rotor, appeared on the scene – Igor Sikorsky's VS-300.

Starting from this milestone of relative technological maturity, one can distinguish three major phases that characterize military utilization of the helicopter. From the 1940s onwards, it was used in a *service support* role for the armed forces, in areas such as observation, logistics or medical missions. By the end of the 1950s, technical and tactical innovations had opened the door to a combat support function contributing directly to maneuvers, in terms of both movement and fire. Finally, the 1980s saw the emergence of the maneuver helicopter concept, organically combining movement and fire as an autonomous and essential force on the battlefield. Of course, each of these stages was more cumulative than successive; capabilities, once acquired, were never abandoned but were used to complement the range of possible missions.

The Fragile Beginnings of the Service Support Helicopter

The technical characteristics of the rotary wing, allowing the aircraft to hover at low and medium altitudes, were immediately recognized by modern armed forces as an ideal platform for artillery observation missions. Altitude afforded an extended line of sight and could therefore reduce the exposure of forward observers, responsible for directing artillery fire. The FI-282 *Kolibri* was built by the *Luftwaffe* for this purpose in 1942 in order to facilitate the task of *Wehrmacht* artillery units on the Eastern front. Despite some conclusive contributions, the machine suffered heavily from its vulnerability as soon as it came within range of the Red Army's powerful

[2] Bernard Bombeau, *Hélicoptères. La genèse, de Léonard de Vinci à Bréguet*, Paris, Editions Privat, 2006.

anti-aircraft guns[3]. On the Western front, the loss of air supremacy also rendered the use of these aircrafts risky for the Germans, even though they were the most advanced in this type of light model. Consequently, it is not hard to imagine the reluctance of high commands to deploy helicopters to high-intensity theaters for years, even decades thereafter. Control of the skies and superiority of firepower quickly became a prerequisite for the use of helicopters– a situation that lasted almost until the 1980s. The pre-eminence of helicopters in counter-insurgency and stabilization operations can undoubtedly be explained by operational logic, but also by a favorable situation in terms of firepower. Absent these conditions, helicopters remained limited to a service support role at the rear and on the fringes of the combat zone.

This was the way the Allies employed helicopters in World War II, specializing in heavier models capable of performing logistics missions to the rear lines of troops operating in difficult terrain, as in the Indo-Burmese theater against the Japanese. Laying telephone cables and resupplying forward positions were the primary missions of the Sikorsky H-4s and, in particular, H-5s purchased by the Americans and the British in 1943[4].

The primary area of utilization, however, was without doubt medical evacuation. Rotorcraft enabled the US Medical Service Corps to rescue pilots shot down over Burma in May 1944[5]. Rescue missions played a key role in the use of helicopters in Korea but also in Indochina where, as early as 1946, the intensity of combat combined with the extremely difficult terrain – mostly without landing strips – raised the issue of casualty evacuation. In April 1950 the medical service of France's Far-East Expeditionary Force (CEFEO) acquired two Hiller 360s and performed its first medevac using a helicopter[6]. Although the fleet was expanded with more powerful machines like the Hiller H-23 and especially the Sikorsky S-55 (H-19), France never had more than around 20 machines in service in Indochina. There were many reasons for this but they were essentially due to "French Air Force reluctance to commit funding for studies into so-called marginal aircraft"[7]. This attitude was the source of a major disagreement between the Air Force and the Army, which finally led then-War Minister Bourgès-Maunory to set up a helicopter group (*Groupement de formation d'hélicoptères)* in 1954 under the command of Major Crespin. This group would later constitute the core

[3] J. Richard Smith and Anthony Kay, *German Aircraft of the Second World War*, London, Putnam & Company Ltd., 1978 (3rd ed.), pp. 595-596.
[4] For cable laying, see Ronald J. Brown, *Whirlybirds U.S. Marine Helicopters in Korea*, Marines in the Korean War Commemorative Series, 2003. Accessible at: http://www.koreanwar.org/usmckorea/PDF_Monographs/KoreanWar.Whirlybirds.pdf.
[5] Matthew Allen, *Military Doctrines of the Major Powers, 1945-1992*, Westport CT, Greenwood Press, 1993, p. 129; Otto Kreisher, "The Rise of the Helicopter during the Korean War", *Aviation History*, 2007. Accessible at: http://www.historynet.com/the-rise-of-the-helicopter-during-the-korean-war.htm.
[6] Michel Fleurance, *Rotors dans le ciel d'Indochine. L'épopée des hélicoptères de l'armée de l'Air en Extrême-Orient (1950-1997)*, Volume 1, *Les Hommes*, Paris, Service Historique de la Défense, 2003, p. 55.
[7] *Ibid.*, p. 356.

of what was to become the French Army's light aviation or ALAT (*Aviation Légère de l'Armée de Terre*).

Less circumspect about this platform than the Air Force, the Army made clear from the outset its desire to diversify its missions. In June 1954, still in Vietnam, Captain Puy-Montbrun suggested trying out a new mission: dropping a parachute commando by aircraft for a special operation assault, followed by a helicopter extraction 48 hours later[8]. The idea was to demonstrate "the advantage of helicopters during maneuvers and to show that there were other possibilities besides artillery spotting or medical evacuation".[9] It was true that there was little difference between picking up a commando team from enemy territory and carrying the team by helicopter both ways. On the tactical level, however, it marked a shift from service support to combat support and the discovery of airmobility.

The Adolescence of the Combat Support Helicopter

The Golden Age of Airmobility

Immediately following World War II, the US Marine Corps expressed its interest in this type of mission, although in this respect they were well ahead of the technical possibilities of the time. In the context of a general debate concerning the future of amphibious operations in the atomic age – the latter constituting a new threat for troop concentrations which were inherent in landing an expeditionary force – they viewed the helicopter as a platform allowing troops to be projected directly into the "hinterland" of a coastal area. In November 1948, Quantico Academy published a draft doctrine entitled *Phib31 Amphibious Operations – Employment of Helicopters*. A precursor of major concepts ahead, this document was notable for introducing the notion of "vertical assault", because of which *Phib31* was adopted as-is by the US Army a few years later in its airmobility doctrine[10].

Building on these bold innovations, the Marines played an important role in Korea, where "the first operational revolution in the use of the military helicopter took place with the progression from rescue-liaison to transport-assault, a precursor for large-scale landing operations"[11]. Operation *Summit* on September 20, 1951 marked the first use of tactical helitransportation of 224 Marines into a combat zone – a particularly inaccessible hilltop. In October, Operation *Bumblebee* carried almost 1,000 Marines by helicopter using twelve H-19s. Several trips were necessary, as the machine could not carry more than about 15 passengers[12].

It was in Algeria, however, that airmobility was systematically employed for the first time. One of the lessons from Indochina was the

[8] Michel Fleurance, *op. cit.*, Volume 2, *Les Opérations*, p. 512.
[9] Déodat du Puy-Montbrun, *L'Honneur de la guerre*, Paris, Albin Michel, 2002, p. 143.
[10] Rodney R. Propst, "The Marine Helicopter and the Korean War", Combat Studies Center, 1989. Accessible at: http://www.globalsecurity.org/military/library/report/1989/PRN1.htm.
[11] Michel Fleurance, *op. cit.*, Volume 1, *Les Hommes*, p. 27.
[12] Ronald J. Brown, *op. cit.*

chronic lack of mobility of modern forces in guerrilla warfare, faced with an insurgent enjoying the advantage of superior intelligence, intimate knowledge of the terrain and population support, eliminating concerns about logistics. This mobility gap forced units to adopt a reactive posture, undermining troop morale by preventing them from taking the initiative. In this "*guerre en surface*"[13], where the insurgents operated over the whole territory and were seemingly blessed with ubiquity, helicopters appeared to offer a technical solution to this unfavorable strategic asymmetry. Building on their own experience from Indochina, but also well informed about US tactical innovations[14], French military leaders decided to set up a "helicopter force" with tactical value.

Created in 1954, the ALAT accounted for over half of the "operational" helicopters in Algeria within what would soon be known as Group 101, itself composed of two helicopter groups (*groupes hélicoptères* GH1 and 2). However, due to the recent creation of the ALAT and the lack of training of its pilots, the Air Force retained responsibility for heavier transport helicopters like the H-34, the replacement for the "flying bananas" (H-21). The Navy also had a unit, placed under the authority of the Air Force. Altogether the 10th Military Region (Algeria) had almost 300 machines in 1955 and continued expanding its fleet until 1962[15]. This organizational dispersion explains the decision taken in early 1955 to create the Bureau for Movements and Transportation (*Bureau des Mouvements et Transports*; BMT) which coordinated the mobility resources at the joint force level for the entire 10th Military Region. Acting as a genuine orchestrator for helicopter transportation, the BMT "establishe[d] priorities, promulgate[d] regulations, and coordinate[d] operational and logistical movements and transport requirements"[16].

For the first time in history, the use of helicopters was largely dedicated to *air assault*. The basic operational unit was the Helicopter Intervention Unit (*Détachement d'intervention hélicoptère* DIH), normally comprising seven H-21s or H-34s for transportation and one or two *Alouettes* for observation and backup. The volume transported by one DIH represented approximately a company of 100-150 paratroopers. This new mission, in close proximity to the combat zone, immediately brought up the question first raised in World War II concerning the vulnerability of helicopters to ground fire. However, the platforms were now more rugged, paving the way for the emergence of the "armed helicopter, the result of the perseverance of Colonel Brunet [former airman and now head of GH2] and

[13] The concept of "*guerre en surface"* does not mean "surface war" or ground combat, but should be contrasted with *guerre de front* and refers to the total absence of fronts, of columns or other familiar military forms. Marie-Catherine Villatoux, *La Défense en surface. Le contrôle territorial dans la pensée stratégique française d'après-guerre*, Paris, Service Historique de la Défense, 2009.
[14] In a memo dated December 29, 1953, the armed forces staff wrote: "*l'Armée profitera largement […] de l'expérience tactique et technique acquise par le* Marine Corps *qui depuis plusieurs années emploie des hélicoptères pour les transports de troupes et de materiel*", cited in Michel Fleurance, *op. cit.*, p. 355.
[15] Charles Shrader, *The First Helicopter War: Logistics and Mobility in Algeria 1954-1962*, Westport, Praeger, 1999, p. 121.
[16] *Ibid.*, p. 103.

his technician, Captain Martin"[17]. Together they managed to "mount heavy machine guns in the windows of an H-34". For each DIH of seven or eight helicopters, High Command recommended the use of at least one armed helicopter[18] capable of covering cargo deployments and providing support for troops on the ground during withdrawal.

The use of helicopters in Algeria undoubtedly reached a peak with the *commandos de chasse* tracking units[19], created in 1959 as a result of General Challe's desire to put into practice the experience and recommendations of Colonel Bigeard – one of the pioneers in the realm of airmobility[20]. As well as possessing "perfect familiarity with the tactics of the nationalist fighters, the population and the terrain"[21], these commandos took full advantage of the mobility differential afforded by the helicopter which enabled them to pursue and harass a rebel group until they were exhausted. Once isolated, the Katiba was destroyed by the rapid intervention of the *Réserves Générales*, also transported by helicopter. In his book *The First Helicopter War,* Charles Schrader cites the example of the destruction of a Katiba that had penetrated the Morice Line during the "frontier battle" and taken up position at Djebel Ergou in March 1958. This operation performed by the 9th *Régiment de Chasseurs Parachutistes* was a typical illustration of the blocking technique. Like hunting an animal, the tactical maneuver gives the adversary no chance, driving him to the ground in one direction while cutting off his withdrawal route through a heliborne vertical envelopment[22].

The French innovations were closely watched in the USA, where they consolidated developments that were already well under way. Intense strife between the services stemming from the Korean War[23] allowed the *Army* to launch its own aviation program in spite of the Key West Agreement which had given the Air Force exclusive control of all air assets since 1948[24]. This liberty given to the US Army Aviation found its primary

[17] Marie-Catherine Villatoux, "Pilotes d'hélicoptères de l'armée de l'Air en guerre d'Algérie", in Jean-Charles Jauffret and Charles-Robert Ageron (dir.), Des *hommes et des femmes en guerre d'Algérie*, Paris, Autrement, 2003, p. 444.
[18] Charles Shrader, *op. cit.*, p. 123.
[19] The very concept of the *commandos de chasse* was to emulate the enemy's superior mobility in tracking closely each enemy company, hunting them until they were finally exhausted. Etienne de Durand, "France" in Thomas Rid and Thomas Keaney (eds.), *Understanding Counterinsurgency: Doctrine, Operations, and Challenges*, London, Routledge, 2010, pp. 11-27.
[20] In 1956, at the head of the 1er *Régiment de Parachutistes Coloniaux*, Bigeard masterminded Operation 744 against ALN resistance fighters in Kabylie. This was one of the very first air assault operations by French forces, in Marcel Bigeard, *Pour une parcelle de gloire*, Paris, Plon, 1975, p. 236 *et alii*.
[21] Pascal Le Pautremat, 'Le commando Georges", *Guerres mondiales et conflits contemporains*, vol. 1, no. 213, 2004, pp. 95-103.
[22] Charles Shrader, *op. cit.* pp. 211-213.
[23] John J. McGrath, *Fire for Effect: Field Artillery and Close Air Support in the US Army*, Fort Leavenworth, KA, US Army Combined Arms Center, Combat Studies Institute Press, 2008, pp. 95-102.
[24] Etienne de Durand, "L'interarmées aux Etats-Unis. Rivalités bureaucratiques, enjeux opérationnels et idéologie de la jointness", *Focus stratégique*, no. 3, November 2007, p. 10.

expression in the form of rotorcraft[25].Taking account of the doctrinal lead of the Marines, the Army decided to create "around 15 transport companies equipped with helicopters […] whose mission will be to move men, equipment and supplies in combat zones and even behind enemy lines"[26]. It is within this context that one must understand the theoretical work of General James Gavin. Immediately following World War II, this pioneer of airborne forces – he was the author of FM 31-30, the first manual on the employment of paratroopers – was appointed US Army Chief of research and development. His thinking stemmed from the observed erosion of the comparative mobility advantage between increasingly heavy armored cavalry, and infantry that was now also motorized. It was for this reason that, in a seminal article[27], he called for the creation of a "flying cavalry" capable of reestablishing this mobility differential that characterizes cavalry in its most Napoleonic tradition.

While work continued at Fort Rucker to test the French armed helicopter innovation on UH-1 *Hueys* equipped with machine guns[28], the airmobility cause was moving forward in Washington. Three elements contributed to this development: Gavin's ideas on airborne cavalry, French experience in Algeria and the new doctrine of *Flexible Response* issued by Maxwell D. Taylor, calling for the reinforcement of conventional elements. Consequently, Defense Secretary Robert McNamara set up a working group on airmobility led by General Hamilton Howze[29]. In February 1963, the latter decided to create an experimental unit: the 11th Air Assault Division, redesignated the 1st Cavalry Division (Airmobile) in 1965 in honor of Gavin's work. For two years, the mission of the 11th Division was to "experiment, innovate, test and evaluate" the possibilities of the helicopter.

The first massive use of Gavin's concepts in the field was in Vietnam during the battle of la Drang which showed both the strength and the dangers of airmobility. In this operation, an airborne cavalry battalion led by Lieutenant Colonel Moore successfully fought against almost two Viet Cong regiments who had taken up position on the Chu Pong Mountain. As part of a reconnaissance operation, Moore landed his troops in a natural clearing ideally suited for helicopter operations. The troops unwittingly found themselves face to face with the entire enemy force; they were surrounded and came under heavy fire. For almost 24 hours, the flexibility and reactivity of the airmobile concept were severely tested. Having established an air bridge with the US base at Pleiku, the men of the 1st Cav finally regained the initiative and dispersed the Viet Cong forces who

[25] The Johnson-McConnell agreements of 1966 gave all rotary wing aircraft to the Army in return for an Air Force monopoly on fixed wing aircraft.
[26] Michel Fleurance, *op. cit.*, Volume 1, *Les Hommes*, p. 355.
[27] James Gavin, "Cavalry and I Don't Mean Horses", *Harper's*, April 1954, pp. 54-60.
[28] Elie Tenenbaum, *L'influence française sur la stratégie américaine de contre-insurrection, 1945-1972*, dissertation from the IEP of Paris under the direction of Pierre Mélandri, Paris, 2009, pp. 105-108.
[29] John J. Tolson, *Airmobility 1961-1971*, Vietnam Studies, United States Army Center of Military History, CMH Pub 90-4, 1989. Accessible at: http://www.history.army.mil/books/ Vietnam/Airmobility/airmobility-ch01.html.

suffered the loss of two regiments[30]. While the Americans thought this battle showed the possibility of adopting a strategy of attrition, "bleeding the enemy" through a series of similar battles[31], the result was the opposite. Impressed by US firepower and tactical mobility, the Viet Cong gave up the idea of provoking another Dien Bien Phu, preferring to shift back on the scale of revolutionary war to an earlier phase based on subversion and guerrilla warfare[32]. The deployment by the US Army and Marine Corps of more than 12,000 helicopters over the course of the entire war boosted airmobility to an unprecedented level. Nonetheless, the erroneous US strategic appreciation of the nature of the war ahead led to failure. In Vietnam, the helicopter, like so many previous weapon systems or tactical innovations, proved the validity of the well-known saying: *"strategy trumps tactics every time"*.

The Helicopter through the Prism of Fire Support

The operational use of helicopters in Vietnam to provide mobility support directly under enemy fire reached its limits in view of the exorbitant cost of the more than 5,000 machines destroyed during the conflict. It rapidly became clear that the armed helicopter introduced in Algeria was not enough and the situation required the development of an appropriate fire support platform. The *Army* had anticipated this problem, as shown by the initiation of the Advanced Aerial Fire Support System (AAFSS) research program in 1964, which was supposed to lead to the first attack helicopter. However, with the AAFSS program struggling to produce results, Bell independently developed its own attack helicopter based on its utility helicopter, the UH-1 Huey, culminating in the AH-1 *Cobra* in 1967. Produced in response to an urgent requirement arising from conflicts in Asia, it retained the Huey's engine but with a streamlined fuselage, a forward-mounted cannon and stub wings to carry rockets. Deployed to Vietnam in 1968, where they took part in operations following the Tet offensive, *Cobras* were used as Aerial Rocket Artillery (ARA), a concept proposed to Fort Rucker in the late 1950s but never really implemented until then[33]. The initial idea was to escort the UH-1s and support ground units, as well as prepare artillery before an assault. However, the system lacked coordination, as illustrated by the friendly fire incidents involving *Cobras* at the battle of Hamburger Hill in 1969. Firing from a range of more than one kilometer on the basis of intelligence provided by aerial observation, the Cobras hit friendly positions four times during this battle, killing seven soldiers and wounding over 50[34]. The ARA concept was dropped in 1972, although the fire support role of combat helicopters was far from being abandoned on both sides of the Iron Curtain.

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[30] The forces were not wiped out, as shown by the ambush the next day of McDade's reinforcement battalion, resulting in the death of about 100 GIs. Steven M. Leonard, "Forward Support in the Ia Drang Valley", *Army Logistician*, March-April 2006, p. 45.

[31] Joseph Galloway and Harold G. Moore, *We were soldiers once… and young*, New York, Ballantin Books, 1992, pp. 367-368.

[32] Mao Zedong, "De la guerre prolongée (1938)", *Ecrits militaires de Mao Tse-Toung*, Pékin, Editions en langues étrangères, 1964, p. 262.

[33] John J. McGrath, *op. cit.*

[34] Andrew Krepinevich, *The Army in Vietnam*, Baltimore, Johns Hopkins University Press, 1986, pp. 256-257.

Soviet observers in Vietnam studied the effectiveness of the AH-1 *Cobra*. Up to that point, the Soviets had developed an airmobile doctrine at the tactical level based on the Mi-8 *Hip*, a multi-function transport helicopter halfway between the *Huey* and the *Chinook*. The idea of a combat helicopter led them to develop the Mi-24 *Hind-A*, which was fielded in 1973. Equipped with a 12.7 mm, later 30 mm, cannon and stub wings capable of carrying rockets, the craft was fitted with titanium armor providing full protection against small arms fire. It was also designed to accommodate eight passengers. This transport capability set it apart from US attack helicopter programs: where the latter had been conceived as "flying tanks", the Mi-24 was more like a "flying infantry combat vehicle", even if in reality it was rarely used for transportation[35].

The primary theater of operations for the Red Army during this period was Afghanistan, where the combat helicopter principle was put to the test. Combat helicopters were much appreciated by soldiers in the field who often saw them as their only reliable source of fire support. Interventions by ground attack aircraft were considered too intermittent, and the drawdown that started in 1985 reduced the reactivity of artillery support. In March 1980, as part of the territorialization of the Red Army, "each district received a detachment of special forces [*spetsnaz*, VDV], a contingent of attack helicopters [Mi-24] and transport helicopters [Mi-8, Mi-6]"[36].

Much has been written about the impact of Man-Portable Air-Defense Systems (MANPADS) and particularly heat-seeking Stinger missiles supplied to the *mujahideen* by the CIA starting in the last quarter of 1986[37]. However, these accounts need to be treated with caution: after an initial period of panic, Mi-24 pilots were able to quickly find effective counter-measures by using flares or by flying either at very low altitude to jam the guidance system or very high, beyond the range of the missiles. Helicopter operations moved progressively from 500 m above the ground to more than 2,000 m, with an equivalent loss in precision and reactivity, which increased collateral damage and further alienated the population. Losses, however, were limited to less than 350 helicopters, more than half of which occurred before the arrival of the *Stinger*. From a strategic point of view, therefore, MANPADS performance was less stellar than has sometimes been suggested – all the more so when one recalls that Gorbachev had decided to withdraw from Afghanistan more than one year before they arrived in-theater[38].

By the end of the 1970s, then, the helicopter seemed to have firmly established its place as a key support for maneuver, whether it be the

[35] [1.0] Hind Variants / Soviet Service (http://www.faqs.org/docs/air/avhind1.html)
[36] Mériadec Raffray, *Soviétiques en Afghanistan, 1979-1989, l'Armée Rouge bouleversée,* Cahier de la recherche doctrinale, Centre de Doctrine d'emploi des Forces, Paris, November 2008, p. 33. Accessible at: http://www.cdef.terre.defense.gouv.fr/publications/cahiers_drex/cahier_recherche/sovietique_afghanistan.pdf.
[37] George Crile, *Charlie Wilson's War: The Extraordinary Story of the Largest Covert Operation in History*, New York, Atlantic Monthly Press, 2003.
[38] Rodric Braithwaite, *Afgantsy: The Russians in Afghanistan 1979-89*, London, Profile Books, 2011, pp. 204-205.

mobility or the fire component. Nonetheless, several limitations had appeared in light of these experiments. First, in Vietnam and in Afghanistan, the helicopter tended to "exaggerate two fundamental traits [of classical military culture], impatience and aggressivity"[39], whereas the irregular wars in which they were engaged required time and a genuine effort to restrain violence. Also, the very nature of "*guerre en surface*" never really made it possible to use helicopters above the tactical level for the simple reason that maneuver at the operational level was non-existent in most cases. Finally, in the absence of organic troops, and contrary to Airborne forces, the helicopter remained a support weapon and not a maneuver weapon – in spite of notions like Gavin's Air Cavalry or later on Simpkin's "helicopter revolution"[40], a reference to the armored revolution.

The Maneuver Helicopter, Unfinished Revolution of the Operational Art

The Soviet helicopter concept of employment was much more ambitious than might be assumed from Red Army actions in Afghanistan. In fact, the Red Army had gone further than anyone in studying the possibilities of a real maneuver based on rotorcraft. The studies had started in the lessons learned by Russian strategists from the Yom Kippur War. They noted the fragility of tanks with respect to the new Anti-Tank Guided Munitions (ATGM), and that of close air support aircraft with respect to sophisticated and multi-layered air defense systems. Thus, the armor/aviation combination on which the entire Soviet (and Israeli) operational art had been based since World War II was thrown into question. The result was a renewed interest in platforms such as self-propelled artillery and combat helicopters[41].

As Richard Simpkin wrote in his work on maneuver warfare, "although the United States Army rushed into the air cavalry business with cries of 'vertical envelopment', it was the Soviets, with maneuver theory in their bones, who grasped the true significance built-up a massive body of rotary-wing technology"[42]. The first manifestation of this application was the creation in the early 1980s of 20 air assault brigades comprising Mi-8 transport helicopters and Mi-24 *Hind*, then (in 1989) Mi-28 *Havoc*, combat helicopters. They possessed their own organic infantry, drawn from the elite paratroopers (VDV), and organic motorized infantry comprising BMD-type armored vehicles designed to be "air-transportable" by aircraft and by helicopter[43]. The full brigade of around 2,500 men[44] was designed to be

[39] Martin Van Creveld, *Command in War*, Cambridge, Massachusetts, Harvard University Press, 1985, p. 255.
[40] Richard Simpkin, *Race to the Swift: Thoughts on Twenty-First Century Warfare*, London, Brassey's Defence, 1985.
[41] Matthew Allen, *Military Doctrines of the Major Powers, 1945-1992,* Westport CT, Greenwood Press, 1993, p. 103.
[42] Richard Simpkin, *op. cit.,* p. 47.
[43] Although initially developed to be air-dropped by cargo aircraft at the strategic level, these light "air transportable" armored vehicles were also designed to be transported at a tactical-operational level by huge cargo helicopters like the Mi-6 or Mi-26. The concept derived from this principle of heli-transportation of heavy equipment was called "airmechanization" by the Americans, who subsequently tried to apply it to their own operations. For further details, see David L. Grange,

projected behind enemy lines in order to execute a "hammer and anvil" maneuver on a given portion of Western defense forces and cut off their retreat.

In this respect, these assault brigades were at a different tactical-operational level from the major airborne divisions that were intended to occupy strategic positions, beyond the scope of helicopters[45]. Nonetheless, by planning to include them in the Operational Maneuver Groups (OMG), Soviet military leaders gave the helicopters a maneuver role at a quasi-operational level. Focused on the notion of deep attack characteristic of Tukhachevsky's thinking, the OMGs were small mobile forces designed for deep penetration of the enemy's rear in order to provoke a "systemic operational shock" [46] (*udar*) by dislocating enemy forces. However, these OMGs quickly would have found themselves out of range of heavy artillery, and their organic support would certainly have proved insufficient[47]. Consequently, Soviet doctrine proposed that the employment of air assault brigades should reside directly with the OMGs. As the OMG progressed deeper into the enemy rear, the role of the helicopter brigade was to "attack enemy weapons posing a threat to the group [i.e. OMG]"[48]. This model of the Soviet assault brigade, therefore, enabled the helicopter to "use ground tactically without depending on it for mobility"[49].

Although it did not pursue the "helicopterization" of the maneuver to the same extent, the Western model also contributed during the 1970s and 1980s to the trend towards a maneuver helicopter providing more than just combat support. While the US Army's post-Vietnam thinking led to the creation of the Training and Doctrine Command (TRADOC) in 1973 and a shift of focus to the European theater, advances in attack helicopters were well in sync with concepts of employment – clearing the way for Congress to vote in that same year for the Advanced Attack Helicopter Program (AAHP) which gave rise to the AH-64 *Apache*[50].

The advances observed in the Yom Kippur War in the ATGM domain fit perfectly into the context of Soviet armored vehicle superiority in Europe. The attack helicopter immediately appeared as the ideal platform for this type of weapon using direct fire, providing an effective solution to

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Richard D. Liebert, Chuck Jarnot, "Airmechanization", *Military Review*, July-August 2001, pp. 10-21.

[44] Herman S. Heath, *The Soviet Air Assault Brigade: vertical dimension of the operational maneuver group*, Carlisle Barracks, US Army War College, PA, 1989, p. 7.

[45] Matthew Allen, *Military Helicopter Doctrines of the Major Powers: Making Decision about Air-Land Warfare*, Londres, Greenwood Press, 1993, p. 103.

[46] On this concept of systemic shock, read Shimon Naveh, *In Pursuit of Military Excellence*, London, Cummings Center Series, Routledge, 1997.

[47] Matthew Allen, *op. cit.*, p. 95.

[48] Matthew Allen, *op. cit*., pp. 95-96.

[49] Richard Simpkin, *op. cit.*, p. 130.

[50] "The attack helicopter's unique ability to provide precise close in fires to the engaged infantryman is essential", in the words of General Creighton Abrams to Congress in April 1973, cited in John J. McGrath, *op. cit.,* p. 136.

intervisibility problems at ground level[51]. Thus, the new *Active Defense* doctrine, adopted in 1976, offered the attack helicopter the central role in slowing down or stopping the advance of the Red Army's armored divisions. The notions of airmobility and air assault, however, were discredited, since they were too closely linked to the counterinsurgency doctrine of the 1960s and deemed untenable in the hyper-mechanized context of the European theater – the Soviet concept of *Airmechanization* was not adopted by US forces until later.

It was not until the following decade, with the much more offensive doctrine of *AirLand Battle* (1982) and the notion of *deep attack*, that the maneuver capacities of the helicopter were truly recognized. Even though helicopters were not included in the initial version of *AirLand Battle*, due to the lack of autonomy of the *Cobra*, the fielding of the first AH-64s (1984) boosted the credibility of their vertical envelopment mission, to which *maneuver warfare* theorists[52] were so attached, thus rehabilitating the notion of air assault[53]. Having shaken off the shackles of its strictly anti-tank role thanks to the transition to an offensive maneuver strategy, the helicopter finally acquired the status of a combat weapon.

On an organizational level, this reinforced role for the helicopter translated into changes in structure, the most notable of which was the birth of the Army Aviation Branch in 1983. This emancipation of *Army Aviation*, hitherto attached to the artillery, definitively established the helicopter as a maneuver weapon[54]. At the same time, the *Division 86* force structure proposed by General Starry called for the creation of aviation brigades, each comprising two attack helicopter battalions (up to 36 AH-64 *Apaches*) and a transport battalion (24 UH-60 *Black Hawks*) with organic infantry. This model of helicopter units specialized in airland maneuvers had an impact at division level: the 101st Airborne Division (Air Assault) became the spearhead for airland maneuvers. In France, the creation of the *4e Division Aéromobile* was based on the same employment principle, on a smaller scale. In general, the idea was to liberate these units from the combined arms approach[55] which required that operational tempo be adapted to the slowest vehicles, thus depriving the helicopter of its mobility differential by confining it in many cases to a fire support role. Conversely, large formations based entirely on rotorcraft constituted a first-rate maneuver force on the operational level: using their speed to compensate for their vulnerability, this type of unit seemed

[51] The term "intervisibility" refers to the fact that a point is visible from another point with no intervening visual obstacle. Typically, an anti-tank vehicle cannot fire from the other side of the hill without a forward observer – the helicopter needs only to increase its altitude to overcome the obstacle. Matthew Allen, *op. cit.*, pp. 22-23.

[52] Etienne de Durand, "*Maneuver Warfare*, entre Vietnam et Transformation" *in* Christian Malis (dir.), *Guerre et Manœuvre. Héritages et renouveaux*, Paris, Economica, 2009, pp. 67-87.

[53] Matthew Allen, *op. cit.*, pp. 42-43.

[54] It was listed as such in FM 100-5 *Operations* in 1986. John J. McGrath, *op. cit.*, p. 137.

[55] After the Vietnam War, helicopters were integrated into so-called *Triple Capabilities* or TRICAP joint force divisions. This was the case for the 1st Cavalry Division which hosted three co-existing capacities (armor, airmobility, *aérocombat*).

capable of bringing to the battlefield the same disruptive effect as Napoleonic cavalry or Guderian's *panzerdivisionen* in their time.

In spite of its theoretical and doctrinal attractions, this principle of employment for maneuvers was never really applied for both political and operational reasons, which made it impossible to risk such a gambit. In 1991, during the Gulf War, the 101st Airborne saw Operation *Desert Storm* as an ideal opportunity to apply the principles of *AirLand Battle*. Positioned /as the flank guard of the allied force, its role was to cut off the road to Baghdad, the primary line of retreat for Iraqi armored divisions fleeing to the North. Having reached the Euphrates, General Binnie Peay, who was commanding the 101st, "planned to airlift an entire brigade across the Euphrates by Chinook and Blackhawk helicopters and plunk it down north of the critical city [Bassorah]."[56] This proposal, unprecedented in the history of warfare, was deemed too risky by General Luck, commander of the XVIII Airborne Corps, and General Schwartzkopf at the head of the Coalition. In addition to the risk of losing such an armada (the 101st alone was worth several billion dollars), serious problems had arisen during the first days of ground operations. In the first place, maintenance issues had turned out to be much more problematic than expected, as the sand found its way into the smallest mechanisms, temperatures caused engines to overheat and, in particular, the poor distribution of *Rapid Refuel Points* slowed down maneuvers considerably.[57] Moreover, once *Army* helicopters managed to build up sufficient momentum to outstrip the armored divisions, they tended to cause confusion at the joint force level, forcing the Air Force to move its Fire Support Coordination Line (FSCL), i.e. the line beyond which it could operate without fear of friendly Air Force fire. This type of complication due to the specific tempo of helicopters drew the wrath of General Chuck Horner, who was in charge of air operations and who held the 101st Airborne responsible for the fact that the *Air Force* was unable to prevent part of the national guard from pulling back to Baghdad[58].

Another missed opportunity for the operational use of the helicopter occurred in April 1999, on the sidelines of Operation *Allied Force* in Kosovo, when the USA planned at one time to deploy a battalion of *Apache* helicopters to directly engage the troops of Milosevic. *Task Force Hawk* comprised 6,000 men, 24 helicopters, one Multiple Launch Rocket System (MLRS) battery and 26,000 tons of equipment transported to Albania at a cost of almost 500 million dollars. Unlike Peay's proposal during *Desert Storm*, the mission no longer corresponded to the model of airland maneuver specified by doctrine. Designed as precision complements to air power, the *Apaches* were intended to supplement *Air Force* strikes without putting boots on the ground. Nonetheless, after losing two machines in training alone, high command finally decided

[56] Michael R. Gordon and Bernard E. Trainor, *The General's War*, Boston, Little Brown and Company, 1995, pp. 403-404.
[57] On this subject, read Major E. J. Spinella, USMC, *Helicopter Support In Desert Storm: Fixes Are In Order!*, Washington, Combat Studies Center, 1993.
[58] Michael R. Gordon and Bernard E. Trainor, *op. cit.*, pp. 411-412.

against their deployment, confirming once again the timidity of the military hierarchy with respect to high-risk missions involving helicopters. [59]

In fact, the only true combat experience involving a heliborne force during that decade was Operation *Gothic Serpent* in Mogadishu in 1993, when *Joint Special Operation Command* (JSOC) deployed a force of 16 MH-60 *Black Hawks* and AH/MH-6 *Little Birds* and their organic troops. Employed in an urban environment at low altitude and in hovering flight – i.e. in contradiction with doctrinal recommendations at the time – the helicopters proved to be particularly vulnerable, as was shown by the loss of two machines within a few minutes[60]. This operation appeared to herald the provisional end of the maneuver helicopter and a return to a more modest utilization, in accordance with the priorities given at that time to peacekeeping and complex stabilization operations.

[59] Etienne de Durand, "Les transformations de l'US Army", *Etudes de l'IFRI*, no. 1, July 2003, p. 35.
[60] Mark Bowden, *Black Hawk Down: A Story of Modern War*, New York, Atlantic Monthly Press, 1999.

Capacity Crisis and Doctrinal Questions

The helicopter gradually imposed itself as a key component in airland maneuvers. Initially it provided service support for ground forces, then combat support, before becoming directly involved in the maneuver, accelerating the rhythm and extending the area of action to a considerable degree. As the strategic context evolved, the relevance of the attack helicopter was called into question for a while, even as the transport helicopter was proving itself indispensable in every theater of operation. However, the intensification of conflicts led to a strong comeback by the attack helicopter, though in different ways from those initially planned. This strong demand for airmobile platforms, however, was not anticipated by Western nations, who had real difficulty building up suitable fleets in sufficient numbers. The armed forces, meanwhile, focused on optimizing the use and organization of their airmobile forces, while gradually updating their doctrines.

Breaking Free of Legacies

The extended duration of the industrial and operational development of the helicopter rendered this weapon, even more than others, dependent on political and strategic concepts inherited from the past. Consequently, at the end of the Cold War we inherited a gleaming helicopter fleet, that was however confronted with considerable challenges in terms of operations, capabilities and technology.

Fleets in Transition

The development and entry into service of a combat helicopter are no exception to the difficulties inherent in producing and operating military equipment whose primary characteristic is its extended duration in time. However, the complexity of this weapon system and the amount of financial and political capital on the line render the process even more delicate. Between the expression of a requirement for a helicopter, the signature of the production agreement and the delivery of the first machines, there can be a time lag of several decades. To this must be added the time required to produce the number of machines that have been ordered and the time required for the machine to enter service, which again can extend to several decades. At the same time, it is necessary to bear in mind two essential parameters: the ageing of machines in the previous fleets and the timing of the transition on the one hand, and the adaptation of the new system to the conflict environment, on the other.

Due to the extended duration of this process, fielded platforms and those to be acquired have been largely inherited from the 1980s, and from concepts of employment linked to the "maneuver warfare" paradigm mentioned earlier, concepts which led to heliborne forces being oriented towards autonomous, deep attack operations. This paradigm translated into fleets divided into two major categories: on the one hand, *Utility Helicopters*[61] (UH) for tactical transport (what the French, somewhat misleadingly, call "maneuver helicopters") and on the other, helicopters whose primary purpose at the time was reconnaissance, protection, attack and particularly anti-tank combat. In the US, the AH-64A *Apache* was one of the first attack helicopters developed along those lines[62], followed by the Italian A-129 *Mangusta* in 1983[63]. France, meanwhile, entered into discussions with Germany in 1975, leading to a decision in 1989 to jointly develop a helicopter of this type, thus giving rise to the Eurocopter group and the *Tigre* program.

The helicopters born in this period of fierce international competition were designed to push back technological boundaries. The quest for performance was pursued in all domains: speed, with the development of faster (and stealthier) machines like the Russian Ka-50 *Hokum* which could reach 217mph[64] with its two counter-rotating coaxial rotors; all-weather capability, allowing the helicopter to fly day and night in adverse weather conditions, an aspect that had long been a weak point of the rotorcraft; and, finally, protection as the AH-64A *Apache* was able to detect and jam enemy radar and, and was partly armored, all of which allowed it to resist damage from munitions up to 23 mm caliber.

The most striking advance, however, was in relation to weapon development. The helicopter became a weapon system integrating the full spectrum of systems for target acquisition (laser telemetry, optics, IR camera) and engagement (cannon, rockets, missiles). The AH-64A *Apache*, for example, was upgraded in the 1990s to produce the AH-64D version with its mast-mounted *Longbow* radar. The latter system was capable of detecting and tracking up to 256 different targets, whatever the weather or lighting conditions. It could thus be used to launch "fire and forget" munitions like the *Hellfire* missile. The UK decided to buy this machine, produced by Boeing; it was assembled under license in Great Britain by UK Westland.

This new generation of helicopters was developed with a view to high-intensity combat in Central Europe against a conventional army spearheaded by battle tanks. However, the collapse of the Eastern bloc marked the beginning of a period of transition characterized by the emergence or re-emergence of asymmetric threats whose goal was to circumvent the technological superiority and firepower of Western armed

[61] UH-1 in its different versions, UH-60 *Black Hawk*; Soviet Mi-6 and Mi-8; *Puma*, then *Super Puma* in the French Army aviation unit.
[62] *Advanced Attack Helicopter* program *(1970-1981).*
[63] Patrick Facon, *Hélicoptères militaires. Des premiers vols à la deuxième guerre du Golfe*, Paris, ETAI, 2005.
[64] *Ibid*., p. 149 and p. 152.

forces[65]. Accordingly, there are grounds for questioning the relevance of this type of platform and its suitability for contemporary conflicts.

Ill-Suited but Adaptable Platforms

There is no denying that the operational conditions in which the new-generation helicopter has been employed over the last 10 years do not correspond to the context for which it was conceived.

On a technical level, first of all, the operations in which Western forces are involved now take place for the most part in what the theorist Shimon Naveh called striated space (mountain, jungle, city) as opposed to the smooth space for which the maneuver warfare of the 1980s had been conceived[66]. This operational context presents many aspects that are hostile to the use of helicopters. Night flights in mountainous terrain, extreme heat, dust and sand storms, and the predominance of urban and peri-urban zones exert heavy stresses on the machines and sometimes show the limits of their utilization. Inadequate power due to high altitude, restricted autonomy, frequent loss of ground references, risks due to natural and artificial obstacles, engine overheating and lack of visibility have caused a significant number of accidents in Afghanistan and Iraq and have often disrupted resupply operations.

On an operational level, these difficulties are compounded by the nature of asymmetric combat which seeks to circumvent the power of Western weapons. Armored vehicles sheltered inside houses or hidden in palm groves; snipers concealed in towns and villages; armed bands crouching in vegetation or seeking the natural protection of the mountains; launch platforms adjacent to public buildings; light infantry weapons dispersed across the terrain and among the population, etc. – these are all threats to which electronic deception systems and countermeasures cannot necessarily respond.

On a political-strategic level, finally, the disappearance of the large-scale symmetric threat has led to the end of a certain traditional conception of war involving territory and, therefore, vital interests. Nowadays, Western forces are involved in limited wars[67], with limited stakes and limited resources. In return, their adversaries, vastly inferior in terms of equipment, nonetheless accept confrontation because they are mostly engaged in a fight to the death. In this way, the imbalance in stakes and motivations makes up for technical and equipment superiority and enables them to exploit Western political weak points. Adopting almost systematically asymmetric postures and modes of action, they

[65] Arnaud de la Grange and Jean-Marc Balencie, *Les guerres bâtardes. Comment l'Occident perd les batailles*, Paris, Perrin, 2008.
[66] Shimon Naveh, "Between the striated and the smooth: Urban enclaves and fractal maneuvers", Conference lectured at the symposium *Arxipelago of Exceptions. Sovereignties of Extraterritoriality*, CCCB, November 10-11, 2005.
[67] Hew Strachan, "Les armées européennes ne peuvent-elles mener que des guerres limitées ?", *Politique étrangère*, no. 2, 2011.

seek to turn the combat into a battle of wills[68], and not of weaponry, by targeting our vulnerabilities: military losses, collateral damage and inability to protect civilian populations. These adversaries often take the form of armed groups engaged in guerrilla warfare, but they can also be regular state or para-state forces like Hezbollah, who possess sophisticated know-how and significant light capacities, and who use them to conduct a "hybrid" confrontation mixing high-intensity combat and guerrilla warfare.

Under these conditions, modes of action (vertical envelopment, deep maneuver) involving airmobile divisions or brigades acting in a centralized manner in order to weaken the second echelon of enemy forces no longer seem adequate to counter a diffuse and multi-form threat, whose primary characteristic is often dispersion.

The accumulation of these three types of difficulty can lead to a reduction in the helicopter's survivability by increasing the risk of some of its combat and firing processes, such as low-altitude flight and hover, processes whose primary role was to evade enemy radar coverage backed up by a particularly dense air defense network. Nonetheless, even though the reality of these discrepancies should not be overlooked, attack helicopters inherited from the Cold War have been adapted to the new conflict environment.

For example, the British forces immediately reacted to problems posed by elevated altitudes and temperatures in Afghanistan by upgrading the *Lynx* Mk9 with new engines in response to an urgent operational requirement in Helmand during the summer of 2002.

The US responded to the new strategic environment by cancelling development of the RAH-66 *Comanche* in 2004. This ultra-modern, stealthy design resulted from the technological innovation race between the two blocs, but it would have swallowed up a large portion of US Army budgets. On the other hand, the US chose to upgrade the "*Apache* family" by introducing the *Longbow Apache* Block III (AB3) version with improved data processing and transmission systems, along with enhanced firing capacities. The Americans do not plan to replace this version until around 2020, with a new multi-role attack helicopter known as the Joint Multi-Role Rotorcraft (JMR).

France, finally, also took these changes into account. The *Tigre* helicopter developed by Eurocopter in cooperation with Germany was initially ordered in anti-tank (HAC) and support/escort (HAP) versions, both conceived as a function of the threat at that time. France has transformed its anti-tank version into a multi-role support and attack (HAD) version

[68] Steven Metz, "La guerre asymétrique et l'avenir de l'Occident", *Politique Etrangère*, no. 1, 2003, p. 31.

whose extended range of missions corresponds more closely to current threats[69]. All HAPs will ultimately be retrofitted to the HAD version.

Apart from this, the helicopter also has intrinsic characteristics making it a valuable asset in the new conflict environment. Its speed, first of all, ensures maximum reactivity, allowing it to compensate for the low numbers present in the field – the combined result of an extended theater and reduced manpower.

In addition, its modern sensor suite gives it an early threat detection capability which is the best guarantee of good area coverage and, therefore, space control. Also, its airborne firepower and the variety of its weapon load, enable it to ensure precision support, which is often sufficient for small units in contact with the enemy. Furthermore, it can constitute a powerful deterrent for a lightly armed adversary, as was illustrated by the engagement on the bridges of Abidjan in April 2011[70].

Finally, the mobility of transport and utility helicopters in particular can be used to compensate for the lack of mobility of dismounted soldiers[71] and to secure logistics – if necessary, it can also provide security for the pendulum movements inherent in a logistics footprint that is often extended. Without going back to the "flying taxis" of the wars in Algeria and Vietnam, it quickly became apparent that this key component constitutes one of the only means of compensating, at least partially, for the fleeting nature of the insurgent threat.

Intensive Utilization and Capacity Deficit

Over the past 10 years, the presence of Western forces in numerous theaters has led to intensive utilization of the helicopter, revealing serious capacity shortfalls in the fleets concerned. The operational requirements of the NATO mission in Afghanistan have highlighted the inadequacies of the coalition's airmobile resources, to the point where, in 2009, the Americans themselves explicitly asked their French, German, Italian, Spanish and Turkish allies to increase their contributions in order to reinforce their own fleets[72]. Since this request produced no results – for political and budgetary reasons – the situation was serious enough to consider turning to the Russians to make up for the shortfall[73]. These examples illustrate the capacity tension that exists today in relation to rotorcraft. They also point to the need for a more detailed analysis of the present state of the main Western fleets.

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[69] See tables in appendix.
[70] Jean-Philippe Rémy, "Côte d'Ivoire : la France frappe au cœur du dispositif Gbagbo", *Le Monde*, April 11, 2011.
[71] Pierre Chareyron "Digital Hoplites. Infantry Combat in the Information Age", *Focus stratégique*, no. 30 bis, December 2011.
[72] Sally McNamara, "NATO Allies in Europe Must Do More in Afghanistan", *The Heritage Foundation*, Backgrounder no. 2347, December 2009.
[73] Tom Balmforth, "Russia considers NATO request for helicopters in Afghanistan campaign", *The Telegraph*, December 23, 2009.

In 2004 US Army Aviation had 4,475 helicopters, the US Navy 662, the US Marine Corps 720 and the US Air Force 198[74]. Altogether, therefore, the US armed forces had a fleet of over 6,000 helicopters, not including those of the *Coast Guard*. The figures bear witness to the high importance attached to airmobility by the US armed forces. Within the *US Army*, every active and reserve division has its own dedicated helicopters, the Combat Aviation Brigades (CAB). Each brigade comprises battalions equipped with a particular type of helicopter – a service support battalion; a combat support battalion (UH-60 *Black Hawk* and CH-47 *Chinook*); an assault battalion (UH-60 *Black Hawk*); a light attack/reconnaissance battalion (OH-58D *Kiowa Warrior*); and a heavy attack/reconnaissance battalion (AH-64 *Apache*). To these brigades is added the specific case of the 101st Airborne Division (Air Assault), the special forces helicopter regiment, a number of *Air Cavalry Squadrons* attached to armored cavalry units and the Theater Aviation Brigades providing reinforcement for the CABs.

In 2004, however, with US forces engaged in two theaters of operation, in Afghanistan and Iraq, a report by the Congressional Research Service[75] highlighted fleet weaknesses due to the excessive number of different types of platform in service, with designs dating back in most cases to the 1960s and 1970s. Machines ranged from the nearly antiquated UH-1 *Huey* to the most innovative designs like the AH-64 ABIII. The report recommended an adaptation and upgrade of the fleets in each service. Three years later, a report by the Congressional Budget Office[76] noted that, despite the modernization of some machines and their replacement, the *US Army* needed to implement a general helicopter modernization plan extending through 2030, at an average annual cost of 3.3 billion dollars.

The primary characteristics of US helicopter forces, then, are the huge size of the structures, the abundance of resources and the technical quality of the platforms. This quantitative superiority, compounded for a long time by technology leadership, explains why US forces, in this domain as in others, have been seen as a reference, including in doctrinal matters. In this respect, but also in view of the operational experience accumulated over the past 10 years by US forces, it is necessary to closely follow the latest doctrinal developments in the USA.

The British Army has a total fleet of slightly less than 500 helicopters. Involved for the past 10 years in intensive military operations in Iraq and Afghanistan, despite major budget cuts since the end of the 1990s[77], the British Army has had to undertake huge organizational and financial efforts to restore inadequate airmobility capacities. This situation explains why in 2008, in the face of growing criticism about the shortfall in

[74] Christian F. M. Liles and Christopher Bolkcom, *CRS Report for Congress, Military Helicopter Modernization: Background and Issues for Congress*, Congressional Research Service, The Library of Congress, June 24, 2004.
[75] *Ibid*.
[76] Congressional Budget Office, *Modernizing the Army's Rotary-Wing Aviation Fleet*, November 2007.
[77] Pierre Chareyron, "Les armées britanniques. Un modèle en crise", *Focus stratégique*, no. 23, July 2010.

airmobility resources, the House of Commons Defence Committee[78] issued several recommendations to the government. It underlined the decisive role of the helicopter, even presenting it as a "cost effective[79]" solution due to its ability to increase the operational impact of other components of the armed forces. The report highlighted the shortage of medium and heavy transport helicopters, as well as the unsuitability of a large number of platforms due to their age or simply the stresses imposed by the physical environment (heat and altitude). The high operational tempo made it essential to be able to draw on a substantial fleet. Created in 1999, Joint Helicopter Command aimed to maintain a fleet of 35 helicopters available for British troops deployed in Helmand province. One-third of the fleet, or almost 10 helicopters, was kept in reserve for maintenance operations, so that the remaining two-thirds were available for warfighting[80]. Helicopter availability was also largely dependent on the qualified personnel assigned to their maintenance and the delivery speed of spare parts, which a just-in-time logistics system has had trouble satisfying.

The French Army has around 350 helicopters, while the Air Force and Navy have around 80 each, the *Gendarmerie,* 54, and civil protection organizations, 36[81]. However, as a parliamentary report on airmobility pointed out, a substantial portion of this fleet belongs to another age[82]. 70% of machines are more than 30 years old[83] and average availability is around 60%. Between 2011 and 2016, French airmobility is heading for a capacity gap due to the withdrawal from service of a number of machines, upgrading of part of the fleet and the late arrival of new-generation helicopters like the NH90 and *Tigre*, the last of which will not be delivered before 2020.

At the same time, French armed forces are facing increasing demand for airmobility due to the evolution of the engagement context. When the 2008 parliamentary report was being finalized, French armed forces had 78 helicopters[84] deployed in six different theaters of operation overseas (Ivory Coast, Afghanistan, Bosnia, Kosovo, Chad and the Central African Republic). In 2011, over 100 machines are deployed, including 13 in Afghanistan – which is still not enough to allow French troops to conduct a heliborne operation without US assistance – and around 15 in Libya for an as yet unknown duration[85]. Under these conditions, the new-generation

[78] House of Commons Defence Committee, *Helicopter capability: Eleventh Report of Session 2008-09*, HC 434, Londres, House of Commons, July 16, 2009.
[79] *Ibid*.
[80] Interview with Colonel Hogan, British liaison officer at the Centre de doctrine d'emploi des forces (CDEF).
[81] Armée de Terre, "L'Aviation légère de l'armée de Terre en 2010", *Lettre d'information du CEMAT*, no. 5, May 2010, p. 4.
[82] Commission de la Défense nationale et des forces armées, *Rapport d'information sur l'aéromobilité*, Paris, Assemblée nationale, no. 666, January 30, 2008, accessible at: http://www.assemblee-nationale.fr/13/rap-info/i0666.asp#P256_34380.
[83] Interview with General Baratchart, Commandement Interarmées des Hélicoptères, *Armées d'Aujourd'hui*, 2010.
[84] 33 light attack helicopters and 45 multi-role helicopters.
[85] The original text was written in June 2011.

helicopters which are gradually arriving are already subject to intensive utilization.

Finally, alongside purely military operations, there are now also missions linked to terrorism, humanitarian disasters or technology risks requiring armed forces resources that can support both defense and civil protection missions. At the top of the list of these resources is airmobility, and many helicopters are mobilized each year. In 2009, for example, the French Army deployed a helicopter group comprising 12 utility helicopters and two *Gazelles* to provide security during the NATO summit in Strasbourg. Altogether, more than 50 helicopters are on alert every day under the different security and emergency plans in effect on French territory.

Dependent on long cycles, the helicopter is therefore obliged to undergo phases of adaptation. However, the uncertainty surrounding the strategic context has in no way diminished its utility, which is confirmed by its intensive utilization and capacity challenges. Under these conditions, it is imperative to ensure that fleets are managed in such a way as to allow these adaptations to be implemented, while responding to new requirements that have emerged from recent operations.

Hard Lessons from Recent Operations

Recent events in Afghanistan, Iraq, Ivory Coast and Libya bear witness to a dual reality. While airmobility has established itself as a key resource in contemporary interventions, in parallel there is an ongoing repositioning of the helicopter within the land forces. Recent conflicts have given new-found relevance to know-how developed 40 years ago while, on the other hand, exposing the limits of certain concepts inherited from the end of the Cold War, in particular deep attack and the envelopment maneuver at the operational level. These readjustments do not reflect the futility of these concepts as much as their inadequacy in the current engagement context. In this process of reactive adaptation, it is necessary to review the main changes that have occurred over the past 10 years.

The Shock of Kerbala

It would be reckless to draw definitive lessons from engagements in Iraq and Afghanistan. Nonetheless, in view of their specific character and their duration, it is undeniable that these two conflicts have led Western forces to question the relevance of certain modes of action which have proved to be poorly adapted to the circumstances. The helicopter has not escaped scrutiny, as illustrated by the primary lessons learned by the US armed forces in these two theaters of operation.

From the very first phase of Operation Iraqi Freedom, US and British land forces identified airmobility as one of the contributing factors in attaining the objective of a lightning campaign assuming a very rapid rate of progression all the way to Baghdad. Deep helicopter attacks in accordance with *AirLand Battle* doctrine, however, soon showed their limits. On March 23, 2003, the 11th Attack Helicopter Regiment carried out a deep strike mission, involving two helicopter battalions, with a view to destroying the

Medina division of the Iraqi Republican Guard. The operation was a complete failure: a single helicopter reached the target zone but had to fall back under heavy fire; of the 30 AH-64 Apaches involved in the operation, one was shot down and the other 29 heavily damaged[86]. This failure was undoubtedly due first and foremost to inadequate preparation, whether in terms of intelligence, close air support or lack of coordination due to the elevated tempo of operations. It also showed adaptation efforts by Iraqi forces which, contrary to the first Gulf War, had understood the advantage to be gained from dispersal of equipment and defense in depth. Two days later, it should be noted that another helicopter attack conducted by the 101st Airborne Division north of Kerbala met with greater success[87].

Nonetheless, it has to be acknowledged that the attack of March 23 failed as a battlefield *shaping operation* and did not provoke any "operational shock" at Iraqi command level. On the contrary, it was a genuine shock for US airmobile forces, casting doubts on their traditional modes of action and, at a more profound level, on a concept of employment that had become integral to their identity. On the basis of a single example, it is clearly difficult to know whether this fiasco was due to a fundamental conceptual error or whether it cannot rather be simply explained away by the errors of execution mentioned above. In any case, *Army Aviation*, in agreement with high command, performed no further strike missions of this type, focusing instead on direct aerial fire support for ground troops and gradually reviving cooperative modes of action that had been abandoned since Vietnam.

The 101st Airborne Division, for example, was involved in heavy fighting near the city of Al Hillah against an entrenched battalion of the Republican Guard using the full range of joint resources (tank squadron, artillery battery, air defense systems). In close collaboration with ground forces, including a tank squadron, the helicopters of the 101st provided almost *"over the shoulder"* support for ground units, using the so-called Close Combat Attack (CCA) procedure. Eight *Apache* helicopters were hit by enemy fire but all remained flyable thanks to their protection. Finally, the AH-64 *Apaches* flew numerous offensive reconnaissance missions, in broad daylight, contributing to the destruction of important targets such as artillery and air defense batteries[88]. This type of operation depended on close coordination between airmobile assets (missile-carrying reconnaissance and attack helicopters) and support systems – long-range artillery, intelligence (JSTARS), jamming (AWACS) and close air support (A10). Identified at a range of eight kilometers, targets were engaged using the various resources available as a function of the autonomy of the different machines, which followed each other in waves to allow for

[86] Anthony H. Cordesman, "The strengths and Weaknesses of the A-64 Apache and other attack helicopters", *The Iraq War, Strategy, Tactics and Military Lessons*, CSIS, Washington, 2003, pp. 317-332; Colonel Russell Stinger, *Army Aviation - Back to its Roots*, USAWC Strategy Research Project, Carlisle, US Army War College, 2009.
[87] Anthony H. Cordesman, *op. cit*., p. 320
[88] Armor and surveillance radars were also prime targets for attack helicopters. On this subject, see Major Jamie Cox (United States Marine Corps), "MILINET : A Cobra Pilot's Eye – View of Iraqi Freedom", May 10, 2003, http://www.grunt.com/corps/forum/.

refueling[89]. More broadly, during the offensive, heliborne forces contributed to security through reconnaissance, flank-guard and interval-control missions.

A Counterinsurgency Workhorse

After the invasion phase, the US forces were still concerned about the threat of "light infantry ambushes" and radically reduced the number of independent or deep heliborne operations[90]. Afghanistan and Iraq highlighted the danger of light infantry weapons in the form of assault rifles and antitank rocket launchers, sometimes associated with short-range air defense weapons (12.7 or 14.5 caliber machine guns, MANPADS). More than the weapons themselves, the real threat came from their dispersion and their tactically pertinent usage in terrain whose features were unfavorable for helicopters, such as mountains or urban zones[91]. Not only were traditional detection and countermeasure systems inoperative, but low-altitude flight could be very dangerous in some cases, as was well illustrated by the attack of 23rd March 2003, during which the specific features of military helicopter design[92] saved the crews. Attack helicopters nonetheless continued their offensive reconnaissance, destruction and, above all, combat support missions. With respect to combat in urban zones, for example, the 101st showed its adaptability, using tactics that proved their effectiveness. *Kiowa* helicopters of the Cavalry Squadrons were used directly over built-up areas[93] in an observation role. Quicker and more maneuverable, these helicopters were harder to hit than the AH-64 *Apaches*, which remained in combat support positions close to the urban areas[94] and were used on occasion for larger-scale attacks. The Americans used this type of tactic in Afghan valleys covered with dense vegetation in mutual support of ground troops. Here again, the Close Combat Attack (CCA) procedure seems to have been used to good effect.

During stabilization and counterinsurgency operations, the helicopter retained a key role. It made it possible to take action across the entire theater, which ground forces could not permanently control due to its size and their limited manpower. In 2004, the US Army Aviation alone deployed more than 500 helicopters in Afghanistan and Iraq[95]. They were an integral part of the combat being fought by troops on the ground and provided absolutely essential support in terms of both movement and firepower. Similarly the French helicopter unit of Task Force Lafayette which was engaged alongside troops deployed in Kapisa and Surobi, flew

[89] Anthony H. Cordesman, *op. cit.*, p. 322.
[90] *Ibid*, p. 321.
[91] Between October 2001 and March 2004, *US Army Aviation* lost 44 helicopters through accidents (probably mostly linked to the environment) and enemy fire; Christian F. M. Liles and Christopher Bolkcom, *op. cit*.
[92] Military helicopters are designed to fly even after sustaining serious damage (material strength, duplication of vital electrical and hydraulic circuits).
[93] Anthony H. Cordesman, *op. cit.*, p. 322
[94] The AH-64D *Longbow* is equipped with remarkable sensors: optical, TV, telemetry and laser designator. It is capable of firing the *Hellfire* missile at a range of 8-12 kilometers.
[95] Christian F. M. Liles and Christopher Bolkcom, *op. cit*.

almost 1,600 missions in 2010, including more than 200 fire support missions and more than 250 heliborne operations[96].

Not only did the helicopter substantially reduce reaction times thanks to its speed, but it allowed forces to bypass terrain barriers and evade the omnipresent threat of IEDs when facing insurgents melting into the population. In other words, the operational and tactical mobility of the helicopter illustrated and confirmed the three basic principles of war according to Foch[97]: retain liberty of action, concentrate efforts at a given time on a particular point in the terrain and thus reduce the forces needed in the theater as a whole.

Finally, the helicopter also played an essential role in terms of logistical and medevac support. Psychologically, this latter point is fundamental, since it means that the soldier is practically guaranteed rapid and safe evacuation. The French helicopter battalion based in Kabul was involved in 160 medevac missions in 2010, with an average of 1 hour 30 min between the alert call and the arrival of the casualty in the operating theater[98].

Finally, it is important to note the leading role played by two specific airmobile functions in current operations. For all of the reasons that have been mentioned above, it appears practically indispensable to have a fleet comprising at least one heavy transport platform. The CH-47 has established itself as the workhorse of US and British forces, due to its rugged design and its logistical and tactical transport capacities. The possibility of inserting the volume of one platoon or one company in a single rotation of a few machines constitutes a first-rate tactical asset and a solid security guarantee. Similarly, in Iraq and Afghanistan, special operations have played, and continue to play, a decisive role. As was recently demonstrated by Operation *Geronimo,* which led to the elimination of Ben Laden, the helicopter is the preferred system for this type of unit due to its unique capabilities. Insertion or extraction of intelligence teams, civil evacuations, hostage liberation and air assault: for missions of this type, specially adapted helicopters, like the MH-60 used by US special forces, represent the only weapon system capable of operating in the most hostile environments, even if these operations involve substantial risks.

Although one should probably be careful to avoid the “Afghanization” of military thinking, it is nonetheless clear that the vast majority of current operations (Afghanistan, Ivory Coast, Chad, the Sahel, etc.) – including peacekeeping operations (Lebanon, Congo, etc.) – illustrate the essential role played by airmobility. The technical and tactical characteristics of the helicopter enable it to respond, at least partially, to a very broad spectrum of threats and risks, provided that the conflict environment has been correctly evaluated and the necessary adjustments carried out. Indeed, it is essential

[96] Colonel Alain Bayle, « Hélicoptères français en Afghanistan », *Lettre d’information du CEMAT*, no. 11, May 2011.
[97] Ferdinand Foch, *Des principes de la guerre*, Paris, Economica, 2007.
[98] Colonel Alain Bayle, *op. cit.*

to adapt not only the equipment, but also the organization of forces and the doctrines they apply.

Doctrinal Trends and Force Organization

In view of the way in which platforms and threats have evolved, many armed forces today have been obliged to modify their doctrine, i.e. the principle of employment of airmobile forces, as well as associated command structures. Historically significant changes are underway, such as the decline of the notion of deep attack or the emergence of crucial themes such as urban combat.

From Deep Attack to *Air Ground Integration* (AGI)

Clearly, recent operations in Iraq and Afghanistan dealt a heavy blow to the US concept of *deep attack*, which had already come under close scrutiny during the 1990s. Operations over "striated spaces" posed intervisibility problems and made a dispersed and fleeting adversary difficult to track. Under these conditions, a massive airmobile attack became obsolete, like attempting to catch flies with a hammer. Traditional modes of action, based on fast flights at low altitude, initially designed to evade the fighters, radars and air defense systems of Soviet massed armor, now carried more risks than advantages – witness the far from conclusive experience of Kerbala in 2003[99]. Confirming this change of direction, the phrase *deep attack* did not appear once in *Field Manuel 3-04.126 Attack and Reconnaissance Helicopter Operations,* published in 2007. Similarly, in the section on Attack Missions, the document mentioned only two: Close Combat Attack (CCA) and Interdiction Attack.

Though marginalized in doctrinal terms, the idea of using helicopters to deliver an operational shock was not abandoned, as shown by the manual's retention of the notion of "*shaping and decisive operations*". Nonetheless it seemed that, from then on, such operations would be closely contingent upon a suitable operational context based on meticulous preparation, solid combat support and close coordination, in real time, between intelligence systems (detection, jamming), support systems (CAS, deep artillery), logistics (resupply fuel munitions) and associated ground troops, if any[100]. Faced with these constraints, it is hard to see how the mobility differential, the primary effect that the airmobile maneuver seeks to achieve, could be accomplished in an optimum manner[101].

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[99] Anthony H. Cordesman, op. cit.; "US Apache pilots taken prisoner", March 25, 2003, *CNN*, accessible at: http://edition.cnn.com/2003/WORLD/meast/03/24/sprj.irq.apache.attack/index.html; "Iraq shows off Apache crew", March 25, 2003, accessible at: http://news.bbc.co.uk/2/hi/middle_east/2883043.stm; "Interview with Thomas White", *PBS,* accessible at: http://www.pbs.org/wgbh/pages/frontline/shows/invasion/interviews/white.html; John M. Curran, "Army Aviation Operations During Operation Iraqi Freedom", October 2003.

[100] Interview with an American officer, US Embassy, May 2011.

[101] Here again we see the dilemma mentioned earlier, where a helicopter maneuver loses its advantage when it is tied to the advance of slower units, such as armored forces, infantry or artillery.

While US deliberations on airmobility led to the erosion of the deep attack concept, they sought, on the other hand, to give new emphasis to the "combat support" component of helicopter missions. The new requirement for fire support from infantry that was short on manpower and dispersed on the terrain called for a reorientation in the direction of a concept closer to what had been proposed in the 1960s and 1970s. In a US Army War College study, Colonel Russell Stinger talked of the US Army going "back to its roots"[102]. In this context, pilots and ground troops had to know and understand each other so that each would be perfectly familiar with the capabilities and limitations of the other. Henceforth, the key importance of this integration between ground troops and the helicopter was highlighted under the designation Air Ground Integration (AGI). On the doctrinal level, the concept was evident in the detailed description of protection, surveillance and stabilization missions[103]. In a more offensive perspective, the detailed description of CCA procedures once again showed the desire to "serve the forces" rather than engage in advance guard maneuvers[104]. However, it is interesting to note that the manual insisted several times on the difference between CCA and CAS missions, the latter being normally used to refer to support from Air Force aircraft. The distinction, not immediately apparent[105], is mainly based on the greater autonomy of the helicopter in terms of maneuver, target acquisition and engagement, and, above all, planning. Against a backdrop of traditional inter-service rivalry, there was also a desire to avoid Army Aviation becoming subordinated to the Air Force. While notions like deep heliborne raids had allowed airmobility forces to gain their autonomy within the *Army*, the decision to more or less abandon these notions, leaving airmobility forces with "only" the support role, could be seen as originating from the Air Force, thus threatening the institutional boundaries of the Army.

In terms of command structure, too, the Combat Aviation Brigades (CAB) learned the lessons from recent operations and gave each Brigade Combat Team (BCT) an airmobile component placed under operational control. These *Multi-Function Aviation Task Forces* (MFATF) were associated with the BCTs right from the projection preparation phase, in order to facilitate mutual familiarity and dialogue and, above all, to integrate the airland component into maneuver training and planning within each BCT. Here again, the helicopter pilots could see their autonomy – acquired at such cost in the 1980s – threatened by operations that were increasingly focused on combat support missions[106].

In France, things seemed to be moving in the same direction following the 2010 dissolution of the Brigade Aéromobile – a unit derived from the former 4e DAM of the 1980s, intended to embody the French notion of deep attack. However, the fundamental reasons for this

[102] Colonel Russell Stinger, *op. cit.*, p. 1.
[103] Department of the Army, *FM 3-04.126 Attack Reconnaissance Helicopter Operations*, Washington, February 2007, sections 33-44, 3-45.
[104] *Ibid.*, sections 3-59 to 3-63 *et alii*.
[105] CCA is defined by FM 3-04.126 as "*a coordinated attack by Army aircraft against targets that are in close proximity to friendly forces*". Consequently, there is no operational difference with respect to CAS, except that, strictly speaking, it does not involve support but combined arms combat.
[106] Colonel Russell Stinger, *op. cit*, p. 30.

dissolution were not solely doctrinal and operational in nature – the capacity deficit due to accumulated program delays, along with cost overruns, undoubtedly weighed heavily against the divisionary model. Furthermore, the elimination of the principle of autonomous helicopter attack was in no way confirmed by French doctrine, which paradoxically differed from that of the Americans in being more ambitious. Far from learning the same lessons as the Americans from recent engagements, the new French concept of employment for airmobile forces, published in February 2011, mentions several times "deep destruction" as one of the ALAT's key missions: it even recalls "the flank guard maneuver of the 3e RHC during [the Gulf War]" [107] in this respect. This reference seems to illustrate at least as much a difference of scale as a doctrinal divergence, since "deep destruction" is undoubtedly not far removed from the US concept of *Interdiction Attack*.

On an organizational level, there was a clear desire to put in place structures that would, if necessary, allow for the implementation of this type of autonomous maneuver. A helicopter command (*PCMO aéro*) was set up within land forces command (CFT) charged with operational preparations of individual units and managing human and equipment resources. The *PCMO aéro* made it possible to ensure operational coordination of predominantly airmobile actions at a higher level than that of an airmobile group (GAM+). It was therefore designed to play a key role in first strike or deep operations[108].

The French concept, however, did not come anywhere close to recommending an airmobile maneuver disconnected from the other land components. By introducing the term *aérocombat*, it underlined the "total integration of the helicopter into the airland maneuver" [109] which is by nature combined arms. Accordingly, the helicopter does not offer "support" for land forces but acts in conjunction with other contact functions such as infantry and cavalry, whatever type of link is chosen. In practice, the recommended procedure is that of the US CCA mentioned above and set out in NATO protocol ATP 49[110], thus illustrating that behind differences in vocabulary and doctrinal positions, the principles of employment across the allied forces are in fact convergent.

Finally, it is interesting to note how this combined arms approach can be extended to the maritime domain, with the capacity to deploy a helicopter force from Navy ships. Recently, in Libya, French Navy amphibious assault ships (BPCs) presented ALAT machines with new options, in conditions closely resembling "deep attack" – in any case that is the expression used at command level, even if, from a purely operational perspective, this type of operation more closely resembles an airmobile raid having much less range and scale than the theory of *deep attack*. Operation *Harmattan* thus constitutes the first deployment of the PCMO aéro in the form of a shipborne *Groupement Tactique Aéromobile*

[107] *Ibid*., p. 28.
[108] Etat-Major de l'armée de Terre, *ALAT 10.001 – Concept des forces aéromobiles au sein de l'armée de Terre*, February 2011, p. 34.
[109] *Ibid*., p. 12.
[110] *Ibid.*, p. 26.

executing targeted destruction operations using the whole spectrum of joint resources (air support, naval, jamming).

Air Assault, the Last Bastion of the Maneuver Helicopter?

Less ambitious than deep attack, air assault is also better adapted to the evolution of threats – the ability to seize an airport or a compound is a skill that is still relevant today, unlike the flank maneuver against armored divisions. Accordingly, air assault is now established as the primary expression of a maneuver-oriented conception of the use of helicopters, which has suffered somewhat in the recent conflict environment. Combined arms by definition, this type of operation nonetheless raises the problem of dedicated troops. Even though the main Western doctrines insist on the need to share this know-how as broadly as possible, so that in theory any infantry unit is capable of taking part in this type of operation[111], the Americans and the British both retain specialized air assault units, like the US Army's 101st Airborne Division (Air Assault) and Rangers regiment, and the British 16th Air Assault Brigade.

On the American side, *Field Manual 90-4 Air Assault Operations,* the doctrinal reference since 1987, was updated in March 2011, demonstrating the vitality of the operational debate in this domain. In this document, the principles of maneuver have been set aside in favor of large-scale operations, such as movement of dispersed units followed by a rapid massed assembly for assault, or flying over enemy positions in order to execute a pincer maneuver by a vertical envelopment landing in the enemy's rear[112]. The manual makes it clear that the know-how of specialized infantry troops is absolutely crucial for such operations. True, the distance to the support helicopters (essentially AH-64Ds) and the increasing air-ground digital integration ensure that inserted forces can enjoy massive and accurate fire support, but they also require specific skill sets[113]. While the know-how to perform a heliborne assault, in the strict sense of the term, is widely distributed, the capacities to coordinate and direct attack helicopter fire from the ground are much more complex and are essentially possessed by the *Pathfinder* groups which are organically present only in the 101st and 82nd airborne divisions – and in the special forces.

British forces also possess this know-how inside a dedicated unit, though at a lower level (brigade). The 16th Air Assault Brigade comprises three helicopter regiments, four specifically trained infantry regiments, reinforced with combat and service support elements. With more than 8,000 men, the 16th is by far the biggest brigade in the *British Army* and has therefore been deployed for an extended duration in Afghanistan, as it was

[111] This was the case in US doctrine. *Field-Manual 90-4 Air Assault* stated in section 1-4 that "*all infantrymen and their supporting arms counterparts must be prepared to execute air assault operations*".
[112] Department of the Army, *ATTP 3-18.12 (FM 90-4) - Air Assault Operations*, Washington, March 2011, section 1-5.
[113] *Ibid.*, sections 1-11, 3-4 and 7-7.

in Iraq – where it helped to secure the Rumaila oil field alongside the *US Marine Corps*[114].

France also has an air assault doctrine, though the concept does not appear in the document *ALAT 10.001*. However, the total lack of heavy helicopters, absolutely essential to carry out large-scale assaults, places a large question mark over French capacities in this domain. This deficit has been resolved in Afghanistan through the US *Chinooks* that French troops have been able to use, but this arrangement does not constitute a long-term solution. In addition, the French Army does not have a dedicated unit, preferring to rely on the general diffusion of heliborne skills across the land forces, particularly the light infantry units, which are specifically adapted to perform this type of operation. This is the case of the *11e brigade parachutiste* which is specially trained for air assault. Finally, the special forces also possess this know-how, which is essential to perform infiltration, action and exfiltration[115].

Adapting *Aérocombat* to Urban Zones

Recent airmobile engagements, whether deep attack or air assault, have all run into difficulties linked to the specific characteristics of the urban environment, for which the helicopter has not been designed. Lessons learned from Israeli experience in this area is enlightening, since the mission of their armed forces is focused on defending a highly built-up territory of limited size. In addition, Israel is engaged in an asymmetric war against hybrid adversaries, who combine sophisticated techniques with irregular combat processes.

Analyses conducted after the Second Lebanon War and Operation Cast Lead in Gaza revealed numerous lessons. Combat within urban zones requires a very high level of precision, which means that technology plays a leading role. Extremely fleeting adversaries taking multiple forms (snipers, armed groups, shelters, command posts in public buildings, civil and military authorities, launch platforms, etc.) must be picked out in the midst of populations. The key is to detect these hostile elements and neutralize them as rapidly as possible (often within one minute) while limiting collateral damage. The solution adopted by the Israelis relies on the use of high-performance sensors combined with launch platforms equipped with a sufficient variety of precision weapons. Apart from the 30-mm cannon, the majority of munitions used are GPS - or laser-guided. Depending on the combat phase, the proportion of guided munitions used can reach 90-100%[116]. All of this has to be coordinated by a command and control system that enables real-time decision-making.

The massive use of UAVs starting in the late 1980s is another Israeli specificity that enables them to “smooth the striated spaces”, to use

[114] John Hodgson, “Basra: Strategic Dilemmas and Force Options”, *Complex Operations Case Studies Series*, Case Study no. 8, Center for Complex Operations, Washington, 2010.
[115] Etat-Major de l’armée de Terre, *ALAT 10.001 – Concept des forces aéromobiles au sein de l’armée de Terre*, February 2011, pp. 31-32.
[116] Interview with a liaison officer from CDEF.

Shimon Naveh's expression[117]. Used as sensors to relay a range of intelligence and fire support data in real time and in transverse mode, Israeli UAVs facilitate permanent liaison between sensor and operator, rendering cooperation with the helicopter particularly effective.

Israeli Defense Forces have also innovated in the fight against ground-to-air threats (MANPADS, RPGs, etc.) which can be particularly deadly in urban zones, as the US experience in Mogadishu showed. Adapting a method devised by the Marines, the IDF placed sniper posts on its *Black Hawk* helicopters[118]. Using the same technique as the *door gunners*, this platform remains relatively stable in spite of turbulence and helicopter movements. Armed with a long-range rifle, the sniper is charged with observing and immediately eliminating any ground-to-air threat that emerges at any moment. This innovative air control initiative has attracted the attention of the US Army, faced with similar problems in Iraq, thus helping to diffuse Israeli know-how to other Western nations[119].

The Consequences of Compartmentalization

These profound changes in the role of the helicopter have also raised important questions about organization and command structures. While France and the USA have historically developed their helicopter force with a strong land orientation ("operationally attached to the ground, without depending on the ground for movement"[120]), other models exist. The increasing altitude at which helicopters operate, weapon range and emerging modes of action pose problems of air deconfliction and coordination which give good grounds for studying these alternative models.

In Israel again, helicopters are placed entirely under the authority of the Air Force. Used in direct support of ground maneuvers, they serve as a veritable bridge between the two services, which had suffered from a dramatic lack of coordination during the Yom Kippur War[121]. They are also involved in detecting and destroying portable and lightweight air defense systems that could pose a threat to aviation. AH-1 *Cobras* and AH-64 *Apaches* fly reconnaissance missions providing intelligence for ground troops and airstrikes.

However, the second phase of the 2006 operations in Lebanon showed up the need for better joint force coordination[122]. During some phases of the operations, attack helicopters were transferred directly to

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[117] Shimon Naveh, *op. cit.*

[118] Barbara Opall-Rome, « Israel to Equip Black Hawks with Sniper Posts », *DefenseNews.com*, October 28, 2003.

[119] Alan Stephens, "A Threat-Based Reassessment of Western Air Power", *Working Paper no. 395*, Canberra, Strategic and Defence Studies Centre, January 2005, pp. 11-12.

[120] Richard Simpkin, *op. cit*.

[121] Pierre Razoux, "La manœuvre aéroterrestre dans l'armée israélienne", in Christian Malis (dir.*) Guerre et Manœuvre*, Paris, Economica, p. 62 *et alii*.

[122] David E. Johnson *et al.*, *Preparing and training for the full spectrum of military challenges : insights from the experiences of China, the United Kingdom, France, India, and Israel*, Santa Monica, RAND Corporation, 2009, pp. 218-219.

land forces command in order to resolve this problem. Finally, difficulties emerged in relation to employment and airspace management, due to the restricted areas and the lack of coordination between fixed wing aircraft, helicopters, UAVs and artillery. The lessons seem to have been learned during Operation Cast Lead in Gaza and have led today to a functional model for the use of helicopters under the direction of an air force.

In the UK, the distribution of battlefield helicopters is organized according to the category and function of the machine between the Royal Air Force, for transport helicopters, and the British Army, for reconnaissance and attack helicopters. This creates the need for a joint force coordination of operations. Initially developed with a view to rationalizing platform maintenance costs, the quest for better coordination led to the creation of the Joint Helicopter Command (JHC) in 1999, a truly unified command structure respecting the cultural differences and specificities on each side. JHC has authority over the use of all combat helicopters[123], except for those involved in rescue missions and those based on frigates.

This traditional organization proved problematic during the deployment of British troops in Iraq for Operation *Telic*[124]. The distribution of helicopters resulted in redundant chains of command and an unsatisfactory allocation of machines to the different units involved. Thus, the Army's reconnaissance and attack helicopters were subordinated to the 16th Air Assault Brigade, while all Royal Air Force and Royal Navy utility helicopters were grouped together in a single command structure. The other units had no dedicated resources at all. The British Army reacted to this situation by creating a joint command structure, the Joint Helicopter Force Iraq, responsible for all resources dedicated to airland combat. However, the units still remained separate and each service continued to be allocated a specific type of machine. This command structure was also adopted in Afghanistan for Operation Herrick.

This example illustrates the importance of organizational and doctrinal choices in peacetime and their consequences during operations. From this point of view, the British vision diverges from the US and French organization, which prefers to integrate within the land forces all airmobile resources intended for airland combat.

In France, where the Army possessed historical primacy over rotorcraft, progress towards coordination and jointness proceeded only gradually and by necessity. Joint Helicopter Command (*Commandement Interarmées des Hélicoptères*; CIH) was only created in 2009 under the direct authority of the Armed Forces Chief of Staff (CEMA); its task was to "optimize, coordinate and harmonize the missions of the armed forces helicopter component". As in all other fields, crews were influenced by their own service's culture and maintained specific skills designed to comply with

[123] Interview with an officer from the Centre de doctrine d'emploi des forces (CDEF), May 2011.
[124] Interview with an officer from the Centre de doctrine d'emploi des forces (CDEF), May 2011.

the operational contracts of the armed forces. To improve coordination, it was necessary to establish helicopter standards and harmonize training and qualifications.

The initiative seems to have been a success since, at the end of 2009, the Kabul helicopter battalion or *Bathelico* serving French forces in Afghanistan had under its command elements belonging to the different services (12 machines in all, including one belonging to the Air Force). However, nobody should be under any illusions about the work that remains to be done in terms of jointness; contrary to its British equivalent the CIH has no authority over the use of platforms but acts in a more indirect manner, advising the CEMA. Far from representing a culmination, this initiative is a first step towards building closer ties in a process whose greatest challenge will be to increase interoperability between the services without losing the know-how specific to each one.

Numerous challenges lie ahead for the helicopter over the years to come, judging by the capacity-related, industrial and tactical-operational issues to emerge from the analysis of recent operations and major doctrinal trends. To be sure, the full spectrum of missions is now completely covered – from logistics and medevac to deep attack, fire support and mobility – signifying the culmination of an extended cycle of technological maturation. Going forward, however, the supreme accomplishment will be to find acceptable terms of employment in the face of the growing gap between the doctrinal and strategic ambitions of the armed forces and the economic and budgetary realities of a system whose cost is now out in the open.

Contrasting Future Perspectives

Based on recent lessons learned and foreseeable trends, strong demand for airmobile forces should in all probability be confirmed in the future. However, the technological orientation of Western forces seems to be reaching certain limits under the combined effect of growing equipment costs and budgetary difficulties. In these circumstances, armed forces opt for mixed fleets and for integrating weapon systems designed from the outset to be adaptable and modular, in order to make best use of their effects and control costs. This reality is of course applicable to helicopters: the armed forces are adapting current platforms while also reflecting on criteria for developing future platforms. While many innovations such as UAVs seem promising, other scenarios could pose problems for the rotorcraft.

The Crucial Question of Costs

In recent decades, the average cost of military equipment has risen steeply. Airmobility is no exception to this rule, particularly due to the arrival of new-generation helicopters. This increase is partly because of technical and technological improvements to the equipment, but there are other causes, too.

First, it is necessary to recall the exact nature of the specificities linked to military helicopter development. When a commercial operator purchases a civil helicopter, his primary concern is to make a return on his investment. The helicopter is in most cases designed for a very specific role, for intensive utilization over a short period, generally involving a fairly limited number of machines. In the military, the approach is completely different. Procurement generally covers an entire helicopter fleet, which must be designed in response to a broad spectrum of missions undertaken in the most adverse conditions (day and night, temperature, weather). Combat helicopters must withstand a wide range of damage, which means systematic duplication of vital systems, use of complex materials and increased structural weight, which is a serious handicap in aeronautical terms. They must achieve high performance levels in terms of engines, noise reduction, autonomy, etc. As a weapon system, they must integrate data acquisition, communication and designation systems, along with, obviously, a whole range of weapons, the use of which generates significant structural stresses. These machines have a service life of at least 20 years, in practice maybe twice that, with utilization rates that can vary widely depending on circumstances. Finally, as with any aircraft, every possible precaution must be taken to avoid equipment failures, which are often fatal. Considering this list of requirements, it becomes easier to understand the

difficulty that the military have in estimating costs and the difficulty that industry has in keeping them under control. The extent of these difficulties can be magnified considerably when, in addition, the helicopter is being developed for the first time.

Second, mention must be made of specific factors related to the key domain of defense aeronautics. Beyond the fact that defense issues are one of the core competences of the state, weapon programs with high development and production costs are nowadays conducted as partnerships between several nations. Aeronautics is a domain of scientific excellence with dual applications. Companies which possess this know-how are relatively few in number but they operate on an extremely competitive market. Accordingly, each state, even in a period of tight budgetary constraints, must monitor the long-term health of these industries. In these conditions, political, security, financial, industrial and economic issues are closely connected. The increasing cost of equipment must also be analyzed with these issues in mind.

In reality, development and production within an international cooperative framework generally mean that the difficulties inherent in the conduct of any ordinary program are greater and more complex. For example, one can observe the excessive duration of frequent negotiations between partners who hesitate and sometimes procrastinate. As an illustration, the first Franco-German discussions on the *Tigre* helicopter took place in 1975, but the development contract was not signed until 1989, 14 years later[125]. The same observation can be made concerning the NH90, whose development was not completed until 1992, even though it had been scheduled to enter service in the 1990s. In addition, and this is a major drawback of cooperation, while the definition of a single platform is intended to reduce production costs, modifications and special features required by certain countries in terms of system specifications end up transforming the concept of an “off the peg” machine into a “tailor-made” machine. The NH90 now comprises more than 20 different versions.

Finally, the reduction in the number of units ordered, for whatever reason (budget constraints, changes in the operational context), automatically leads to an increase in unit cost. In the long term, this increase has an impact on shrinking budgets and completes a vicious circle by causing a further reduction in the number of units ordered. Few companies can withstand regular, significant changes to their order book. The French order for the *Tigre* helicopter was reduced from 215 machines to 80, resulting in a cost increase of 78.1%[126]. The same phenomenon can be seen with the NH90, where the reduction from 220 to 160 machines has led to a 21.4% cost overrun[127]. Production delays are another major source of cost increases, whether they are due to technical or industrial difficulties, a stretch-out of orders for budgetary reasons, or a combination of several of these factors.

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[125] Cour des comptes, *Rapport public annuel 2010*, February 2010, p. 51, accessible at: http://www.ccomptes.fr/fr/CC/Sommaire-23.html.
[126] *Ibid*., p. 50.
[127] *Ibid.*

All of this makes it easier to understand what appears at first sight to be a massive increase in costs marking the transition from one helicopter generation to the next (between the *Gazelle* and the *Tigre*, the ratio is reportedly around 1 to 25). This explosion in acquisition and ownership costs inevitably has an influence on how these platforms are used and reinforces trends towards cautious engagement, preferably at standoff distance. It also influences future trends in force structure, whether in terms of the heliborne platforms themselves, the number of platforms ordered or available or, finally, the mixed fleet makeup that is destined to become a long-term feature of Western helicopter forces.

Platform and Fleet Evolution

Any deliberation regarding platform evolutions depends on current and foreseeable data concerning the operational context and budgetary constraints. The operational context calls for machines capable of responding to a broad spectrum of missions and a high level of demand. At the same time, budgetary constraints and increased equipment costs oblige all players, whether political, military or industrial, to take every possible step to encourage cost control, which probably implies the emergence of mixed fleets, i.e. comprising several generations of platforms dedicated to specific mission profiles. In other words, it will prove impossible, particularly in Europe, to modernize the entire helicopter fleet. This raises the question of upgrading older systems like the *Gazelle* and, more generally, leads one to evaluate the optimum mix between upgrading and modernization – knowing that technological progress is ongoing, which makes it necessary to examine certain hypotheses, including the future role of UAVs and their possible use in conjunction with helicopters.

Short-Term Adaptations

To achieve the goals of adaptation, there are five main levers: reactive adaptation, the upgrade of existing platforms, force reorganization measures, the optimization of maintenance and logistics support chains, and, finally, resource-sharing within coalitions or as part of specific government agreements.

Reactive adaptation consists in finding a rapid response to a specific problem by adapting existing platforms. This solution relies on the learning process within the armed forces, which analyze the reports from operational theaters and pick out the most relevant lessons learned[128]. Once the need has been identified, there are different processes enabling the armed forces to make contact with industry while seeking an extra budget envelope if need be. These procedures may be specific to one service, like the reactive adaptation procedure that has been set up within the French Army, or they may be joint in scope, like the procurement procedure for urgent operational requirements used by the French, British and American forces. During recent conflicts, this type of procedure has covered the re-engining of certain helicopters such as the British *Lynx* MK9, in order to cope with the combined effects of heat and altitude in Afghanistan, which imposed significant limits on helicopter capacity. It has also covered ballistic protection against small arms

[128] Corentin Brustlein, “Apprendre ou disparaître. Le retour d’expérience dans les armées occidentales”, *Focus stratégique*, no. 33, October 2011.

fire (protection of the floor and pilot seats on the CH-47); and the absence or inadequacy of weaponry, leading to the installation of the SH20 cannon on the EC-725 *Caracal*. Rapid adaptation, potentially limited to machines deployed in a specific theater of operations, can be complemented by other measures on a larger scale.

Such measures constitute the second lever, based on upgrading existing platforms, in order to extend their operational life. Required when an excessive service life makes it necessary to ensure compliance with standards, this option generally provides a stopgap solution pending the arrival of a new platform. Thus the UK has launched the Puma Life Extension Programme (LEP). It has also modernized the CH-47 Chinook, the earliest version of which dates all the way back to 1962[129]. Although the current model is deemed entirely satisfactory, the D version will be equipped, among other things, with a more powerful engine and, therefore, increased payload capacity. France is also planning to upgrade certain machines, including the *Cougar*[130], to compensate for the late fielding and stretched deliveries of the NH90. If necessary, this procedure may be complemented by the procurement of a few machines, such as the Caracal, to ease the transition, but this solution is not generally favored in order to avoid the problem of micro-fleets, which are costly and complex to manage.

The third and fourth levers aim to enhance the use of helicopters within the armed forces through reorganization and optimization measures. The purpose of reorganization measures is to increase interoperability and flexibility of missions in the armed forces through improved coordination and harmonization of procedures. This was one of the reasons why the UK and France created a joint helicopter command in 1999 and 2009, respectively. In the case of the UK, the process was accelerated and intensified by the need to support a joint detachment of 30 helicopters[131] and 600 people from 2006 onwards. The second measure aims to increase the availability of helicopters through increased efficiency of the maintenance and logistic support chains. It is partly linked to the first, in that certain efforts, such as procedure harmonization, contribute towards it. In this way, the British government managed to increase helicopter availability for forces in Afghanistan between 2006 and 2009 by around 60% and the number of flight hours by 84%[132].

The last lever is both political and organizational. Fleet-sharing in the context of deployments of coalition forces is a good example- as was the case in Afghanistan when the British Joint Aviation Group was integrated into the 3rd US Marine Aircraft Wing. Thanks to this integration,

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[129] Boeing Media, "Boeing Celebrates Production of 100th CH-47F Chinook", Boeing Rotorcraft Systems, July 21, 2010, accessible at: http://boeing.mediaroom.com/index.php?s=43&item=1333.

[130] Revue d'information de l'ALAT, *En vol vers la 4ème Génération*, no. 21, January 2011, p. 48.

[131] See tables in appendix.

[132] House of Commons Defence Committee, *First Special Report: Helicopter Capability - Government response to the Committee's Eleventh Report of Session 2008-09*, London, House of Commons, accessible at: http://www.publications.parliament.uk/pa/cm200910/cmselect/cmdfence/381/38102.htm.

British troops enjoyed increased availability in airmobility and better support than they would have had in an autonomous operation. Such a solution can also proceed from a bilateral political agreement covering shared capacity and resources. An obvious example is the Franco-British treaty of 2010, which established a framework for unprecedented forms of pooling and sharing. An agreement of this type would offer French forces the possibility of relatively stable access to British Chinooks, a heavy helicopter that France does not possess at all[133]. This type of arrangement naturally assumes that the two partners can find mutually advantageous common ground and can define satisfactory "loan" conditions.

Some of these levers have the advantage of implementing solutions that appear to be relevant in the long-term. Others undeniably produce effects in the short and medium term but do nothing to resolve underlying problems such as platform ageing, which continues to increase. They inevitably lead to overuse of the overall fleet and only postpone the timing of the capacity shortfall, the size of which will be, at the end of the day, even greater because of them.

Another factor is that life extension programs decided in haste generate substantial maintenance costs due to the significant increase in frequency of shop visits, the need to sustain the training cycle for pilots and mechanics on too many helicopters of different types, or the effort to bring downgraded machines into compliance with standards. At the very least, pushing back and spreading out over several years the entry into service of new machines results in a capacity shortfall and considerable extra expenditure. French transport helicopters are a case in point[134]. While the high tempo of operations is the primary cause of over-utilization of the *Puma*, the delayed entry into service of the NH90 and the stretch-out of deliveries only exacerbate the phenomenon and generate extra costs for all the reasons mentioned above. The timely replacement of platforms with new-generation machines should not, therefore, be considered exclusively on the grounds of operational considerations; it also seems to constitute, from a budgetary viewpoint, a more coherent solution in the long term.

Despite these considerations, in the absence of any foreseeable perspective of integral platform replacement, upgrading is a necessity in the face of ongoing operational imperatives. From this point of view, it is hard to imagine the *Gazelle* in its current form operating alongside the *Tigre* in 2020 without receiving an upgrade. Thus the coexistence of upgraded platforms alongside new-generation machines could well constitute a major trend over the coming years.

[133] Etienne de Durand, "Entente or Oblivion: Prospects and Pitfalls of Franco-British Co-operation on Defence", *Future Defence Review*, Working Paper No. 8, Royal United Service Institute, September 2010.
[134] Commission de la Défense nationale et des forces armées, *op. cit.,* p. 27.

Mixed Fleets on the Way?

All of the parliamentary inquiries[135] undertaken in the US, the UK and France call for the development of multi-role platforms capable of responding to a broader spectrum of missions while reducing costs related to production, utilization and maintenance of helicopter fleets. But is this aspiration realistic? On several occasions in the past, industry and the armed forces have considered building a single platform combining transportation and attack capabilities. True, certain specific situations require transport helicopters to be armed so as to give them an increased defensive capability and a certain offensive potential, e.g. in the case of the MH-60 *Black Hawks* ("Velcro Hawks") of the US special forces which have been fitted with additional weapons. However, the vast majority of airmobile forces have opted for a distinction between a segment dedicated to transport and a segment dedicated to reconnaissance and attack, in view of the increased specificities required from each type of machine.

While the distinction between these two segments seems likely to persist in coming years, it is nonetheless legitimate to seek to reduce the number of different platforms within each category. Thus, most airmobile land forces have opted, on the one hand, for a multi-role utility helicopter able to perform all essential tactical transport missions (personnel, medevac and logistics) and, on the other, for a combat helicopter, also multi-role, able to perform all attack missions (reconnaissance, support and destruction of an extremely wide target selection). This adaptation is often carried out in mid-life, in view of the long cycles mentioned above. France provides an excellent example. Initially planned in support/protection and antitank versions, the *Tigre* helicopter was modified for the support-destruction role in cooperation with Spain, as the expanded capabilities of the HAD version are better suited to current requirements. Similarly, the NH90 is intended to satisfy Army and Navy requirements in its different versions: tactical transport helicopter (TTC) and NATO frigate helicopter (NFH).

However, budgetary constraints and program stretch-outs, which have limited the number of available machines (30 *Tigres* in 2011), have combined to prevent a general modernization that is rapid enough to cover the operational requirements of the forces. Furthermore, feedback from recent operations has shown the advantages and relevance of mixed patrols (*Apache-Kiowa* and *Tigre-Gazelle*). As such, the activation of the second lever, i.e. the upgrading of a portion of existing platforms, seems inevitable. Thus, the US Army is simultaneously upgrading its fleet of *Chinook, Black Hawk, Kiowa* and *Apache* helicopters while studying the introduction of two types of rotorcraft after 2020: the Joint Multi-role Rotorcraft (JMR) in a *utility helicopter* version and an *attack/reconnaissance* version. They are intended to replace the *Army's* UH-60 *Black Hawk* and AH-64 *Apache*, but they are also expected to be fielded with the other services to help reduce the number of different platform types.

[135] House of Commons Defence Committee, *op. cit.*; Commission de la Défense nationale et des forces armées, *op. cit*; Christian F.M.Liles and Christopher Bolkcom, *op. cit*.; Congressional Budget Office, *Modernizing the Army's Rotary-Wing Aviation Fleet*, November 2007.

Upgrades make it possible to carry out a transition while waiting for new fleets to enter service. Thus, the *Gazelle* helicopter should remain in service in the armed forces until 2020 or even longer, pending the arrival of the four-ton helicopter, HC-4. This multi-role helicopter is intended to replace several types of machine currently in service in the French armed forces, in order to help reduce the number of platforms and thereby cut costs. However, its definition is complicated in view of the requirements and differences in use in each of the services, and there is a risk that this future platform may end up not satisfying anyone.

As far as the transport segment is concerned, the question of developing or purchasing a heavy platform remains open. The lesson learning process shows that the requirement exists. The nature of the environment, tactical imperatives and the decisive importance of logistics support have not only increased the need for mobility; they have also highlighted the key importance of the volume transported. Four CH-47s can set down the volume of one infantry company in a single rotation, thus enjoying the advantage of surprise and a favorable balance of force. Air assault operations conducted in the past have always validated the significance of these findings, which are particularly important for infantrymen. British and American forces have these platforms, which France lacks, in Afghanistan and elsewhere. In view of the costs, the acquisition of a machine of this type would have to take the form of either a joint development bringing together several states and the know-how of several industry players, or a sharing agreement. Although *Tigre* and NH90 deliveries clearly remain the priority for now, it is nonetheless necessary to start thinking right now about the different options that might one day fill this capacity shortfall which is weighing heavily on the French Army.

Future Developments

New-generation platforms feature the latest advances in aeronautics, giving military helicopters improved flight performance. These platforms are also weapon systems that a long process of incremental technological progress has taken to the highest level. This process of gradual improvement seems assured, however the possibility of breakthroughs, negative and positive, cannot be ruled out. The possibilities offered by *aérocombat* could reach a new milestone through the combined effect of networking and the combination of different systems. Conversely, the proliferation of high-performance air defense systems could jeopardize all or part of the modes of action of airmobile forces.

Technical and technological progress offers new-generation machines unprecedented capabilities: lighter and stronger materials of construction, increased autonomy, more powerful engines, reduced acoustic signature, more accurate navigation systems, enhanced data acquisition and protection systems, and more effective weapons and munitions. In future, scientific advances will in all probability continue to shape airmobility developments. Designed as weapon systems integrating multiple functions, helicopters will have to become truly modular, making it possible to change part of the system without affecting overall integrity. In view of current and foreseeable budget constraints, this need for modularity is likely to increase and make itself felt at all levels (equipment,

protection, weapons), especially with the emergence of multi-role machines. For example, most modern reconnaissance and attack helicopters, like the *Apache* or the *Tigre*, are equipped with a cannon developed to fire different types of munition, but it is not possible to choose the desired munition at a given time. Lessons learned from combat in urban areas, however, shows the advantage of being able to select precisely the munition to be used in an effects-based perspective[136]. Modifying the existing system at this stage appears complex, although it is still possible to equip helicopters in the same patrol with different munitions. In the long run, it will be imperative for all players involved, on the military side and on the industry side, to take this type of data into account in their considerations.

In terms of data acquisition, day/night observation and detection capabilities will probably increase and become more diversified, e.g. through progress in information sharing and cooperation with other aircraft such as UAVs. The helicopter would then become as capable of detecting a group of insurgents moving through mountainous terrain under cover of fog, as an armored column crossing the desert at night. There will probably be an increasing need for this capability, even including discrete variables: e.g. to pick out an armored vehicle or a sniper camouflaged in an urban zone and to alert the pilots in the event of a surface-to-air missile launch or small arms fire.

Target engagement capabilities will be subject to the same requirements. Weapon range and precision are likely to remain the focus of continuing efforts, but one can probably also expect the development of a whole range of munitions adapted to different situations. Missiles, rockets and projectiles will have to destroy armored vehicles, reinforced buildings and dismounted personnel with maximum effect. In parallel, they will have to be capable of penetrating a building and neutralizing the occupants without causing the building to collapse, or conversely eliminating a sniper in a street without the munitions penetrating buildings and hitting civilians[137].

Helicopter protection and armor, finally, will require special attention. Beyond installing additional protection, reinforcing certain structures and duplicating vital circuits, other factors can be improved which contribute indirectly to reinforcing helicopter survivability. Advances in stealth, such as reductions in radar, visual and acoustic signatures[138], offer significant results in this respect, as does the development of early detection capabilities or jamming countermeasures.

In parallel with progressive improvements to current machines, breakthroughs, if there are any, will stem either from a radical increase in

[136] Interview with an officer from the Centre de doctrine d'emploi des forces (CDEF).
[137] Interview with the head of Domaine Armement at Nexter Industries.
[138] Onera, "Nouvelles pales silencieuses grâce au partenariat Onera-Eurocopter", 2009, accessible at: http://www.onera.fr/actualites/2010-0503-nouvelles-pales-silencieuses-partenariat-onera-eurocopter.php.

the threat or from the transformational effects resulting from platform networking and in particular from cooperation between UAVs and helicopters. Networking and cooperation should encourage a "combination of capabilities" allowing for even greater target differentiation without systematically resorting to combined effects.

UAVs will undoubtedly contribute to major advances in airmobility. Two avenues are already being explored and implemented in different countries: UAV-helicopter cooperation and the development of rotary wing UAVs. UAV-helicopter cooperation can work in two different ways. The UAV can be an autonomous platform, capable of intelligence gathering, detecting and identifying different types of threat using a variety of onboard sensors (optical, thermal, radar, as well as localization and listening systems). Integrated within a digital communication and exchange network, it can then relay these data in real time to different platforms, including the helicopter. The latter can then engage safely by using standoff fires and a wide spectrum of weapons and munitions, to be significantly enhanced in the near future by a beyond-line-of-sight (BLOS) firing capability.

The UAV can also operate as an extension of the helicopter, with the latter taking control of all or part of the UAV's sensors or even the complete UAV. The most recent, Block III (AB3) version of the AH-64D Apache includes this capability. In parallel, the rotary wing UAV can also function as an autonomous intelligence-gathering and data-transmission platform, but with all the advantages of the rotorcraft in terms of flight and flexibility of utilization (touchdown zone). It can be fitted with appropriate weapons. Several models already exist, such as the EADS *ORKA* naval UAV or Boeing's A160 *Hummingbird*.

Integration of all modern weapon systems into increasingly sophisticated communication and digitization networks should constitute a major focus of future developments. In the French SCORPION program, the helicopter is intended to become totally integrated into a high-performance battle management and information system. Even as things stand, the helicopter's acquisition systems, combined with its ability to bypass terrain barriers and climb to higher altitude, give it unique intelligence-gathering and support capabilities. Integrated into a digital network, the helicopter can share these capabilities while using information from ground sensors that directly contribute to its protection. Connecting ground forces and helicopters to the same network should accelerate all decision-making and alert procedures, while also optimizing fire coordination and use of support (selection of appropriate munitions). It should also help limit the risk of friendly fire among ground forces.

Finally, the development of innovative concepts, along the lines of the *V-22 Osprey*, could generate fresh momentum in the heavy transport domain. These hybrid, tiltrotor aircraft have fixed wings enabling them to fly greater distances. The US is looking at the Joint Heavy Lift Rotorcraft[139], a platform designed to enter service in all three forces in the 2030 timeframe.

[139] Cf. appendix.

However, this type of machine seems mostly suited for operations such as an assault landing to seize control of an airport facility.

Of course, the achievement of these various possibilities is partly dependent on maintaining the current situation, which is characterized by the total tactical dominance of Western forces. Like fixed wing aircraft, helicopters have become accustomed over the past 20 years to the absence of a symmetrical enemy. However, this superiority could be endangered in the future, either by the development of high-performance, widely available new-generation air defense systems (MANPADS in particular), or by the emergence of comparable adversaries, equipped with modern forces and a significant aviation fleet. The latter point is all the more important considering that the latest helicopters tend to avoid threats by climbing to higher altitude. In such a scenario, the advantage of mixed fleets and especially the viability of upgraded previous-generation helicopters would soon be jeopardized. From this point of view, the current new-generation helicopter is the only one capable of providing a genuine response in the long term to a broad spectrum of missions and scenarios ranging from stabilization operations to high-intensity combat.

The current political-strategic environment determines not only the nature of conflicts; it also influences the format of the armed forces. In Europe, budget difficulties and political choices have led successive governments to opt for a reduction in manpower and force structures. Accordingly, armed forces, with minimal human resources, are more often than not tasked today with bringing long-term stability to vast areas with hostile physical characteristics and significant local populations. The helicopter is no substitute for the lack of personnel but it does reduce the impact. As a platform for operational and tactical mobility, it gives ground forces a real capability to anticipate, prevent and act, which can prove decisive across a theater of operations.

Looking further ahead, it is therefore essential that the major European armed forces do not lose the capabilities and aptitudes to fight against a symmetrical enemy. The current and foreseeable drawdowns affecting European land forces have left them with heavily reduced force structures, particularly in terms of armor, with the result that attack helicopters will perhaps soon represent one of the only remaining decisive capabilities. Combat aircraft and helicopters are one of the rare domains in which Europe can hope to retain a net advantage over its most probable adversaries in the medium term.

In many respects, the helicopter is a good example of the evolution of Western forces in the direction of high technology and standoff combat, with all the consequences that this transformation implies in terms of utilization, doctrine and costs of those same airmobile forces. In this regard, helicopters seem to be undergoing a similar evolution to that of combat aircraft, despite the fact that current engagements call for a general return to “safe military values” such as simplicity, ruggedness and all-arms combat. In reality this paradox, typical of contemporary interventions, is only apparent: Western superiority indeed breeds an asymmetrical adaptation which in turn reinforces the “capitalistic (i.e. technological)

intensity" of Western forces. However much one might deplore it, noting for example the lack of tactical mobility of "modern-day hoplites" [140] or the soaring cost of equipment, only through lucid anticipation of these trends can we hope to control them. As Clausewitz would surely have observed, the kind of warfare that Western armed forces are engaged in reflects the socio-political realities of our time and it is largely futile to seek to go back in time to earlier conditions. The evolution of the helicopter towards increasing sophistication fully reflects this state of affairs.

[140] Pierre Chareyron, *op. cit*.

Conclusion

After their rather humble beginnings, helicopters were at one time seen as the future of land warfare, the new decisive weapon replacing the battle tank, both tactically and, especially, grouped in formations at the division level and beyond, operating deep behind enemy lines. This vision, typical of the end of the Cold War, has proved poorly adapted to the political conditions and the operational realities of today's conflicts, where Western armies face light, dispersed forces in campaigns that combine stabilization and coercion, and in some cases counterinsurgency. Western airmobile forces have had to adapt and rediscover some of the tactics and procedures used 40 years ago when the helicopter was making its debut as a combat platform. They have been largely successful in this effort, combining interdiction and support at standoff distance performed by latest-generation platforms incorporating all the latest technological advances, as well as close support using older helicopters.

Valid for both attack and utility helicopters, this distribution of roles seems destined to endure and constitutes a good argument for maintaining mixed fleets combining several types and generations of machines. It is only in this way that airmobile forces will be able to respond to the numerous demands that are being, and will continue to be, made of them. Faced with a broad spectrum of missions in theaters that are most often vast and bleak, demand for tactical transport and for systems providing cover or decisive impact, i.e. utility and attack helicopters *par excellence*, should logically remain high and perhaps even increase, unless a drastic reduction in missions or force structures were to take place.

Nonetheless, numerous questions remain unanswered, particularly concerning costs. While there is no doubt about the need for helicopters, the capacity of European forces to meet that need remains very problematic. Combined with the continued downward trend in defense spending, which seems very likely to continue under the impact of the current economic and budgetary crisis, acquisition and ownership costs of the latest-generation platforms represent such a burden on French Army budgets that it has already been obliged twice to revise downward the number of machines initially planned. More generally, investments in sophisticated equipment like helicopters leads to technology "crowding out" numbers, and there are grounds to believe that this phenomenon has already reached the limits of what is reasonable, regarding helicopters and also more generally. To guarantee the long-term viability of the force structures developed today, it is therefore essential to achieve better cost control. Some elements of the answer already exist, starting with the intensive use of simulation or the outsourcing of certain functions, but the

exact contours of tomorrow's mixed fleet still have to be specified and the optimum mix of upgrading and modernization have yet to be defined, which implies some delicate trade-offs in defense budgets and between the services.

The helicopter today is a potentially autonomous weapon, a permanent support solution and the modern-day cavalry of ground forces, as well as a genuine workhorse for all the services, all rolled into one. It constitutes an indispensable capacity in correspondingly strong demand. The same will apply tomorrow, with extra benefits for countries that are able not only to integrate their airmobile forces into land maneuvers, but also to take full advantage of the possibilities offered by digitization and real time, whether in *aérocombat* itself, in cooperation with UAVs, or in the conduct of truly joint air operations.

Appendices

Helicopter forces in the United States

Number of platforms and helicopters in the Armed Forces[141]

Army		Navy		Marine Corps		Air Force	
H-1	791	H-1	22	H-1	279	H-1	62
H-6	67	H-3	46	H-3	11	H-53	35
H-47	458	H-46	40	H-46	233	H-60	101
H-58	823	H-53	231	H-53	189		
UH-60	1613	H-60	323	H-60	8		
AH-64	721						
RAH-66	2						
7	**4475**	**5**	**662**	**5**	**720**	**3**	**198**

Evolution of helicopters in service in the US Army Aviation[142]

1960/70/80	1990	2000/10	2020/30/40
UH-1 Huey	UH-1 Huey	UH-72 A Lakota	
UH-60 Black Hawk A	UH-60 Black Hawk L	UH-60 Black Hawk M	JMR
CH47	CH47 D	CH47 F	CH47 G
OH-58 A/C	OH-58D Kiowa/Warrior	UH-72 A Lakota ARH (Armed Reco.)	
AH-64 Apache A	AH-64 D-Longbow	AH-64 A Block III	JMR

[141] Christian F.M.Liles, Christopher Bolkcom, *CRS Report for Congress, Military Helicopter Modernization: Background and Issues for Congress*, Congressional Research Service, The Library of Congress, 24 juin 2004.

[142] Congressional Budget Office, *Modernizing the Army's Rotory-Wing Aviation Fleet*, novembre 2007.

Helicopters under development

Attack Helicopter	Joint Multi-Role (JMR)	Under development	Horizon 2038
Utility Helicopter	Under development	Under development	Horizon 2038
Joint concept	Joint Heavy Lift Rotorcraft (JMR) 	Under development	Horizon 2030

Helicopter forces in France

Number of platforms and units in the Armed Forces

Armée de Terre		*Marine Nationale*		*Armée de l'Air*	
NH90	0	NH90	3		
Caracal	8	EC225	2	Caracal	6
Cougar	24	Alouette 3	17	Cougar	3
Puma	94	Dauphin	12	Puma	29
Fennec	18	Lynx	31	Fennec	42
Tigre	30	Panther	16		
Gazelles	185				
7	**359**	**6**	**81**	**4**	**80**

Evolution of helicopters in service in the Aviation Légère de l'Armée de Terre (ALAT)

1970	**1980/90**	**2000**	**2005/10**
SA-330 Puma	AS-532 Cougar	EC-725 Caracal	NH-90 Caïman
SA-341 Gazelle			EC 665 Tigre

Helicopters under development

Multi-role Helicopter	HC4	Under development	Horizon 2020

Helicopters deployed in Afghanistan in 2011

Task Force Mousquetaire	Cougar	3
	Caracal	3
	Gazelle	4
	Tigre	3
	TOTAL	**13**

Helicopter forces in the United Kingdom

Number of platforms and units in the Armed Forces

Army		Royal Navy		Royal Air Force	
AH Mk1	67	HT1	64	Ch-47	48
Lynx	88	Lynx		Bell 412	18
Gazelle	22	Ecureuil		AW109	
Bell 212	7	EH101	86	EH101	91
Dauphin	4	Sea King		Puma	
				SeaKing	
5	**188**	**5**	**150**	**6**	**157**

Evolution of helicopters in service in the Army Air Corps

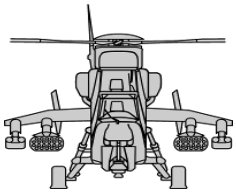
1970	1970/80	2000
SA-341 Gazelle	Lynx Mk9	AH Mk1 Apache

British Army helicopters in service in Afghanistan in 2011[143]

Joint Helicopter Force Irak	AH Mk1 Apache	10
	Lynx Mk9	4
	Merlin Mk3	5
	Ch-47 Chinook	9
	Sea King ASaCS	3
	Sea King Mk4	4
Total platforms/units	**6**	**35**

[143] Source : Centre de Doctrine d'Emploi des Forces.

The Eurocopter *Tiger*'s different versions[144]

Version	Armament	Other features	Orders
HAD **Support** **Destruction** **HAD/E**	- 30 mm gun - Rockets - Air-to-air Missiles - Air-to-ground Missiles 	**Target acquisition** - Laser rangefinder - Roof-mounted sight **Defensive features** - Increased protection - Improved engine - IFF/RWR[145] **Missions** - Recognition - Protection - Support - Anti tank - Air to air Combat	**France** 40 machines **Spain** 18 machines
HAP **Support** **Protection**	- Canon 30 mm - Rockets - Air-to-air Missiles 	**Target acquisition** - Laser rangefinder - Roof-mounted sight **Missions** - Recognition - Protection - Support - Air-to-air combat	**France** 40 machines **Spain** 6 machines
UHT	- Rockets - Air-to-air Missiles - Air-to-ground Missiles 	**Target acquisition** - Laser rangefinder - Mast-mounted sight **Missions** - Recognition - Protection - Support - Anti tank - Air-to-air defense	**Germany** 80 machines
ARH Attack Recce	- Canon 30 mm - Rockets - Air-to-air Missiles - Air-to-ground Missiles 	**Target acquisition** - Laser rangefinder - Roof-mounted sight **Missions** - Recognition - Support - Air-to-air combat	**Australia** 22 machines

[144] Source: Eurocopter.
[145] Radar Warning Receiver.

The Eurocopter Tiger program[146]

Missions
- The Tiger is a multi-task attack helicopter designed above all for the fire support of airmobile units, by day and by night, against land targets (including tanks) and air targets. - Since July 2009, three HAP Standard 1 have been deployed in Afghanistan where they are deemed satisfactory.
Technical Description and Performance
Two versions are planned for France: - Support and Protection Helicopter (HAP): equipped with 4 air-to-air Mistral missiles, a 30 mm gun turret, 68 mm rockets, roof-mounted sight. On the long run, HAPs should be upgraded to the HAD variant. - Support and Destruction Helicopter (HAD): a 30 mm gun, 68 or 70 mm rockets, air-to-air Mistral missiles, AGM-114 Hellfire II air-to-surface missiles, and laser-guided rockets. The HAD also differs from the HAP because of its modified roof-mounted sight (laser de désignation), improved power engine and IFF system. The decision to launch the development of the HAD version in cooperation with Spain was made in 2003. This version replaces the anti-tank version initially planned (HAC with 8 anti-tank missiles off-the-shelf/ 4 Mistral /mast-mounted sight).
Industrial Organization
The industrial project manager, Eurocopter Tiger GmbH, is in charge of the industrial architecture, the equipped airframe, the integration of the engine as well as B and C equipments, the support architecture. The main French equipment manufacturers B are: - SAFRAN (SAGEM): roof-mounted sight STRIX; - THALES Communications: radio-communication and radio-navigration equipment (PR4G, SATURN, TRA2020, VOR/ILS, TACAN); - THALES Avionics: helmet-mounted sight display and optical sight ; - TDA Armement: rocket sub-systems; - MBDA: MISTRAL sub-systems; - NEXTER: 30 mm gun turret; - CASSIDIAN: Diadème 2G program; - TTS for the simulator. - Other major equipment: - MTRI (MTU, Turboméca, Rolls-Royce and Industria de Turbo Propulsores) for the engine; - INDRA Sistemas for the IFF system and transponder mode 5 ; - EADS Dornier for the numerical cartography.

Calendar – Key Dates	
- Avenant 1 à l'accord de 1984 relançant le programme	11-1987
- Signing of the industrial agreement	06-1995
- Signing of the production agreement	05-1998
- Signing of the trilateral HAD agreement	03-2004
- Delivery to users of the 1st mass-produced HAP	03-2005
- Order of OCCAr Tigre HAD (40 for France + 6 for Spain)	12-2007
- First operational capacity (PCO) HAP	05-2009
- Delivery of the first HAD	09-2012

[146] Sources: Eurocopter.

International Aspects
- France, Germany and Spain (2004) cooperate through the OCCAR which was granted the management of numerous support activities in service. - In 2004, Germany confirmed its wish to limit its target to 80 UHT (Tigre anti-tank Germain Tiger), a version which has met some difficulties adjusting. - Spain has purchased 24 HAD equipped with the SPIKE-ER missile and implemented 6 HAP until 2012. - On the 21st December 2001, Australia purchased 22 Tiger ARH (Armed Reconnaissance Helicopter) for its armed forces. Derived from the HAP, it is equipped with a *Hellfire* missile. The two first units were delivered in December 2004.
Target - Orders and Deliveries
- Initial target in France: 215 units, down to 120 in 2005 and 80 in 2009. - Program parameters cover the delivery of 40 HAPs and 40 HADs. - 7 HAP should be delivered in 2010.
Stakes
- Given the inappropriateness of the German version (UHT) in the operational context, the multi-task version HAP/HAD constitutes the active branch of the development and of the exportation of the Tiger. - The French choice, the quantity ordered (80), the level of expertise of official services (in particular CEV and ALAT) have made French leadership durable for Eurocopter and the main manufacturers (SAGEM, NEXTER, THALES). However, Spain wishes to acquire its own competence (development, production and support). - The Tiger's engagement in operations is likely to lead to its upgrade, as for other arms systems. However, the evolutions of the Tiger are not, as yet, included in the scheduling.

NHIndustries NH90 Program[147]

Missions
- The NH90 missions are, for the French Army, the airmobile manœuvre and the tactical transport within the aircombat framework ; for the Marine, the anti-submarine and anti-naval fight as well as the naval aerial support.
Technical Description And Performances
Depending on its missions, the NH90 declines in two versions : - The land version TTH (Tactical Transport Helicopter) will replace the ageing *Puma* helicopters. It allows to keep at all times a tactical transport capability of 14-20 commandos or of an off-road light vehicle in action zone. Range is superior to 700 km. Its autonomy is about 2,5 hours. - The naval version NFH (NATO Frigate Helicopter) covers the whole spectrum from the antinaval and antisubmarine warfare (for the strategic oceanic force), the carrier vessel battle group (CVBG) or the amphibious battle group (14 NFH “Combat” NHC), to the support of the naval forces and the public service missions (13 NFH “Support” NHS). Its autonomy is about 4 hours.
Industrial Organisation
- The contracts are signed between the NAHEMA NATO agency, which represents the member states, and NHIndustries (NHI), a joint venture of Eurocopter, Agusta Westland and Stork Fokker. - NH90 is a joint venture program for which NAHEMA plays the contractor role. The financial participations of the cooperating countries are based on the “fair return” rule: 41,6 % (France), 28,2 % (Italy), 23,7 % (Germany) and 6,5 % (Netherlands) for the development, and 30,85 % (France), 31,6 % (Italy), 30,85 % (Germany), 5,5 % (Netherlands) et 1,2 % (Portugal) for the production.
Calendar- Key Dates
- Launching of development — 1992
- Launching of production — 2000
- First flight of a NH90 — 2004
- Delivery of the french NFH — 2010
- Delivery of the french TTH — 2011
- First NFH significant operational capacity — 2011
- First TTH significant operational capacity — 2014
International Aspects
Orders from the states cooperating on the programme and the NAHEMA members arise to 95 (61 firm, 34 in option) for France, 117 for Italy (1 option), 134 for Germany (122 firm, 12 in option), 20 for the Netherlands, 10 for Portugal and Belgium which has joined the program with an order of 8 machines and 2 options. - In competition with the American *Black Hawk* and S-92 helicopters, as well as with the EH-101 Agusta Westland, the NH90 is successful when it comes to exports : Sweden (18), Finland (20), Norway (14), Greece (20 firm, 14 in option), Oman (20), Australia (46); New-Zeland (9) and Spain (45). - On the overall (export and cooperation), 507 units have been firmly ordered and 85 are still to be confirmed. - The MoU “NH90 community” (defining the cooperation modalities between the NATO programme member states and the nordic NH90 buyer states) was signed in July 2004 and the MoU “service support” was signed in December 2004 by the 5 member states of the NATO programme.

[147] Source: Eurocopter

Target – Orders And Deliveries
- NFH : start of the deliveries of the NFH support in 2011 ; 27 equipments delivered in 2011. - TTH : 71 deliveries between 2011 and 2020. - Accumulation of deliveries late 2014 : 37 (14 NFH and 23 TTH) - The first french NFH is in process at Marignane and should be delivered in May 2010.
Issues
- The NFH delivery delay (5 years) demands the implementation of palliative solutions until 2012 to garantee the **state sea action** continuity (to limit the Super Frelon fleet service withdrawal). - The TTH delivery, in compliance with the **ministerial referential for programmation**, will gain power to catch up as soon as possible with the serious deficit in the tactic airmobility field. - In parallel to the equipment delivery, training facilities have to be set up before 2015 according to the NAHEMA contractualisation that has to be effective before the end of 2011.

The evolution of a platform: the example of AH-64 *Apache*[148]

AH-64A Apache
- AH-64A is a two-seater attack helicopter designed within the framework of the Advanced Attack Helicopter (AAH) programme in the 1970s. - With 827 units produced, it has been conceived as a anti-tank platform in deteriorated meteorological and low light conditions. - Benefiting from an armored protection, it is designed to resist to the damages caused by munitions up to 23 mm. - AH-64 is equipped with optical means, a target designation system, very low light level and infrared visions and laser rangefinder. - It is equipped with a 30 mm cannon (1300 shells), it can carry 16 Hellfire laser-guided missiles and 76 rockets.
AH-64D *Longbow* 
- Conceived in the years 1990, the AH-64D *Longbow* is the second version of the AH-64 Apache. It contains technical and electronical improvements in terms of avionics and fire. - This version is equipped with a *Longbow* mast-mounted Fire Control Radar (FCR), capable of detecting up to 256 targets and guide the Hellfire missile regardless of the meteorological and visibility conditions. - AH-64D is equipped with radar and laser warning system as welle as radar and countermeasures jamming.
AH-64D *Block III*
- This new platform evolution is intended to enter progressively in service as of 2011. The Block III integrates the improvements initially planned for the *Comanche* – the *Apache* would-be successor but cancelled in 2004. - The improvements apply to the networking means (communications, data process systems) and an increased **range of the fire control system.**

[148] Congressional Budget Office, *Modernizing the Army's Rotory-Wing Aviation Fleet*, novembre 2007.

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