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The Role of Dual-Use Helicopters in the Security and Defence Field

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Executive Summary

This volume analyses the use of helicopters by Armed Forces, law enforcement agencies and emergency services, in three countries: Italy, France and the United Kingdom. In this context, "dual-use helicopters" refer to platforms that have been designed in compliance with certain standards and are structurally built so that they can satisfy civilian, military or security users with only minimal adjustments or additions. The first three chapters examine the aforementioned countries while the last chapters draws the final conclusions by considering the option of dual-use helicopters within a wider framework of transformation that is occurring in the technological and defence procurement environment.

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The first chapter examines the approach of the Italian Armed Forces, namely the Italian Army(Esercito Italiano, EI), the Air Force (Aeronautica Militare, AM), the Navy (Marina Militare, MM), and the Carabinieri (CC), as well as of the law enforcement agencies and the emergency services, to the use of the helicopter. The Italian Armed Forces consist of a total fleet of around 600 helicopters, including light, medium and heavy helicopters, carrying out several missions both within and outside the national borders. The average service life of the fleet is around 30 years, with the exception of more recent aircraft, including the AW-101, the NH-90 and the AW-139.

In total, the fleet of the four Armed Forces is based on 12 different lines of helicopter, as follows: NH-500 (AM), AB-206 (EI), A-109 (EI and CC), AB-205 (EI), AB-212 (EI, MM and AM), AB-412 (EI and CC), AW-139 (AM and CC), AW-129 Mangusta (EI), NH-90 (EI and MM), HH-

3F Pelican (AM), EH-101/AW-101 (MM and, in future, AM), and, finally, CH-47 (EI).

As regards the Army's military operations abroad from 1978 onwards, around 80% of missions in which rotary-wing components were used were Combat Service Support. However, over the last 15 years, especially from the operations in Kosovo, missions have had a more focused Combat and Combat Support nature. In particular, in Afghanistan, rotary-wing forces, such as for example the AW-129, were used in combat operations and were exposed to enemy fire, without losses in the theatre. Alongside the traditional contribution that the Army's special forces provide to military operations, Army Aviation (Aviazione dell'Esercito, AVES) constitutes an often crucial element in the implementation of the tasks of security and civilian protection, both in terms of urgent aid to save human lives and to provide immediate assistance to affected populations, and in terms of other structural emergency interventions. In the vision of EI, the helicopter is an aerial force considered in some sense "terrestrial" for its intrinsic connection with land operations. Airmobility as a concept presupposes the presence of three elements: a Combat helicopter component; a Combat Support component; and airmobile infantry. The real concept of air mobility is indeed based on the double-named component terrestrial/rotary-wing, and finds concrete application in carrying out the so-called "airmobile" and "aero-mechanised" operations. Airmobile operations are operations in cooperation with other ground units that, with their equipment, carry out operations in the battlefield through helicopters in order to engage combat from the air and to follow it up on the ground with cavalry units and airmobile infantry. On the other hand, aero-mechanised operations are defined as operations constituted essentially of exploration and escort helicopters, which carry out combat actions, possibly supported by combat support helicopters; the usage of the terrestrial component is employed as a mean of support to operations, or sometimes it is not even provided. Other than airmobile and aero-mechanised operations that, as emphasised, have a significant combat character, operations carried out by the Army's helicopter component include, amongst other things, logistical or tactical helicopter transport.

AVES is the main user of helicopters among the Italian Armed Forces,

with a fleet composed of around 225 helicopters in eight lines of aircraft, divided into the following three categories: Exploration and escort helicopters, represented by the Mangusta AW-129; Combat Support helicopters (Elicotteri da Supporto al Combattimento, ESC), arranged officially in the following five lines: AB-206, A-109, AB-205, AB-212 and AB-412; Transport helicopters, such as the CH-47C and the NH-90, in tactical transport helicopter (TTH) configuration. The reform process of the military instrument provides for a reduction of the fleet from the current 225 aircraft to around 160 over the next 10 years, with a possible reduction of the number of lines of aircraft, considered excessive, from the current eight to four or five. There are three main programmes currently underway that are aimed at the substitution and/or renovation of the Army's helicopter fleet: the acquisition of 60 NH-90s, the purchase of 16 CH-47Fs, and the modernization of 32 AW-129s.

The Navy, and in particular Naval Aviation (Aviazione Navale) conceives its own aerial assets as a "weapon system for the naval unit," of which these constitute the operational "long arm" rather than an "autonomous weapon system." Indeed, the Navy refers to the concept of "aero-naval power" rather than "aerial power," in the context of which the aerial and maritime dimensions are indivisible, and the naval forces amplify not only the observation and the recognition capability of the fleet, but also its engagement capability. The Navy's aircraft are used to carry out three main activities: Anti-Submarine Warfare (ASW), Anti-Surface Warfare (ASuW) and amphibious combat, the last of which in support of Amphibious Forces and Special Forces operations in so-called "helicopter assault operations." In addition, the Navy's rotary-wing assets contribute to maritime security through Maritime Interdiction Operations (MIO) and Search and Rescue (SAR) missions at sea, and in the context of anti-piracy activities. Even if the Navy's helicopters are mainly predisposed for "operations from on board," they were also used on land during the ISAF mission in Afghanistan. Deployed in the Air Task Group (ATG) "Shark," the three HH-101 helicopters of the Primo Gruppo Elicotteri di Luni-Sarzana (La Spezia) carried out tasks in relation to surveillance, patrol, support for the movement of convoys and sensitive personnel, deterrence and MEDEVAC. In the context of operations which are not strictly military, but which could also be of dual use

in nature (meaning both civilian and military), the aircraft are used in support of both the Civil Protection Department (Dipartimento della Protezione Civile) for operations for the rescue of populations affected by natural catastrophes, and the Corpo Nazionale Soccorso Alpino e Speleologico (CNSAS) in interventions in mountainous areas. As in the case of AVES, the Navy's rotary-wing assets also participate in the Anti-Forest Fire (Anti-Incendi Boschivi, AIB) campaign, through the use of some AB-212s. A radical renovation and modernisation is foreseen also for the helicopter component of Naval Aviation, in the face of a significant reduction in quantitative terms from the current 105 aircraft to around 70 aircraft in the near future. In this perspective, the Navy's rotary-wing fleet will be made up of two principal lines of aircraft, for which programmes are already underway: 56 NH-90s in naval version (NATO Frigate Helicopter, NFH), and 22 EH-101s.

The AM's helicopter component is asked to carry out a vast range of operations. It plays an essential role in SAR and Combat Search and Rescue (CSAR) missions, MEDEVAC, casualty evacuation, and aerial support for Special Operations (SPECOPS). The SAR and CSAR fields come under the widest definition of the category of Personnel Recovery (PR). This also includes mission profiles known as Combat Recovery, which are also executed by the Air Force with the HH-3F and in future the HH-101, such as Non-combatant Evacuation Operations (NEO), which are aimed at recovering untrained personnel in semi-permissive or non-permissive environments. These operations are carried out jointly, including the deployment of Special Forces, as happened in Libya and Somalia. The helicopter capability is also used for aerial defence against low-altitude aircraft (Slow Movers Interceptor, SMI), an activity which aims at surveillance and at guaranteeing the security of the aerial space from possible threats on the occasion of large public events, such as for example the G8 summits in Genoa and L'Aquila, or demonstrations of particular relevance. The Air Force's helicopter fleet is currently in a reorganisation stage: the plan is to have a helicopter fleet that by 2020 will be mainly structured around two lines of aircraft: the HH-139 and the HH-101. For what concerns the programmes underway or in the finalisation phase, the Air Force received the last 13th HH-139A (a militarised version of the AW-139 civilian platform), gradually replacing the

HH-212A and in part also the HH-3, both in service for almost 30 years. The aircraft was originally chosen as an "ad interim" or "gap filler" measure while waiting for the medium helicopter, in the eight ton class, as part of the Air Force's Medium Helicopter programme (Elicottero Medio dell'AM, EMAM). However, given the budget restrictions and the reduction in allocations, it is possible that the HH-139A will remain in service for some years to come, if not up to 2020. As regards the training field, the Air Force's 72nd Stormo in Frosinone carries out an activity that is almost unique at a national level, being the only flight school able to provide a whole series of basic rotary-wing training courses for both the Armed Forces and the public safety and rescue authorities, as well as for pilots coming from other countries such as Afghanistan, Albania, Malta, and Zambia.

The Aerial Service of the Carabinieri Corps (Servizio aereo del Corpo dei Carabinieri) is aimed to integrate and to increase the prevention and the control of the national territory (internal security) carried out by the land units in fulfilment of institutional tasks.

From 2007 to 2013, the helicopter fleet witnessed a reduction of 52 helicopters, from 95 to 43 units the fleet has a relatively modern face, with an operative time-span of up to 2030-2035. It is currently made up of AB-412, A-109 Power and AW-109N helicopters.

The helicopter fleet of law enforcement agencies and emergency services – the National Police, the Coast Guard, the State Forestry Corps, the Financial Police, and the National Fire Corps – is estimated at around 250 aircraft in the various traditional configurations. The fleet is called upon to carry out different missions, including SAR, law enforcement, patrol, and control of the national territory. This fleet as well has an average service life of around 30 years, excluding the more recent aircraft, such as the AW-109N and the AW-139.

Considering the three traditional roles for the use of helicopter by the Armed Forces, i.e. Combat, Combat Support and Combat Service Support, it could be imagined that the dual helicopter could be used for Combat Support and Combat Service Support tasks. Indeed, Combat tasks necessarily require "characteristics of intrinsic protection" from threat, characteristics whose conception starts from the design phase. Protection, at least "passive" protection, is certainly one of the main as-

pects that distinguishes a "military" from a "civilian" helicopter. It is necessary, indeed, that the basic design responds to various needs: the provision of intrinsic "ballistic" protection, for example through tolerance to damage from reduced-calibre projectiles, normally non-explosive; or the minimisation of environmental "detectability" in terms of footprint, be that acoustic, radar, or infrared, so as to render the helicopter less detectable. As far as "active" protection is concerned, such needs include the ability to host with relative ease systems able to detect and to combat threats by means of devices certified for plug-in. Differently from "passive" protection, "active" protection can be inserted through specific kits able to detect and combat threats. For example, the AB-212 helicopter in Italy was created with civilian standards and now constitutes a Combat Support helicopter, on which active self-defence systems have been installed.

Beyond the indispensable nature of protection, weight and load capability play an equally important role, to be taken into the utmost consideration in the eventuality that it is decided to configure a dual helicopter that is able to carry out military tasks. Further elements to be considered are the capability for landing on different types of terrain, "maintainability" on the battlefield, and the range of temperatures, altitudes, and conditions of use.

The option of the dual helicopter opens up interesting perspectives for the Italian Armed Forces. Indeed, among the most advantageous aspects of such a perspective is the great availability of ready-to-fly forces, as a rule over 80%, a percentage higher than in the case of aircraft designed exclusively for military purposes. Furthermore, the production of the platform on a larger scale and for a greater number of clients, counting on the catchment represented by the civilian market, would allow for a more efficient and less expensive supply of spare parts, and a lower cost also in terms of logistic support. This is particularly important insofar as the cost of the entire life-cycle of the helicopter amounts between two to four times the purchase cost of the platform, meaning that savings in this context could be significant, and these could compensate the expenditure necessary to install mission systems for Combat and Combat Support tasks on the helicopter.

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The second chapter analyzes the French case-study. French government's helicopter fleet totalizes 581 aircraft, 481 for Armed Forces and 100 for Security Forces (Gendarmerie, Police and Customs). Within the Ministry of Defence (MoD), the Army is the main operator with around 70% of the fleet. Moreover, Army Aviation (Aviation Légère de l'Armée de Terre, ALAT) has the overall responsibility for the initial training of Armed Forces and government agencies aircrews. Several issues should be highlighted. The first issue is the constant decrease of the Armed Forces fleet total strength, from 481 aircraft as of 2013 to 392 by 2019. Secondly, one third of the 2019 fleet will be composed of last generations military helicopters (Tiger and NH-90), giving an improved fighting power to ALAT and Navy in spite of shortcuts.

French Army Aviation is the major player of French government helicopters' policy because of two reasons: the size of its fleet – ALAT is the main helicopter operator in France – and its unique role as Armed Forces and government initial training authority with the ALAT Initial Training Center in Dax. The ALAT has developed the concept of air-land integrated combat, that is to say the integration of helicopters within the land manoeuvre in combination and coordination with other military branches. First of all, ALAT squadrons are supposed to manoeuvre, combat and fire like armoured or infantry squadrons, that means using ground features to optimally shield the helicopters from enemy observation and direct hits by means of elaborate day and night Nap-Of-the-Earth (NOE) flight. The second key element characterizing ALAT tactic is that, differently from fighter aircraft's pilots, helicopter crews have permanent cockpit delegation of authority for finding and identifying targets then accurately firing weapons. It is important to note that ALAT tactical doctrine has been developed and implemented from the very beginning using civilian platforms like the Sud-Aviation Alouette, later Gazelle families as attack aircraft, and Puma family as tactical transport aircraft. This is a proof that dual-use helicopter can be suitable for Aérocombat if they are agile enough for NOE flight and if they can technically evolve to meet military standards. Currently, specific military platforms have been developed and fielded with the Attack Helicopter (AH) EC

665 Tiger family and the Tactical Transport Helicopter (TTH) NH-90 Caiman.

The most important characteristic of French Navy is its permanent responsibility pertaining to two different fields: the military field with the maritime warfare missions and the maritime surveillance field with the "coast guard" missions. In each case, helicopters are not considered as a coherent operational tool designed to develop a specific air-to-sea manoeuvre beside a naval force. They are seen as an individual force multiplier tool for the vessel on which they are shipped. Navy's helicopters have four main tasks: Anti-Submarine Warfare (ASW) and Anti-Surface Warfare (ASUW) part of Maritime Warfare Operations (MWO) in which helicopter are individually and closely link to the vessel for their manoeuvre; Maritime Surveillance Operations (MSO) in which helicopter is to conduct its own manoeuvre, alone or in coordination with other vessels or aircraft and Special Forces operations in which they are part of joint unit. Navy planned to field as of 2020 a rotary Unmanned Aerial Vehicle (UAV) on board its main vessels (Aircraft carrier, LHD, FREMM and FS). Army is associated to this project with regard to amphibious doctrine whose ashore operations are under Land Component Command (LCC) operational control responsibility under a joint operational command. Only off-the-shell procurement are considered for this project.

Air Force operates a fleet of 84 helicopters composed of 42 AS 355N Fennec, 23 SA 330 Puma, 7 AS 532 Super Puma, and 11 EC 725 Caracal. For Air Force global doctrine, helicopters are not really seen as a coherent combat system. They are employed in specific "niches" where fixed-wing aircraft are not efficient (lower air-space policing) or to support air-power operations (C-SAR). In addition, Air Force is contributing in Armed Forces General Support and Public Service mission and Special Operations missions. So, there is no overarching helicopter doctrine but ad hoc technical and tactical criteria for each task.

Beside Police, Gendarmerie is a police force formerly part of the Ministry of Defence and subordinated since 2009 to the Ministry of Interior (Ministère de l'Intérieur). Its personnel, the gendarmes, and platforms retain a military status. With a budget of 25 million of euro the Groupement des Forces Aériennes de la Gendarmerie (GFAG) pays 19.000 flying hours for its 56 helicopters.

The Sécurité Civile (SC) helicopter group has 22 bases in mainland France and its overseas territories. The SC missions are primarily Emergency Medical Services (EMS), SAR and maritime SAR, with additional tasks for fire fighting – i.e. surveillance and monitoring – for land and maritime surveillance and Coast Guard missions. Being a Minister of the Interior agency, SC could also be tasked with law enforcement missions in support of Police units.

Because of the need to replace the remaining legacy fleet, the MoD has set up a Joint Light Helicopter Program (Hélicoptère Interarmées Léger, HIL) in order to define the future aircraft system. The HIL project had the ambition to develop, based on a dual-use platform, a family of aircraft whose different versions would permit to meet Services and government Agencies' multiple requirements. The problem is that, due to budget cuts and planning uncertainty for at least the next six years, this program has been delayed. Finally, concerning provisions for non-permissive environment two points should be made. First, for military use and adapting to modern battlefield conditions, future helicopter should feature survivability, suitability for tactical flight and manoeuvrability, low observability, low vulnerability to projectiles, crashworthiness. Second, future helicopters should be ready to receive specific devices providing a high survivability to small arms and missiles direct hits.

In the French case, history shows that all so called "military" helicopters owe much to civil designed platform. This history is not yet finished, with Armed Forces eagerly looking for savings by evolving off-the-shell platforms procurement. In this context, two ideas are worthy to consider. First, instead of designing a civil aircraft that will have a long and costly process to be militarized, to design a platform according to basic military requirements, in terms of assets technical compatibility, provision for additional equipment, etc. Then, to remove, case by case, everything which is not in accordance with customer requirements.

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The third chapter considers the British case-study. If the ubiquity and utility of the UK's military rotary wing forces have been highlighted in recent conflicts involving British forces, then residual strains and ten-

sions have been apparent concerning the acquisition, operation and size of the helicopter fleets required. However, as on-going operations understandably became the overriding priority, longer term planning and budgeting were to suffer, including in the rotary arena, exacerbating underlying issues with Britain's military helicopter fleets. Short-term fixes put in place in an attempt to address urgent operational requirements were often at the expense of coherence in the longer-term programme. This state of flux was compounded by the cumulative effects of three defence reviews and two revisions of defence industrial strategy over the past 15 years. The UK's 2005 Defence Industrial Strategy (DIS) paper, the single most lucid unclassified exposition of London's military equipment needs and industrial policy, described the Future Rotorcraft Capability (FRC) as intended to identify a "strategy that maximised the capability that could be delivered from available funding. The FRC programme was directed to explore opportunities to use each helicopter type to deliver more than one capability, reduce the number of types of helicopters in-service and promote off-the-shelf solutions, limiting unique UK requirements to the essential in order to drive down costs of ownership."

Each service is in the midst of fleet replacement or the introduction of upgraded variants of types already fielded, with a continuing emphasis on multi-role capability. While all of the British military's front line types are dedicated military designs, dual-use helicopters have and continue to be used for both training and some niche utility roles. Since 1999 "battlefield helicopters" and "air assault forces" from the three services have been operated under the banner of the Joint Helicopter Command (JHC).

The Army has long adhered to a "manoeuverist approach:" at its simplest a focus on applying "strength against vulnerability" across the spectrum of land warfare. Army's rotary capability falls within two of its four main land force elements: Combat and Combat Support – the others being Combat Service Support and Combat Command Support. The Army defines Combat elements as "those that engage adversaries directly" including "attack aviation units," while Combat Support "provides indirect firepower and other essential operational assistance to combat elements." The army's rotary attack capability is based on its two regi-

ments of Apache AH1. The complement to the army's future attack helicopter is the Agusta Westland AW159 Lynx Wildcat being developed to meet its Battlefield Helicopter Reconnaissance Requirement. The Wildcat forms a common airframe baseline also for the Royal Navy's Surface Combatant Maritime Rotorcraft Requirement (SCMR).

Speed, reach and agility are identified as key characteristics of air power in the RAF's British Air and Space Power Doctrine (AP3000), descriptors well suited to military rotary aviation, while air mobility is one of the four "fundamental air and space power roles." "Support helicopters are lynch pins of tactical mobility. They are fundamental enablers of ground manoeuvre, adding speed, surprise and allowing forces to leapfrog difficult terrain and bypass ground threats."

An area of doctrinal friction, resulting arguably from a doctrinal absence, was that of air-land, or land-air, integration, which became apparent during Operation Telic in Iraq during 2003. The Navy considers that it provides "the backbone of the UK expeditionary capability by maintaining a maritime task force of naval air, surface, sub-surface, amphibious and associated joint assets that are capable of operating in the open ocean and gaining access to a contested littoral."

In this context, the Fleet Air Arm is viewed as an "essential element of maritime power," covering the primary roles of "anti-submarine warfare, anti-surface warfare, troop carrying, airborne surveillance and area control, and search and rescue."A key element of the Navy's future expeditionary capability are two Queen Elizabeth-class aircraft carriers. The first ship, HMS Queen Elizabeth will embark the multi-role Merlin Mark 2 helicopter which will be used to deliver both intelligence, surveillance, target acquisition and reconnaissance, and air-space management. The Navy's Maritime Doctrine suggests that "in the littoral manoeuvre, special forces or expeditionary roles, the Queen Elizabeth Class may carry a mixed air group comprising Chinook and Merlin support helicopters, Wildcat and Apache attack helicopters in support of a Lead Commando Group or other embarked landing force."

The Royal Navy has to manage the replacement or upgrade of all of its rotary wing inventory within the Fleet Air Arm over the course of this decade.

There is also interest in the potential of unmanned rotary systems

within the military. the Rotary Wing Unmanned Air System project is a research effort into the utility of a multi-role rotary UAV in the maritime environment. In the context of the Tactical Maritime Unmanned Air System (TMUAS) project, in August 2013 Agusta Westland has been awarded a $3,6 million contract from the UK Ministry of Defence for a Rotary-Wing Unmanned Air System (RWUAS) Concept Capability Demonstrator (CCD) programme.

From the outset moving the UK rotary search and rescue provision into private sector had proved divisive. Bristow Helicopters was to emerge in March 2013 as the winner of a further competition, providing a total of 22 helicopters, 11 Sikorsky S92s and 11 Agusta Westland AW189 (including a spare of each type) at ten sites around the UK. The company will begin to provide SAR services under the contract from April 2015, for a ten year period.

The Defence Helicopter Flying School provides single-engine training for all three armed services, and follow on twin-engine training for air force and Navy crew. It is in the area of training that the British military has adopted a dual-use approach to the types operated. Single-engine training is provided by the Airbus Helicopter AS350BB Squirrel HT1, with the twin-engine requirement met by the Bell 412EP Griffin HT1.

Moving to the public security and emergency services sector, England and Wales had 43 police forces that had either operated their own rotary support or worked in conjunction with other forces in their own region. The National Police Air Service (NPAS) began to come into effect in June 2012 and was intended to start rationalize the patchwork of ad hoc regional capacity, and to return significant cost savings. It is meant to be fully in place by 2015. As part of the restructuring, the number of helicopter bases was to cut as were the number of helicopters available to the police. The number of bases was to fall from 30 to 22 with the number of helicopters reduced from 33 to 27, including three spares.

Stability within the main military fleets will mean that in the near-to-medium term there is little scope for the introduction of dual-use rotary types within the core of the services helicopter capability. Whether an opportunity emerges to meet a possible Puma successor, and perhaps to address the helicopter requirements of the Special Forces with a combined civil/military design remains to be determined. Were such an ap-

proach to be adopted then the type would be purchased off-the-shelf, given the comparatively small numbers to be acquired.

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The fourth chapter addresses the reflection on the role of dual helicopters in a wider context, with the aim to draw some conclusions for the future. From the 1990s onwards, such processes have witnessed the growth of "generic," rather than "specific," modalities for the creation of knowledge, i.e. modalities that connect diverse sectors and that create scientific/technological heritages which can be used for a wide range of applications. The IT and telecommunications revolution was fundamental in this sense, allowing for the sharing of information at both intersectoral and international levels. In Europe, the dividing line between the civilian, defence and security sectors became less clear and more permeable, with an increased convergence at the technological level between the three fields, and a certain overlap between the security and defence sectors. More specifically, concerning these categories of technology, one can see a greater degree of interaction between the R&T and R&D activities carried out in the various sectors, with a transfer of technology from the military field to the civilian and vice versa – the so-called "spin-offs." The first type of spin-off – from the military to the civilian – has been widely studied, as well as rigidly regulated for reasons of national security, already during the Cold War, and boasts of among its examples Internet, which was initially developed at the request of the US Department of Defence as a network to connect the computers of the US' military installations; and the well-known Global Positioning System (GPS). The second type of spin-off represents a relatively recent phenomenon that gathered pace from the 1990s onwards, and which is still in evolution. At the beginning of the 2000s, certain academics were emphasising how the rhythm of innovation in a series of civilian sectors field had overtaken that in the military field, and that products developed for the former market were providing a better price-quality relationship than similar products developed specifically for military clients.

The greatest obstacles to spin-offs, and in general to the synergies between the civilian, security and defence sectors achievable through

the use of dual technologies, occur on the demand side rather than on the supply side of this complex market. In the first place, there is a difference of approach between military users and those from the security or civilian fields: the former are more used to setting requirements and to launching medium- to long-term procurement programmes that lead to the acquisition of products and platforms specifically designated to satisfy those requirements; the latter, on the other hand, are more likely to acquire "off-the-shelf" products on the market insofar as they have less stringent requirements or attribute greater importance to the price-quality relationship (and to the speed of the procurement process), rather than only to the performance of the acquired product.

The change in technological innovation processes has affected certain defence sub-sectors, such as airspace, electronics, sensoristics, and network-enabled capabilities. Other fields have been similarly influenced to a lesser, or a different, degree. In the case of helicopters, the case studies analysed – Italy, France and the United Kingdom – present both common elements and national specificities in the approach to the rotary wing, in particular as regards the possible role of dual helicopters. Above all, from the three cases analysed, it can be seen that, in the face of a common tendency towards a reduction in rotary-wing fleets, a process of improvement in the operational capabilities of helicopter assets is taking place, and this is the fruit of the development of technologically more advanced and better-performing machines. A further common aspect concerns the law enforcement authorities and the emergency services. In each of the three countries, for example, the actors and competent authorities are multiple and diversified in different structures, thus determining inefficiencies caused also by the complexity of defining "who does what" in terms of competences, functions and territorial responsibilities. The long-lasting European economic crisis has raised awareness among the political classes of the need to rationalise rotary-wing assets across the law enforcement authorities and emergency services.

This said, the key question is what could be the approach of the three countries to the possible role of dual helicopters. The answer is not identical, insofar as orientations appear to vary between countries. For example, 100% military aircraft, such as the Chinook, Merlin, Apache

and Wildcat, will still represent the heart of the British Armed Forces' helicopter capabilities, while dual-use platforms will continue to be used especially for training tasks – see the Defence Helicopter Flying School case – as well as for utility tasks. Going from one extreme to the other, French Army Aviation has historically relied on civilian-designed platforms. The HIL programme can be considered as part of this approach.

Italy seems to be taking a middle way between the opposing positions of France and the UK towards dual helicopters, with interesting prospects for the Armed Forces. The case of the AW-139 appears paradigmatic. The aircraft is currently in use by the Air Force, which was the first domestic user to employ on the battlefield, and therefore to test a helicopter that can be described substantially as a dual one. The machine, denominated HH-139A, a militarised version of the AW-139 civilian platform, was originally chosen as an ad interim or "gap filler" measure and the models at disposal are principally used for SAR tasks on the national territory. At the moment, the models in issue are principally used for SAR tasks on the national territory, and given the budget restrictions and the reduction in allocations applying to the EMAM programme as well, it is highly probable that the HH-139A will remain in service for some years to come, no longer filling its original "gap filler" role, but evolving as an aircraft in permanent and stable issue to the Armed Force. The discussion of the HH-139A revolves around the possibility of employment not only for SAR tasks on the national territory, but equally for more demanding missions, including in semi-permissive or non-permissive environments.

When one compares the situation in the helicopter field in the three cases of study to the more general context of the scientific/technological innovation of the defence sector, one is struck by the low level of awareness of the opportunities presented by the possible use of dual-use technologies and platforms, i.e. the dual helicopter option. The common technological base, which is design-related and systemic, is ensured by the high standards achieved in the civilian market in order inter alia to comply with the extremely stringent safety and crashworthiness requirements set by national and international authorities as regards, for example, the following features: redundancy and duplication of systems to ensure safety in the event of the breakdown of certain key systems;

Health and Usage Monitoring Systems (HUMS), which increase the safety of the helicopter by monitoring its most sensitive parts and avionics, Situational Awareness and man-machine interfacing, which benefit from the progress achieved in ICT in recent years in the civilian field. Such a common technological base represents a leap forward in quality compared to military machines used for civilian purposes, or vice versa; we are talking about designing a dual helicopter ab origine, by preparing it for an improved and more efficient optimisation for the uses that will be made of it in the military, civilian and security fields – and therefore for the missions that it will have to carry out.

Therefore, the crucial point is the evaluation of the dual helicopter option against the missions to be carried out in particular, but not only by the Armed Forces. In fact, if there is a common technological base, then this is sufficient and it does not present insurmountable obstacles; the questions to be answered concern the safety, effectiveness and efficiency of the use of dual helicopters in the various military missions. The issue to be kept in mind is that the optimisation work that has to be carried out on a dual helicopter, in order to ensure safety in permissive or semi-permissive environments, is less than that required for non-permissive environments. As regards effectiveness and efficiency, four remarks should be made. Firstly, it depends on the mission: in the case of attack helicopters, and in general of helicopters used for "airmobile" or "aero-mechanised" operations in the Italian approach, for "air combat" operations as foreseen by French doctrine, or the British equivalent of the "manoeuverist approach," given the quantitative and qualitative significance of the optimisation necessary, the use of dual helicopters is less effective and efficient. Vice versa, for logistical and tactical helicopter transport missions, which do not bring the helicopters and their crews into ballistic contact with the enemy, the use of dual helicopters is more effective and efficient. Once certain requirements, regarding such things as load capacity and resistance to atmospheric and environmental conditions (in terms, for example, of temperature, altitude and the presence of dust), are met in the design phase, a level of effectiveness equal to, or greater than that of dedicated military machines can be achieved by dual helicopters with timely and limited modifications, for example as regards the undercarriage.

Effectiveness and efficiency are closely connected to the concept of balance between "high-end" and "low-end," i.e. the so-called "High Low Mix." As analysed in the individual case studies, the rotary-wing assets of France, the UK and Italy (though the argument is valid for almost all NATO Member States) are called upon to carry out a wide range of missions as regards intensity during their life-cycle, both genetic and combat-related. The missions in the upper part of the spectrum are high-intensity, "high-end," and tend to be carried out in non-permissive environments, and therefore impose more stringent requirements. Vice versa, "low-end" missions are located in the lower part of the spectrum, are usually conducted in semi-permissive (or permissive) environments, and are less ambitious as regards the requirements and the related technological level – and therefore less expensive. The concept of "High Low Mix" refers essentially to the maintenance of a balance between a capability, albeit not predominant, for high-end missions, and a capability, equally not marginal, for low-end missions. This allows to the aircraft adapted for low-end missions, and capable of carrying out the assigned task at a significantly lower cost as compared to the use of more advanced and expensive platforms, to be used for many types of missions, such as logistical and tactical helicopter transport, and of operational theatres, such as natural disasters, humanitarian crises, and support for pure peace-keeping operations and internal security activities.

In this perspective, it is probable that dual helicopters, which can rely on a technological, design-related and systemic base that is common to the civilian sector, will guarantee greater availability and financial benefits, in terms both of spare parts and of maintenance and modernization activities and services, thereby improving not only the readiness of the assets, but also the efficiency of the management of the helicopter fleet.

All this does not mean, obviously, refraining tout court from the use of dedicated military machines, for example for missions with a marked combat nature or in the upper part of the intensity spectrum, i.e. high-end. It is rather a question of looking at the matter in terms of maintaining an adequate rotary-wing capability, by means inter alia of the use of dual helicopters to deal with scarce and dwindling resources, which translate into a drastic reduction in the number of aircraft.

An approach of this kind implies two radical changes in the defence

world. The first is a leap ahead in the nature of the relationship between the Armed Forces and industry, to move from the client-supplier duality to a true partnership. The second change concerns the very concept of crew security, and in general of military personnel in the discharge of missions in the operations theatre. Security, conceived as to include protection from the enemy, is not determined only by the level of protection that a given platform can theoretically provide, be that the helicopter itself or a terrestrial light armoured vehicle. Safety is determined, rather, by the package of conditions which, in the reality of the operational theatres are ensured for the discharge of the mission, and that include inter alia: the aircraft's safety standards, which today are absolutely comparable between the civilian and military fields; the readiness of the platform, which avoids having recourse to much less secure assets, or to leftovers supplied by lease or in some other manner; the non-obsolescence of the helicopter, which can therefore benefit from recent technological progress; its capability to connect to the other nodes in the military network, thereby ensuring better situational awareness and therefore greater chances of not being hit or shot down; and its use on the tactical, operational and strategic levels, which is connected to elements of procedure, doctrine, organization and training.

In conclusion, the dual helicopter option represents an interesting prospect to ensure greater safety, effectiveness and efficiency in the use of rotary-wing assets by the Armed Forces, in the light both of recent dynamics in technological progress, and of the current limits on defence budgets.

Introduction

Helicopters are highly flexible instruments because of their inherent nature. In this study, the "dual-use helicopters" concept refers to platforms that have been designed in compliance with certain standards and are structurally built so that they can satisfy civilian, military or security users with only minimal adjustments or additions.

This concept is part of a broader process of transformation in the way technological innovation is achieved, a process which is having an impact on the defence industry and the military procurement. Indeed, nowadays there is in Europe a growing debate on dual-use technologies which can be used to develop systems and equipment able to carry out both civilians and military tasks.

This Research Paper analyses helicopter's employment by the Armed Forces, the law enforcement agencies and the emergency services of three countries, namely Italy, France and the United Kingdom. This is a diversified and fragmented landscape, with different approaches and, above all, helicopter fleets made up of diverse platforms of diverse generations – some with more than 30 years of life cycle behind them. In all three countries, national defence budget's restrictions demand more efficient solutions for the necessary fleets' renewal – a renewal often coupled with a reduction in number – as well as for the maintenance and upgrade of the platforms in the medium term.

In this respect, dual-use helicopters represent an interesting option in order to ensure greater security, effectiveness and efficiency in the utilization of rotary-wings assets by European Armed Forces. A common and in-depth reflection is required by all stakeholders in order to explore this option.

Alessandro Marrone and Michele Nones

List of Abbreviations

ADH	Attack and Destruction Helicopter
AH	Attack Helicopter
AIB	Anti-Incendi Boschivi
AIS	Automatic Identification System
ALAT	Aviation Légère de l'Armée de Terre
ALAVIA	AmiraL commandant l'AVIAtion
AM	Aeronautica Militare
AMC	Air Mission Commander
APH	Attack and Protection Helicopter
ASH	Assault Support Helicopter
AsuW	Anti-Surface Warfare
ASW	Anti-Submarine Warfare
ATG	Air Task Group
AVES	Aviazione dell'Esercito
BATUS	British Army Training Unit Suffield
BLUH	Battlefield Light Utility Helicopter
BRH	Battlefield Reconnaissance Helicopter
C3	Command Control and Communication
CAE	Centro Addestramento Equipaggi
CAS	Close Air Support
CASEVAC	CASualty EVACuation
CBRNE	Chemical Biological Radiological Nuclear Explosive
CC	Carabinieri
CCA	Close Combat Attack
CCD	Concept Capability Demonstrator
CNSAS	Corpo Nazionale Soccorso Alpino e Speleologico
COA	Comando Operazioni Aeree

COAU	Centro Operativo Aereo Unificato
CONOPS	Concepts of Operations
CSAR	Combat Search and Rescue
CSDP	Common Security and Defence Policy
CSG	Centre Spatial Guyanais
CSR	Common Staff Requirement
DGA	Délégation Générale pour l'Armement
DHFS	Defence Helicopter Flying School
DIS	Defence Industrial Strategy
DSAE	Direction de la Sécurité Aéronatique d'Etat
EAC	European Air Crane
EASA	European Aviation Safety Agency
EC	Eurocopter
EDA	European Defence Agency
EES	Elicottero da Esplorazione e Scorta
EI	Esercito Italiano
EMAM	Elicottero Medio dell'Aeronautica
EMS	Emergency Medical Services
EO/IR	Electro-Optic/Infra-Red
ESC	Elicottero da Supporto al Combattimento
FARP	Forward Arming and Refueling Point
FASGW[H]	Future Anti-Ship Guided Weapon Heavy
FCP	Flying Command Post
FFG	Force Française au Gabon
FLIR	Forward Looking Infrared
FMH	Future Medium Helicopter
FOC	Final Operational Capability
FRC	Future Rotorcraft Capability
FREMM	Frégates Européennes Multi-Missions
FRWS	Future Rotary Wing Strategy
FS	Forze Speciali
GFAG	Groupement des Forces Aériennes de la Gendarmeria
GIS	Gruppo di Intervento Speciale
GPS	Global Positioning System
HAD	Attack and Destruction Helicopter
HAP	Attack and Protection Helicopter
HD TV	High Definition TeleVision

HEP	Helicopter Exercise Programme
HIL	Hélicoptère Interamrées Léger
HIL	Hélicoptère Interarmées Léger
HISWG	Helicopter Inter-Service Working Group
HLH	Heavy Lift Helicopter
HMSD	Helmet-Mounted Sight/Displays
HPO	Operational Training Helicopter
HSSq	Helicopter Strike Squadron
HTP	Helicopters Training Programme
HUMS	Health and Usage Monitoring Systems
ICAO	International Civil Aviation Organization
ICO	Implementazione Capacità Operativa
ICT	Information and Communication Technology
IFR	Instrumental Flight Rules
IMEX	Immediate Extraction
IOC	Initial Operational Capacity
ISAF	International Security Assistance Force
ISR	Intelligence, Surveillance and Reconnaissance
JAPCC	Joint Air Power Competence Centre
JHC	Joint Helicopter Command
LAH	Light Assault Helicopter
LCC	Land Component Command
LHD	Landing Helicopter Dock
LLTV	Low Light TV
LOAM	Laser Obstacle Avoidance and Monitoring
LPM	Loi de Programmation Militaire
LUH	Light Utility Helicopters
MEDEVAC	Medical Evacuation
MIO	Maritime Interdiction Operations
MLU	Mid Life Update
MM	Marina Militare
MOC	Meaningful Operational Capability
MRO	Maintenance, Repair and Overhaul
MRO	Maintenance, Repair e Overhaul
MSH	Medium Support Helicopter
MSO	Maritime Surveillance Operations
MTOW	Maximum Take-Off Weight

MWO	Maritime Warfare Operations
NEO	Non-combatant Evacuation Operations
NFH	Nato Frigate Helicopter
NOE	Nap-Of-the-Earth
NPAS	National Police Air Service
NSA	NATO Standardization Agency
NVG	Night Vision Goggles
OPV	Offshore Patrol Vessel
OTSWS	Observation/Targeting & Spike Weapon System
PFI	Private Finance Investment
PMI	Piccole e Medie Imprese
POA	Presidio Operativo Avanzato
PR	Personal Recovery
R&D	Research and Development
R&T	Research and Technology
RAC	Raggruppamento Aeromobili Carabinieri
RAF	Royal Air Force
RCC	Rescue Coordination Center
REOS	Reparto Elicotteri per Operazioni Speciali
RMS	Roof Mounted Sight
RNAV-GNSS	aRea NAVigation-Global Navigation Satellite System
RWUAS	Rotary Wing Unmanned Air System
SABR	Support Amphibious Battlefield Rotorcraft
SAF	Speleo Alpinistico Fluviali
SAR	Search and Rescue
SAR-H	Search and Rescue Helicopter Harmonisation
SC	Sécurité Civile
SCMR	Surface Combatant Maritime Rotorcraft
SDAM	Système de Drone Aérien pour la Marine
SDSR	Strategic Defence and Security Review
SERVAL	Système Embarqué de Reconnaissance Vecteur Aérien Léger
SF	Special Forces
SIMMAD	Structure Intégrée de Maintien en condition opérationelle des Matériels Aéronatiques de la Défense
SMI	Slow Movers Interceptor
SoS	Security of Supply
SOVAC	Sala Operativa Centro Aviazione Vigili del Fuoco

SPECOPS	Special Operations
TADS/PNVS	Target Acquisition and Designation Sight/Pilot's Night Vision Sensor
TAI	Turkish Aerospace Industries
TMUAS	Tactical Maritime Unmanned Air System
TTH	Tactical Transport Helicopter
TWIST	Tidal
UAV	Unmanned Aerial Vehicle
VHF	Very High Frequency
VTOL UAV	Vertical Take-Off and Landing Unmanned Aerial Vehicle

1.
The Italian Case Study

Alessandro R. Ungaro

This chapter examines the approach of the Italian Armed Forces, namely the Italian Army (Esercito Italiano, EI), the Air Force (Aeronautica Militare, AM), the Navy (Marina Militare, MM), and the Carabinieri (CC), as well as of the law enforcement agencies and the emergency services, to the use of the helicopter. The study considers, wherever possible, the different doctrines, capabilities, and lessons learned from operational experience during those missions in which helicopters have been involved.

The Italian Armed Forces consist of a total fleet of around 600 helicopters, including light, medium and heavy helicopters, carrying out several missions both within and outside the national borders.[1] The average service life of the fleet is around 30 years, with the exception of more recent aircraft, including the AW-101, the NH-90 and the AW-139.

In total, the fleet of the four Armed Forces is based on 12 different lines of helicopter, as follows: NH-500 (AM), AB-206 (EI), A-109 (EI and CC), AB-205 (EI), AB-212 (EI, MM and AM), AB-412 (EI and CC), AW-139 (AM and CC), AW-129 Mangusta (EI), NH-90 (EI and MM), HH-3F Pelican (AM), EH-101/AW-101 (MM and, in future, AM), and, finally, CH-47 (EI).[2]

The helicopter fleet of the law enforcement agencies and the emergency services, i.e. the Police (Polizia di Stato), the Port Authorities Corps-Coastal Guard (Corpo delle Capitanerie di Porto-Guardia Cost-

[1] Pietro Batacchi and Eugenio Po, "AgustaWestland guarda al futuro", in *Rivista italiana Difesa (RID)*, No. 10/13 (October 2013), p. 29.

[2] Ibid.

iera), the State Forest Corps (Corpo Forestale dello Stato), the Financial Police (Guardia di Finanza), and the Fire Brigade (Vigili del Fuoco), is composed of around 250 aircraft, in the various traditional configurations, such as light, medium and heavy.

1.1 THE ARMY

Considering the history of Italian military operations abroad from 1978 onwards, around 80% of missions in which rotary-wing components were used were Combat Service Support missions, i.e. the transport of material and men as in Lebanon, Namibia, Somalia and Kurdistan. These missions were carried out above all in permissive or semi-permissive environments, in which the "unprotected" helicopter's configuration permitted to gain good results. For operations in semi-permissive environments, self-protection systems kits, for example, were added for detection and combat activities.

Over the last 15 years, especially from Kosovo onwards, missions have had a more focused Combat and Combat Support nature. In particular, in Afghanistan, rotary-wing forces, such as for example the AW-129, were used in combat operations and were exposed to enemy fire, without losses in the theatre. In March 2014, Italy was the second among the approximately 50 countries which participated with a contribution of fixed and rotary-wing forces to the International Security Assistance Force (ISAF), a mission under NATO guidance. Furthermore, Italian helicopters contributed to Special Forces operations, in particular Task Force 45, which has been operating in the theatre without interruption since 2006, mainly in Regional Command West under Italian command. Operations in congested aerial spaces such as Afghanistan, with a corresponding battleground in which hostile and allied forces, combatants and civilians are often mixed, have demonstrated the extreme importance of the integration of the terrestrial and aerial dimensions of operations. This has helped, among other things, to ensure the precision of engagement, as well as the execution of all the missions of Combat Support and Combat Service Support, such as for example medical evacuation (MEDEVAC).

Alongside the traditional contribution that the Army's special forces provide to military operations, Army Aviation (Aviazione dell'Esercito, AVES) constitutes an often crucial element in the implementation of the tasks of security and civilian protection, both in terms of urgent aid to save human lives and to provide immediate assistance to affected populations, and in terms of other structural emergency interventions. Interventions by AVES' helicopters are available to carry out reconnaissance and these are also useful for transportation of injured persons needing to be evacuated, technicians and experts, and emergency material. To this effect, the Army has at its disposal aircraft of different kinds, whose versatility allows to deal with various needs, from the transportation of loads of up to nine tons, to the possibility of using the external winch to rescue personnel.

As regards strictly military operations, airmobile doctrine has been developed from the beginning of the 1990s firstly by AVES' initiative, also after the operational experience in Somalia, and it has been concentrated on the capability to develop terrestrial manoeuvres in the third dimension. In the vision of EI, the helicopter is an aerial force considered in some sense "terrestrial" for its intrinsic connection with land operations; in fact, it depends on the operations command in the theatre, and not on a strategic command as in the case of fixed-wing aircraft. Airmobility as a concept presupposes the presence of three elements: a Combat helicopter component; a Combat Support component; and airmobile infantry. From the 1990s, indeed, the awareness of the need to change the speciality of AVES as a pure role of support has increased, and it was started to look at it as

> a channel for the development of a new Great Elementary Unit, able to carry out with autonomy the five basic functions of terrestrial combat: exploration, firepower, manoeuvring, command and control, and logistics.[3]

[3] Antonio Bettelli, "La capacità aeromobile nel progetto di riordino dello strumento militare terrestre: punto di situazione e possibili sviluppi", in *Rassegna dell'Esercito*, No. 6/2013, pp. 30-39, http://www.perseonews.it/index.php?option=com_content&view=article&id=3246. Author's translation.

The real concept of air mobility is indeed based on the double-named component terrestrial/rotary-wing, and finds concrete application in carrying out the so-called "airmobile" and "aero-mechanised" operations.[4] Airmobile operations are operations in cooperation with other ground units that, with their equipment, carry out operations in the battlefield through helicopters in order to engage combat from the air and to follow it up on the ground with cavalry units and airmobile infantry.[5] On the other hand, aero-mechanised operations are defined as operations constituted essentially of exploration and escort helicopters, which carry out combat actions, possibly supported by combat support helicopters; the usage of the terrestrial component is employed as a mean of support to operations, or sometimes it is not even provided.[6] Other than airmobile and aero-mechanised operations that, as emphasised, have a significant combat character, operations carried out by the Army's helicopter component include, amongst other things, logistical or tactical helicopter transport, i.e. transport activities, also in the operational theatre, without however foreseeing the involvement of helicopters and their equipment in ballistic contact with the enemy.[7]

In parallel to the doctrinal development, the EI's helicopter component has also undergone a process of transformation as regards its organisational, technical and tactical aspects, in order to implement the doctrine of the Army, which was predicated on the concept of airmobility. Starting from 1993, this component changed its name from "Aviazione Leggera dell'Esercito" to "Aviazione dell'Esercito" (AVES), while between 2000 and 2003 it was called "Cavalleria dell'Aria." This change at the time reflected the existence of two schools of thought: the first considered that was necessary to give some independence to the aerial component of the Army, as well as a wider margin of autonomy; the second, instead, was more inclined to consider the aerial component in its traditional role of support to the other terrestrial units of the Army. The

[4] Interview, 5 March 2014.

[5] Pagine di Difesa-Redazione, "Dottrina, le operazioni delle unità aeromobili", in *Pagine di Difesa*, November 2005, http://www.paginedidifesa.it/2005/pdd_051155.html.

[6] Ibid.

[7] Interview, 5 March 2014.

latter finished by winning, leading to that passage of conversion and transformation that changed the "Friuli" Brigade from a mechanised unit to an airmobile one,[8] creating an integrated system based on infantry squads, heavy forces and helicopters in order to put into practice the doctrine which was gaining strength in the airmobility and aeromechanisation field.[9] At the end of the aforementioned reconfiguration – which took place in 2004 when the Brigade became fully operational[10] – and until the half of 2013, the Brigade was made of the "Friuli" Command and Tactical Support Division, two helicopter regiments (5th Reggimento Aviazione Esercito, "Rigel," and 7th Reggimento Aviazione Esercito, "Vega"), and one aircraft infantry regiment (66th Reggimento Fanteria Aeromobile, "Trieste"), as well as a cavalry regiment (3rd Reggimento Savoia Cavalleria).

In the light of the measures taken as part of the revision of the national military instrument, the "Friuli" airmobile Brigade will be reconfigured and strengthened: it will integrate the 6th Reggimento Trasporti di Budrio (BO), reconfigured as the Reggimento Logistico della Brigata Friuli; it will lose the Reggimento Savoia Cavalleria (3rd) di Grosseto to the Brigata Paracadutisti Folgore; and it will rely on the Divisione Friuli, relocated in Florence, with the concomitant closure of the 1st Comando Forze di Difesa di Vittorio Veneto, and the redenomination of the Divisione Mantova.

Moreover, this reconfiguration foresees that the airmobile Brigade will acquire amphibious capability, making use of it through a Command and Tactical Support Division at battalion level, and through eight regiments of which four will come from the dissolved Brigata di Cavalleria Pozzuolo del Friuli: the Reggimento Artiglieria a Cavallo Voloire di Milano, the Reggimento Lagunari Serenissima di Mestre (VE), the 3rd Reggimento Genio Guastatori di Udine, and the 4th Reggimento Genova

[8] Michele Nones and Stefano Silvestri (eds.), "The Role of the Helicopter in the New Defence Model", in *IAI Quaderni English series*, No. 1 (November 2000).

[9] Riccardo Niccoli, "La Brigata Aeromobile 'Friuli'", in *Coccarde Tricolori 2005*, pp. 77-85.

[10] The Brigade achieved validation after the "Forward Challenge 2004" exercise, undertaken between February and March. In August 2004, it provided a contribution to the "Antica Babilonia" operation in Iraq.

Cavalleria (Palmanova). Nevertheless, in order to achieve its transformation, the new Brigade will be able to count on seven regiments, namely two infantry regiments (one aircraft and one amphibious), one cavalry regiment, one artillery regiment, two helicopter regiments and one logistics regiment.[11]

Such a process of reconfiguration appears in line with the doctrine consolidated by the EI, without leaving room for further misunderstandings between the concept of airmobility and that of transport. The most recent measures on the subject provide not only for the maintenance and the strengthening of the airmobile capability of the "Friuli" Brigade, a capability provided on the three-pronged 5th Reggimento AVES, Rigel, 7th Reggimento AVES, Vega, and 66th Reggimento fanteria aeromobile, Trieste, but also for its broadening through the integration of the so-called capability for sea-borne protection.[12]

In this context, the agreement signed by the Army and the Navy, in November 2012 at AVES command in Viterbo, on future capability for the use of AW-129 Mangusta helicopters on naval units, it permits to complete and to open new perspectives for the extension of this helicopter capability for sea-borne operations.[13] This important agreement provides for the validation and use of flight instructors from the MM in the service of the Mangusta, with the aim of qualifying a certain number of pilots from the Army's 5th Reggimento Elicotteri di Attacco, Rigel, for operations on board naval units.[14] The initiative is all the more relevant considering that Italy was the first country to use the Mangusta on naval units, especially the Garibaldi, during the evacuation of UN personnel from Mogadishu during the 1990s. More recently, French and British ships have also decided to employ combat helicopters, for example during the Libyan crisis in 2011.[15] Nevertheless, this is a process that will

[11] Riccardo Niccoli, "Esercito: verso i 90.000 uomini", in *Forze di Terra 2013*, pp. 20-29.

[12] Antonio Bettelli, "La capacità aeromobile nel progetto di riordino…", cit., p. 33.

[13] Analisi Difesa, *Accordo tra Esercito e Marina Militare per l'imbarco dei Mangusta*, 23 November 2012, http://www.analisidifesa.it/?p=1576.

[14] RID Redazione, "Notizie: Gli AW-129 sulle navi: finalmente!", in *Rivista italiana difesa (RID)*, No. 1/13 (January 2013), p. 12.

[15] Interview with General Claudio Graziano, by Pietro Batacchi and Eugenio Po, "Di-

require time to achieve the reconfiguration of the aircraft, which should be equipped with a system to fold its blades, and which will require suitable training activity. Moreover, aircraft such as the Mangusta, projected to operate from land, can be used from on board ship only in specific situations or theatres of operation. Once operative, the Mangusta will be able to carry out missions such as convoy escort, direct attack, Close Air Support (CAS) and civilian protection.[16] Furthermore, it is not to be excluded that in future such cooperation between the two Armed Forces might be extended to other platforms such as the CH-47, notwithstanding the fact that this aircraft – given its limits in folding its blades – risks to block the bridge of the naval unit and, therefore, to compromise the use of the rest of the flight component.[17]

1.1.1 The helicopter fleet and procurement programmes

AVES is the main user of helicopters among the Italian Armed Forces, with a fleet composed of around 225 helicopters in eight lines of aircraft, divided into the following three categories: Exploration and escort helicopters, represented by the Mangusta AW-129; Combat Support helicopters (Elicotteri da Supporto al Combattimento, ESC), arranged officially in the following five lines: AB-206, A-109, AB-205, AB-212 and AB-412. To be more precise, part of the AB-206 fleet has been withdrawn from service and the remaining models are used for advanced training activities. The A-109 has moved from experiments in anti-tank tactics to liaison and advanced training activities. Finally, both the AB-205 and the AB-412, in service for many years, will be replaced by the NH-90; Transport helicopters, such as the CH-47C and the NH-90,[18] in tactical transport helicopter (TTH) configuration.

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fesa domani. Parlano i Capi di Stato Maggiore", *RID*, n. 6/13 (June 2013), pp. 32-37.

[16] Ibid., p. 36.

[17] Interview with Admiral Giuseppe De Giorgi, Ibid., pp. 26-31.

[18] Italy was the first nation to use the NH-90 in Afghanistan, to be precise the TTH IOC+ Improved version. This deployment, which began in mid-August 2012 in the service of Task Force "Fenice" of Regional Command West (RC-W), was intended to accompany and then to replace the AB-205s. In comparison to the latter, the NH-90 provides, amongst other things, almost twice the maximum autonomy: 450 miles, as against 250.

The reform process of the military instrument provides for a reduction of the fleet from the current 225 aircraft to around 160 over the next 10 years,[19] with a possible reduction of the number of lines of aircraft, considered excessive, from the current eight to four or five.[20] The quantitative reduction of the Army's forces has a precedent in the 1990s, when the helicopter fleet could count on around 400 aircraft. The decision taken at that time to work for a drastic quantitative reduction of the rotary-wing component, in order to reach the current 250 aircraft, not only allowed to the operational capacities to be maintained, but also to be broadened and increased, thanks to adequate levels of investment, as well as tailored and planned upgrade programmes, which led to the acquisition of qualitatively more advanced aircraft.[21]

According to the multi-annual defence programme for the three-year period 2013-2015, published by the Ministry of Defence in April 2013, there are three main programmes currently underway that are aimed at the substitution and/or renovation of the Army's helicopter fleet:[22] the acquisition of 60 NH-90s, the purchase of 16 CH-47Fs, and the modernisation of 32 AW-129s.

As regards the acquisition of the TTH version of the NH-90, intended to renovate and to unify the current line of aircraft, organised around the AB-205 and the AB-412, the first model in Final Operational Capability (FOC) configuration was delivered in May 2013, bringing the number of aircraft at the service of the Army to 21, in view of a request of 60. Prior to the delivery of the first model in FOC configuration, the Army had taken delivery of five TTH IOC (Initial Operational Capability) mod-

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For a detailed analysis, see RID-Redazione, "Notizie: In Afghanistan gli elicotteri NH-90 dell'AVES", in *Rivista italiana difesa (RID)*, No. 10/12 (October 2012), p. 7; Riccardo Niccoli, "Gli NH-90 in Afghanistan", in *Coccarde Tricolori 2013*, pp. 80-85.

[19] Hearing of the Army's Chief of Staff, General Claudio Graziano, joint sitting of Senate and Chamber of Deputies Defence Committees, 5 June 2013, http://www.senato.it/service/PDF/PDFServer/DF/293981.pdf.

[20] Pietro Batacchi and Eugenio Po, "AgustaWestland guarda al futuro", cit., p. 29.

[21] Interview, 5 March 2014.

[22] Italian Ministry of Defence, *Documento programmatico pluriennale per la Difesa per il triennio 2013-2015*, April 2013, http://www.difesa.it/Amministrazionetrasparente/bilandife/Pagine/Bilanciopreventivoeconsuntivo.aspx.

els, seven IOC+ models and eight IOC+ Improved models. The new FOC configuration has an obstacle warning system of the LOAM (Laser Obstacle Avoidance and Monitoring) type, as well as more advanced avionic software. In time, previous versions will be updated with the new software and the addition of the necessary armour.[23] The program, in cooperation with Holland, France and Germany, concerns the development, the acquisition and the related logistical support for the Army's tactical transport needs and the Navy's needs (see paragraph 1.2.1). The total cost amounts to around €3,895 million and the completion of the programme is foreseen for 2021. The financial contribution for 2014 and 2015 has been shared between the Ministry of Defence and the Ministry of Economic Development: the former has set aside an allocation equal to €38.3 million in 2014 and €188.3 million in 2015, while the latter intends to contribute with financing equal to €139 million and €77 million respectively for 2014 and 2015.

The second programme concerns the acquisition of 16 medium-heavy CH-47F transport helicopters (with an additional four under option), intended to replace the current line of CH-47Cs, in service since 1973. The new CH-47Fs will be mainly used by the I Reggimento AVES, "Antares," based in Viterbo. The new aircraft completed its inaugural flight in June 2013, and delivery is foreseen by 2017. This new platform presents a series of improvements compared to previous models, such as, a more secure communication system, self-protection systems, and an advanced data-link. The new CH-47F has a maximum weight at full load (Maximum All Up Weight) of 23 tonnes, and it is equipped with two Honeywell T55-GA-714A engines, which allow it to travel in conditions of high temperatures and at high altitude (hot and high capability), while nevertheless being able to cope with all kinds of climactic conditions. The first tactical task of the CH-47F is the aerial transport of troops and equipment, but it is equally furnished with new digital avionics, additional armour-plating and modern weapons. Material can be transported internally and externally thanks to an internal and external

[23] RID-Redazione, "Notizie: AgustaWestland consegna il primo NH-90 FOC all'Esercito", in *Rivista italiana difesa (RID)*, No. 6/13 (June 2013), p. 8.

hitching system on the craft. The noteworthy useful load and the high cruising speed over long distances make this helicopter an indispensable instrument for carrying out special support operations, relief operations in the event of natural disasters and even anti-fire operations. The four helicopters under option could be configured for the Special Forces, with additional petrol tanks and supplementary communications equipment, and assigned to the Reparto Elicotteri per Operazioni Speciali (REOS).[24] The total cost of the programme corresponds to €974 million, and its completion is foreseen for 2018. The financial allocations for the years 2014 and 2015 amount respectively to €172.8 million and €158.5 million.

The third programme concerns the modernisation and the upgrading of 32 AW-129 Mangustas. The AW-129 entered into service in two waves: the first was made of 45 models, while the second, beginning in 2002, was made of further 15 in combat (CBT) configuration, making a total of 60 aircraft. The CBT configuration, A-129C for AVES, is a version which incorporates the same improvements as the A-129 International version, namely strengthened transmission, a five-blade rotor, a 20mm cannon and weapons composed of Raytheon TOW 2/2A anti-tank missiles. The current upgrade programme concerns 32 of the 48 AW-129 models available today, and foresees principally the modernisation of the sighting system with the OTSWS (Observation/Targeting & Spike Weapon System) apparatus TOPLITE III, and the introduction of the air-to-ground/anti-tank missile Rafael Spike ER (Extended Range) to replace the current Raytheon TOW 2/2A.[25] Furthermore, the programme includes the installation of a package of instruments for satellite and encrypted communications, such as a self-protection suite improved with new chaff-launch dispensers.[26] In this way, the service-life of the Mangusta could be extended by further 10 years, up to 2024. The total cost

[24] RID-Redazione, "Notizie: Primo volo per l'elicottero ICH-47F dell'Esercito", in *Rivista italiana difesa (RID)*, No. 8/13 (August 2013), p. 8.

[25] Eugenio Po, "L'EI cambia volto", in *Rivista italiana difesa (RID)*, No. 2/12 (February 2012), pp. 22-31.

[26] Eugenio Po, "Il punto sul 'nuovo' Esercito", in *Rivista italiana difesa (RID)*, No. 3/14 (March 2014), pp. 38-43.

of the project is around €200 million and its completion is foreseen for 2014. The financial costs connected to the programme for the years 2014 and 2015 amount respectively to €62.6 million and €27 million. The 32 new models, denominated AW-129D, will be accompanied by the remaining 16 models from the preceding AW-129C version. Indeed, in the Army's plans there is a desire to establish a fleet of 48 exploration and escort helicopters, among which 32 AW-129Ds to be used in complex and hostile operational contexts, and 16 A-129Cs for training and less risky operations.[27] Nevertheless, one should bear in mind that the Mangusta has now reached the limits of its capability with this upgrade, and that further upgrade packages will no longer be possible without radical, but no longer efficient, interventions. This is why the Army has for some time been thinking about equipping itself in the future with a helicopter derived from the T-129 ATAK, made by Finmeccanica-AgustaWestland in collaboration with Turkish Aerospace Industries (TAI) for the Turkish Army.

1.2 THE NAVY

The Navy, and in particular Naval Aviation (Aviazione Navale) conceives its own aerial assets as a "weapon system for the naval unit," of which these constitute the operational "long arm" rather than an "autonomous weapon system".[28] Indeed, the Navy refers to the concept of "aero-naval power" rather than "aerial power," in the context of which the aerial and maritime dimensions are indivisible, and the naval forces amplify not only the observation and the recognition capability of the fleet, but also its engagement capability.

The Navy's aircraft are used to carry out three main activities: Anti-Submarine Warfare (ASW), Anti-Surface Warfare (ASuW) and amphibious combat, the last of which in support of Amphibious Forces and Spe-

[27] Ibid., p. 42.

[28] Interview with Rear Admiral Paolo Treu, "Le Forze Aeree della Marina", in *Coccarde Tricolori 2010*, pp. 82-91.

cial Forces operations in so-called "helicopter assault operations".[29] These operations have benefited significantly from the aircraft component, which has allowed for a leap in the quality of the modalities of execution of amphibious combat, bringing depth and allowing the instrument to operate behind enemy lines.[30]

In addition, the Navy's rotary-wing assets contribute to maritime security through Maritime Interdiction Operations (MIO) and Search And Rescue (SAR) missions at sea, and in the context of anti-piracy activities.[31] A good example is the Mare Nostrum operation, commenced in October 2013 with a duration of 12 months, and decided upon by the Government in the wake of various tragedies in the sea which witnessed the death of migrants heading for the Italian coastline. The military and humanitarian operation, coordinated by the Navy, was intended to reinforce the mission for surveillance and rescue at high sea, using various naval and aerial forces, including those of the Armed Forces. The naval mission already in place operated concomitantly in both humanitarian assistance and maritime security activities. In the course of the operation, the Navy deployed 920 men and five ships. As regards the overall helicopter component, it is worth noting the use of four AB-212 helicopters, one HH-139 search and rescue helicopter, and two EH-101 (MPH) helicopters endowed with infrared optical instruments and surface search radars. The EH-101 helicopters were manned or ranged on land near Lampedusa, Pantelleria and Catania.

Finally, as a result of their multi-role character, all the aircraft of the Navy's helicopter fleet can be used for utility tasks and sanitary relief.[32] In the context of operations which are not strictly military, but which could also be of dual use in nature (meaning both civilian and military), the aircraft are used in support of both the Civil Protection Department (Dipartimento della Protezione Civile) for operations for the rescue of populations affected by natural catastrophes, and the Corpo Nazionale Soccorso Alpino e Speleologico (CNSAS) in interventions in mountainous

[29] Interviews, 25 and 26 March 2014.
[30] Interview, 25 March 2014.
[31] Italian Navy, *Rapporto 2010*, p. 48.
[32] Interview, 25 March 2014.

areas. In this context, two exercises were respectively carried out in April and October 2013, organised in collaboration with the Civil Protection Department and intended to increase and to verify the synergy between civilian and military forces, and to consolidate an operational module for rapid reaction in case of emergency. In the October exercise, named "Tidal Wave in Southern Tyrrhenian Sea," the aircraft carrier Cavour was made available as a "hospital area" and for training for Speleo-Alpini-Fluviali groups. Furthermore, an Advanced Operative Garrison (Presidio Operativo Avanzato, POA) was set up on the Cavour for the coordination of the information flow between the assets in use on the ground and the Department for Civilian Protection's Italy Situation Room (Sala Situazione Italia, SSI) in Rome. The area affected by the disaster was captured by the Navy's aircraft on video and images, which were transferred in real-time to the Operative Committee for Civilian Protection (Comitato Operativo della Protezione Civile) to be worked on.[33]

As in the case of AVES, the Navy's rotary-wing assets also participate in the Anti-Forest Fire (Anti-Incendi Boschivi, AIB) campaign, through the use of some AB-212s.[34]

Since the aircraft is conceived as a weapon system for the ship and not as a mean in itself, in the Navy's vision the design of the cell, the avionics and the platform in general has to be compatible with the maritime environment – the term used is indeed "navalisation" – and perfectly able to operate in symbiosis with the ship, thereby demonstrating a certain multi-role character. For example, there is the problem of defusing the conflict between the helicopter systems and the rather dense electromagnetic environment of the ship. This is true also for aircraft personnel who are especially "sailors" rather than pilots, flight operators or aircraft specialists, both in terms of training and effective use.[35]

Even if the Navy's aircraft are mainly predisposed for "operations

[33] Interview, 26 March 2014. See also Italian Navy, *La Marina Militare all'esercitazione "TWIST" con la Protezione Civile*, 25 October 2013, http://www.marina.difesa.it/Conosciamoci/Notizie/Pagine/20131025_twist.aspx.

[34] Italian Navy, *Rapporto 2010*, p. 34.

[35] Paolo Treu, "Le Forze Aeree della Marina…", cit., p. 88.

from on board," they were, however, also used on land during the ISAF mission in Afghanistan, thereby showing the polyvalent character that distinguishes both the aircraft and the crew.[36] Deployed in the Air Task Group (ATG) "Shark," the three HH-101 helicopters of the Primo Gruppo Elicotteri di Luni-Sarzana (La Spezia) carried out tasks in relation to surveillance, patrol, support for the movement of convoys and sensitive personnel, deterrence and MEDEVAC.

1.2.1 The helicopter fleet and procurement programmes

A radical renovation and modernisation is foreseen also for the helicopter component of Naval Aviation, in the face of a significant reduction in quantitative terms from the current 105 aircraft to around 70 aircraft in the near future.[37] In this perspective, the Navy's rotary-wing fleet will be made up of two principal lines of aircraft, for which programmes are already underway: 56 NH-90s in naval version (NATO Frigate Helicopter, NFH), and 22 EH-101s. The former will replace the AB-212 ASW component, in service since 1976, both for anti-submarine combat and for SAR, utility and helicopter assault missions. On the other hand, the latter have already replaced the SH-3D, in service since 1968, and used for transport and Special Forces support tasks.[38]

Of the 56 NH-90 models ordered by the Navy, 46 are in NFH configuration (these are named SH-90A) for ASW, ASuW, SAR and troop transport missions. The remaining 10 are in tactical transport and helicopter assault version (these are named UH-90A), with a rear cargo ramp and foldable blades, a typical characteristic of helicopters used onboard naval units.[39] In November 2013, the first NH-90 NFH Step B or FOC (Full Operational Capability) model was delivered, with various improvements in terms of weapons, avionics, sensoristics and satellite communications.[40] This sixth aircraft is in addition to five Step A or MOC

[36] Interview, 26 March 2014.

[37] Hearing of the Chief of Defence Staff, Admiral Luigi Binelli Mantelli, joint sitting of Senate and Chamber of Deputies Defence Committees, 22 May 2013, http://www.senato.it/service/PDF/PDFServer/DF/293457.pdf.

[38] Riccardo Niccoli, "Marina Militare", in *Coccarde Tricolori 2013*, pp. 144-146.

[39] Paolo Treu, "Le Forze Aeree della Marina…", cit., p. 82.

[40] In particular, the FOC helicopters are equipped with a Chaff and Flare system inte-

(Meaningful Operational Capability) models already delivered to the 5th Gruppo Elicotteri di Luni-Sarzana, which do not have any of the weapon systems or sensors of the FOC version and for which an update to the new standard is foreseen by means of retrofit.[41] The decision to deliver aircraft in MOC configuration was determined by the need to begin the training of the flight crews and the support personnel on land and, at the same time, to evaluate the optimum operational procedures following from the introduction of the new helicopter into active service.[42]

Overall, the SH/UH-90As will be used to cover a wide range of operations: ASW, ASuW, SAR, transport, special operations, helicopter assault, MEDEVAC, anti-piracy actions, and maritime patrol, in all weather conditions, by day and by night.

Alongside the NH-90, the Navy can count on 22 EH-101s in the following versions:[43] 10 MPH in ASW and ASuW version, able to carry out anti-submarine and anti-surface activities, and tasks in relation to the command and control of aero-naval operations, maritime patrol, SAR, and, if required, helicopter assault; four HEWs (Helicopter Early Warning), intended principally for wide-range aerial and surface surveillance, and created from the need to control a huge section of sea, or to maintain control over an operation underway over a vast scale, such as an amphibious landing. Finally, eight ASHs (Assault Support Helicopters), used above all to support Special Forces and Amphibious Forces, which have a relatively wide rear cargo ramp,[44] and which can transport up to 16 stretchers, if configured for MEDEVAC missions.[45]

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grated into the EWS (Electronic Warfare System), an improved-performance radar, a third UHF/VHF radio with satellite capability, and weapons systems qualified to be brought on board naval units. For further details, see Riccardo Niccoli, "I nuovi SH-90 della Marina", in *Coccarde Tricolori 2012*, pp. 88-95.

[41] RID-Redazione, "Notizie: Consegnato alla Marina il primo NH-90 FOC", in *Rivista italiana difesa (RID)*, No. 12/13 (December 2013), p. 13.

[42] Paolo Treu, "Le Forze Aeree della Marina…", cit., p. 82.

[43] Riccardo Niccoli, "Marina Militare", in *Coccarde Tricolori 2013*, p. 145.

[44] During operation White Crane in Haiti, the rear ramp of the EH-101 in ASH version allowed wheeled vehicles of the Defender 90 type to be transported from the aircraft carrier Cavour to land.

[45] Paolo Treu, "Le Forze Aeree della Marina…", cit., p. 83.

1.3 THE AIR FORCE

The AM's helicopter component is asked to carry out a vast range of operations. It plays an essential role in SAR and Combat Search And Rescue (CSAR) missions, MEDEVAC, casualty evacuation, and aerial support for Special Operations (SPECOPS). Other secondary, but not less important activities are, for example, searching for those lost at sea or in the mountains, or the urgent sanitary transport of sick people in danger of their lives. Finally, considering its pervasive and extensive presence on the national territory, the Air Force is reflecting on the possibility of regaining possession of anti-fire capability, like the other Armed Forces, such as the Army, which are called upon to intervene with their own aircraft during the Anti-Forest Fire campaign.[46]

Concerning SAR, it is necessary to distinguish between "civilian" and "military" SAR: in the former case, the Air Force continues to guarantee the activity of national search and aerial rescue in support of civilian aviation and naval forces, in cooperation with other administrative entities of the state. At the moment, however, a normative framework which clearly defines authorities, responsibilities and competences seems to be lacking, giving rise to a rather fragmentary and confused situation.[47] As regards "military" SAR, on the other hand, the Air Force is the actor responsible for the search and rescue of any pilots and military crew who should find themselves in conditions of danger following a flight incident. Overall, the SAR function is entrusted to the 15th Stormo, with its principal headquarters deployed in Cervia (Ravenna), from which depend the 81st Crew Training Centre (Centro Addestramento Equipaggi, CAE), the 83rd CSAR Centre in Cervia, the 85th CSAR Centre in Pratica di Mare, the 82nd CSAR Centre in Trapani, and the 84th CSAR Centre in Gioia del Colle (Bari). All these departments are called upon to intervene at the signal of Aerial Operations Command (Comando Operazioni Aeree, COA) in Poggio Renatico, Ferrara, and are coordinated by the Rescue Coordination Centre (RCC).

[46] Interview, 21 February 2014.

[47] Ibid.

In the case of "civilian" SAR, the RCC, after having received the intervention request from another entity such as the Prefecture, the Carabinieri or the Port Authority, sends out the intervention task and it alerts the SAR Group nearest to the affected area, ordering the helicopter to take off. From the moment that an intervention is conducted together with the aerial forces of other state entities, as it is often the case, especially for natural disasters, the practice is that the first entity to arrive on the scene will later coordinate and interface with all the others. Such was the situation, for example, in the case of the Costa Concordia shipwreck, when an HH-3F Air Force helicopter coordinated in-flight the first rescue interventions of the Port Authority and the Financial Police.[48]

To ensure the necessary speed in the case of emergency, the Air Force maintains every day, in different airports, a SAR helicopter ready to take off in a maximum time of 30 minutes. Given that such operations can also take place at night, thanks also to the use of Night Vision Goggles (NVG), in difficult meteorological conditions, or when other actors are not able to intervene, the integration of man and aircraft ("assetto," in technical language) must always be in the optimum conditions for adequate operation.[49] The attention to this last aspect, and more generally to the issue of flight security, has gradually increased within the Armed Force; a careful analysis of the technical conditions of the aircraft must start from a consistent study, distinguishing the areas of risk that involve the human factor (above all the pilot), whose features, including personal conditions, should not compromise operational activities.[50]

The SAR and CSAR fields come under the widest definition of the category of Personnel Recovery (PR). This also includes mission profiles known as Combat Recovery, which are also executed by the Air Force with the HH-3F and in future the HH-101, such as Non-combatant Evacuation Operations (NEO), which are aimed at recovering untrained personnel in semi-permissive or non-permissive environments. These op-

[48] Stefano Monteleone and Chiara Rosati, "15° Stormo dell'Aeronautica militare: al servizio della comunità", in *Aviation Report*, 20 December 2012, http://www.aviation-report.com/dblog/articolo.asp?articolo=539.

[49] Interview, 21 February 2014.

[50] Ibid.

erations are carried out jontly, including the deployment of Special Forces, as happened in Libya and Somalia.[51]

The helicopter capability is also used for aerial defence against low-altitude aircraft (Slow Movers Interceptor, SMI), an activity which aims at surveillance and at guaranteeing the security of the aerial space from possible threats on the occasion of large public events, such as for example the G8 summits in Genoa and L'Aquila, or demonstrations of particular relevance.

As previously highlighted, Air Force helicopters contribute to medical evacuation (MEDEVAC) and casualty evacuation (CASEVAC) operations, as well as to Special Operations.

Finally, helicopter support for Special Operations constitutes a "niche" capability that the Armed Force has developed over the years and continues to develop, filling a previously-identified gap in capability through the creation of small specialised units.[52]

1.3.1 The helicopter fleet and procurement programmes

The Air Force's helicopter fleet is currently in a reorganisation stage, with the phase-out both of the HH-3F (where HH stands for Hospital Helicopter) and of the HH-212A, and the phase-in of 13 HH-139As. The HH-139As have been assigned to the 83rd Centre in Cervia, the 84th Centre in Brindisi (Gioia del Colle), and the 82nd Centre in Trapani to carry out SAR operations. Together with the arrival of 12 (plus other three optional) HH-101s, the plan is to have a helicopter fleet that by 2020 will be mainly structured around two lines of aircraft: the HH-139 and the HH-101.[53]

Turning to the HH-3F, this aircraft derives from the need of the US Coast Guard to endow itself with a search and rescue aircraft with amphibious capacities. The first 20 models were purchased by the Italian Air Force from 1977 onwards at initial Alpha standard, while between 1991 and 1992 further 15 were delivered, which were configured to

[51] Ibid.

[52] Interview, 25 February 2014.

[53] Interview, 27 February 2014.

Bravo standard for CSAR missions. These were equipped, amongst other things, with Forward Looking Infrared (FLIR), i.e. last-generation thermal vision systems, armour for the cockpit, and devices for mounting aircraft-guns.[54]

With respect to SAR, after the first three HH-212As purchased in 1979, between 1984 and 1988, the Air Force obtained other 32 of these, equipped with more advanced systems, including a four-channel autopilot, HF radio and a search lamp. However, the aircraft was subject to various upgrades, firstly with the integration of a new autopilot and NVG, and later with the updating of 12 aircraft to Operational Capability Implementation[55] (Implementazione Capacità Operativa, ICO) standard.[56]

For what concerns the programmes underway or in the finalisation phase, the Air Force received the last 13th[57] HH-139A (a militarised version of the AW-139 civilian platform), gradually replacing the HH-212A and in part also the HH-3, both in service for almost 30 years. The total cost is equal to around €285 million, including techno-logistical support over five years, and crew and technical personnel training, with a financial outlay of €46.8 million in 2014 and €13.8 million in 2015.[58] The aircraft was originally chosen as an "ad interim" or "gap filler" measure while waiting for the medium helicopter, in the eight ton class, as part of the Air Force's Medium Helicopter programme (Elicottero Medio dell'AM, EMAM). However, given the budget restrictions and the reduction in allocations, it is possible that the HH-139A will remain in service for some years to come, if not up to 2020.[59] While two of the 13 models are in VIP transport configurations (these are called VH-139), to substi-

[54] Riccardo Niccoli, "Aeronautica Militare", in *Coccarde Tricolori 2013*, pp. 126-138.

[55] The HH-212 in ICO configuration, equipped with passive crew protection, defensive weapons, and antimissile counter-measures with infrared guide, was deployed in the operations theatre by the 21st Gruppo Tigre of the 9th Stormo at Grazzanise in support of the ISAF contingent in Afghanistan.

[56] Alfonso Mino, "L'Aeronautica Militare riceve i primi HH-139 per il rinnovo del SAR", in *Dedalonews*, 10 March 2012, http://www.dedalonews.it/it/index.php/?p=27091.

[57] Interview, 27 February 2014.

[58] Italian Ministry of Defence, "Documento programmatico pluriennale…", cit.

[59] Interview, 21 February 2014.

tute the obsolete SH-3D/TS, of which just one model remains, the aircraft is used mainly for SAR tasks on the national territory. As a tested helicopter that is in service with other national civilian and military entities, including the Financial Police and the Coastal Guard, the HH-139A allows for joint and inter-agency synergies to be achieved in the aerial rescue sector as a whole, often in prohibitive conditions, at night, in bad weather, and in particularly inaccessible and isolated areas. Indeed, the HH-139A is able to operate both by day and by night, thanks to the use of NVG, in difficult areas or in a marine environment.[60] Furthermore, the raised and strengthened undercarriage allows for landings on unprepared services, while a FLIR turret is installed beneath the nose. Finally, it has also been fitted with a self-protection suite able to guarantee full efficiency in medium- or low-level combat environments.

This aspect is connected to the other programme underway concerning the acquisition of 12 HH-101s to replace the HH-3F. The HH-101 will be used principally for CSAR missions and Special Operations, with a secondary role in military SAR, so-called SMI missions, MEDEVAC, and utility missions.[61] Furthermore, the aircraft will have the capability to be refuelled in-flight, so as to extend and multiply operational efficiency in different and diverse deployment scenarios. The Ministry of Economic Development foresees financial support for the programme through a contract structured around several long-term options.[62] The first helicopters should arrive by the end of 2014 or in the first semester of 2015, while completion is foreseen by 2017-2018.[63]

As concerns the sector of helicopter training at the 72nd Stormo in Frosinone, newly-licensed pilots being trained for helicopter service follow the basic course on the TB-500B, of which 50 models have been acquired since 1990, and of which today around 40 remain in service.[64] It

[60] Italian Air Force, *Schede aeromobili: HH-139A*, http://www.aeronautica.difesa.it/Mezzi/velivoliDotazione/Pagine/HH-139A.aspx.

[61] Interview with General Pasquale Preziosa by Pietro Batacchi and Eugenio Po, "Difesa domani. Parlano i Capi di Stato Maggiore", cit., pp. 38-43.

[62] Interview, 27 February 2014.

[63] Ibid.

[64] Ibid.

is a light helicopter with five blades used for training and transport and characterised by increased flexibility of use and versatility.

The helicopter has also been used since 1990 for the initial training of pilots of the other Armed Forces and state bodies. In this sense, the Air Force is examining the possibility of acquiring a possible substitute for the aircraft, or of commencing a Mid Life Update (MLU) programme for 2018-2020,[65] although at the moment no specific request is foreseen. The initiative comes within a project of wider scope in the field of training, intended to find new solutions with industrial counterparts in such a way as to offer to the crews a more complete and versatile training path.[66] Indeed, Finmeccanica-AgustaWestland and the Italian Air Force signed in March a letter of intent aimed at strengthening further their already established collaboration in the field of pilot training. The partners intend to co-develop new capacities to satisfy future rotary-wing training needs, making use of the synergies between the 72nd Stormo in Frosinone and Finmeccanica-AgustaWestland's training structure, through the existing establishment in that city.

Staying in the field of training, the Air Force's 72nd Stormo in Frosinone carries out an activity that is almost unique at a national level, being the only flight school able to provide a whole series of basic rotary-wing training courses for both the Armed Forces and the public safety and rescue authorities, as well as for pilots coming from other countries such as Afghanistan, Albania, Malta, and Zambia.[67] Specifically, the centre provides not only training for the award of the Military Helicopter Pilot License (Brevetto Militare di Pilota di Elicottero, BMPE) for the Army, the Carabinieri and the Financial Police, but also training for the attainment of the Helicopter Pilot License (Brevetto Pilota di Elicottero, BPE) for the Police, the Fire Brigade and the State Forest Corps. Finally, the centre provides for training for the award of the basic helicopter

[65] Ibid.

[66] Federico Cerruti, "Nuovo iter addestrativo per l'Aeronautica", in *Analisi Difesa*, 2 November 2013, http://www.analisidifesa.it/?p=6254.

[67] Matteo Marianeschi, "72° Stormo M.O.V.M. 'Marcello de Salvia': la formazione per l'ala rotante", in *Aviation Report*, 16 February 2011, http://www.aviation-report.com/dblog/articolo.asp?articolo=162.

qualification to pilots coming from the Air Force, the Navy, and the Port Authorities. After the completion of the initial course, pilots are assigned to the operational department of the Armed Force to undertake training with the respective aircraft to which they have been assigned. This training is intended to allow them to acquire the ability to use the aircraft. This ability is different and specific to every Armed Force,[68] as it is closely connected to tactics and procedures for the missions to be carried out, as well as to the specific vision of the use of rotary-wing forces. Therefore, the 72nd Stormo in Frosinone gives a significant but limited contribution to basic training, standardisation and interoperability between the Armed Forces and the police and public rescue authorities.[69]

1.4 THE CARABINIERI

The Aerial Service of the Carabinieri Corps (Servizio Aereo del Corpo dei Carabinieri) is aimed to integrate and to increase the prevention and the control of the national territory (internal security) carried out by the land units in fulfilment of institutional tasks. As regards the "external defence" tasks, the Carabinieri, not deploying any aerial combat support service, use the aerial combat support service provided by the other Armed Forces. The non-combat aerial service, i.e. the service closely connected to the national territory, is composed of:

- an Aerial and Naval Services Office (Ufficio dei Servizi Aereo e Navale), included within the 2nd Department of the General Command Staff (II Reparto dello Stato Maggiore del Comando Generale), with directional, training, inspection, logistical and technical consultancy functions;
- a Carabinieri Aircraft Group (Raggruppamento Aeromobili Carabinieri, RAC), with its base in Pratica di Mare, at Specialised Carabinieri Units Division's (Divisione Unità Specializzate Carabinieri) disposal;

[68] Interview, 12 March 2014.

[69] Interview with General Pasquale Preziosa by Pietro Batacchi and Eugenio Po, "Difesa domani. Parlano i Capi di Stato Maggiore", cit., p. 42.

- 14 Helicopter Units (Nuclei Elicotteri, NEC),[70] spread equally across the country in order to guarantee a timely intervention, and operationally managed by the RAC in a flexible manner and according to the needs.

Several times, the Aerial Service has been the subject of measures intended to rationalise the entire organisation. From 2007 to 2013, the aircraft fleet witnessed a reduction of 52 helicopters, from 95 to 43 units; two flight departments were abolished; and the ceiling for annual flight activity was reduced from 9,000 to 7,500 hours.[71]

With the withdrawal of the last AB-206s and the discarding of the A109A/A-II, the fleet has a relatively modern face, with an operative time-span of up to 2030-2035.[72] It is currently made up of AB-412, A-109 Power and AW-109N helicopters.[73] The AB-412 is normally used for personnel transport and in support to special units, such as the Tuscania Carabinieri Parachutist Regiment (Reggimento Carabinieri Paracadutisti Tuscania), the Squadroni Cacciatori and the Special Intervention Group (Gruppo di Intervento Speciale, GIS). Thirty-five models were originally purchased, but currently less than 30 remain in service. On the other hand, the 21 A-109s are present in two versions: three A-109E Power helicopters and 18 AW-109Ns.[74]

[70] Volpiano, Orio al Serio, Bolzano, Pisa, Bari, Pontecagnano, Vibo Valentia, Palermo, Olbia, Elmas, Fontanarossa, Forlì, Treviso, and Villanova d'Albenga.

[71] Hearing of the Head of the 2nd Dept of the General Command of Carabinieri Corps, Brigadier-General Enzo Bernardini, Senate Defence Committee, 11 June 2014, http://www.senato.it/japp/bgt/showdoc/frame.jsp?tipodoc=SommComm&leg=17&id=772308.

[72] Interview with Colonel Michele Sirimarco, Commander of the RAC, "Il punto sul Raggruppamento Aeromobili", in *Coccarde Tricolori 2014*, pp. 164-169.

[73] The fleet also included the AB-206, but in June 2012, Italy and Argentina signed an implementing agreement under which the AB-206 fleet would be ceded by the Carabinieri to Argentine Army Aviation. Italian Ministry of Defence, *Il Gen. Debertolis firma l'accordo per la cessione degli AB206 all'Argentina*, 25 June 2012, http://www.difesa.it/SGD-DNA/Segretario/Eventi/Pagine/IlGenDebertolisfirmal%27accordo.aspx.

[74] Riccardo Niccoli, "Carabinieri", in *Coccarde Tricolori 2013*, pp. 147-148.

1.5 LAW ENFORCEMENT AGENCIES AND EMERGENCY SERVICES

The helicopter fleet of law enforcement agencies and emergency services – the National Police, the Coast Guard, the State Forestry Corps, the Financial Police, and the National Fire Corps – is estimated at around 250 aircraft in the various traditional configurations. The fleet is called upon to carry out different missions, including SAR, law enforcement, patrol, and control of the national territory.

This fleet as well has an average service life of around 30 years, excluding the more recent aircraft, such as the AW-109N and the AW-139. It should be noted that an attempt was made to outline a ten-year adjustment plan, which would have introduced "a personalised but single helicopter model" for the Police, the Carabinieri and the Financial Police.[75] The plan, drafted in 2009 by the then Italian Ministry of Interior Roberto Maroni, would have allowed for "reference to be made to a single training centre and the same spare parts, consequently leading to a drastic cut in maintenance costs".[76] The idea was not implemented, leaving unchanged a status quo that undoubtedly presents inefficiencies in the management of the helicopter fleet used for public safety and rescue tasks.

1.5.1 The Italian National Police

Among the operational commitments assigned to the Police Aerial Service (Servizio Aereo della Polizia di Stato), there are control of the roads, criminal policing activities, SAR and control of the national territory in order to guarantee law and order. At the moment, the rotary-wing fleet is composed of 68 aircraft: 28 AB-206s, 12 A-109s, 23 AB-212s and five AW-139s, while geographic coverage of the country is en-

[75] Statements by Italian Ministry of the Interiors Roberto Maroni on the forthcoming European programme for justice and home affairs (the so-called "Stockholm programme"), joint sitting of Senate Committees European Union Policies, Constitutional Affairs and Justice, 11 November 2008, http://www.senato.it/service/PDF/PDFServer/DF/216224.pdf.

[76] Ibid.

sured by the presence of 11 flight departments.[77] The AB-206 has been used for many years to carry out initial daily training activities and operational activities over unpopulated areas, as well as reconnaissance, surveillance, escort and aerial support. Of the 12 A-109s, 11 belong to the A-109A and A-109A-II versions for law and order and city surveillance missions, and for the rapid transfer of celebrities and VIPs. The single A-109N model entered into service in 2008.[78]

In December 2013, the Police received the fifth of the eight AW-139 ordered models, which will be deployed at Reggio Calabria,[79] joining the four already operative at the bases in Puglia, Sicilia, Calabria and Lazio. In particular, the first two models were delivered in the middle of the same year, and were dispatched to the 1st Reparto Volo at Pratica di Mare.[80] The order was initialled in July 2012, and it sees the partial contribution of the European Union's FRONTEX agency. The commissioned AW-139s are equipped with a FLIR system, satellite communication systems, a lamp for night searches, a rescue winch and a mission control console integrated into the cabin. The configuration includes a high-definition video link that will be fitted to the other aircraft of the Police fleet as well.

1.5.2 The Italian Coast Guard

The Aerial Service of the Coastal Guard is expected to carry out numerous activities, including SAR at sea, control of merchant shipping, patrolling of fishing activities, monitoring of the marine environment, where it is tasked with maritime policing and the oversight of protected marine areas, and, finally, safeguarding the state's maritime patrimony and the internal waters with the aim of prosecuting crimes against the environment.[81] In particular, the Coastal Guard is in charge of those functions

[77] Italian National Police, *Le sedi dei Reparti volo*, updated 10 May 2013, http://www.poliziadistato.it/articolo/view/24324.

[78] Riccardo Niccoli, "Polizia di Stato", in *Coccarde Tricolori 2013*, pp. 152-154.

[79] Elitaliana, "Un nuovo elicottero AW-139 per la Polizia di Stato", in *EliNews*, 17 December 2013, http://www.elinews.elitaliana.eu/schede-49.

[80] RID-Redazione, "Notizie: Primi AW-139 alla Polizia di Stato", in *Rivista italiana difesa (RID)*, No. 8/13 (August 2013), p. 12.

[81] Interview with C.A. Franco Persenda, "Il punto sulla Guardia Costiera", in *Coccarde Tricolori 2013*, pp. 118-121.

falling within the competence of the Ministry for Infrastructure and Transport, related to SAR in the sea and in the great lakes through the General Command, which ensures overall coordination.[82]

Established in 1988,[83] the Coastal Guard has at its disposal a rotary-wing fleet made up of two lines of aircraft, the AW-139 and the AB-412CP. The AB-412's CP configuration, intended to be used by the Coastal Guard, is derived from the SP commercial version for the first series of four aircraft with limitations, and from the more powerful HP version for the further two batches, composed by five aircraft. The main difference between the two configurations is that the second and the third batch of helicopters are equipped with strengthened transmission, thereby allowing a considerable improvement in performance in the stationary flight phases, beyond ground effect, in hot and high conditions.[84] The nine helicopters are used primarily for SAR missions, and secondly for maritime policing activities, i.e. fishing patrol and surveillance of maritime areas that are protected or subject to environmental or archaeological restrictions, as well as for transport and civilian protection. Intended to replace gradually the AB-412, the four AW-139GCs in SAR configuration are equipped with glass cockpit, FLIR system with Low Light TV (LLTV), Night Sun search lamp and winch, a mission system Automatic Identification System (AIS)[85] in Very High Frequency (VHF), and digital autopilot.[86]

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[82] AIP Italia, Ricerca e soccorso (GEN.3.6), http://www.enav.it/enavWebPortalStatic/AIP/gen/gen3/GEN3-6.pdf.

[83] Raffaele Fusilli, *Il ventennale della componente aerea della Guardia Costiera*, September 2008, http://www.avia-it.com/act/reparti/Reparti_settembre_2008/Il_ventennale_della_componente_aerea_della_guardia_costiera.pdf.

[84] Italian Coastal Guard, *I mezzi: Elicottero AB-412*, http://www.guardiacostiera.it/mezzi/ab412.cfm.

[85] The AIS system identifies and recognises all surface maritime traffic. In other words, this sophisticated system makes use of a simple aeronautic "transponder" suitably converted for maritime use; in compliance with maritime legislation currently in force, the AIS is obligatory for all ships of gross tonnage greater than 300 tons, and optional for smaller units. The system is able to pin-point the position of a craft, its speed, direction, identification code and all data connected with it. As regards passenger ships, the AIS is also able to tell the number of persons on board.

[86] Riccardo Niccoli, "AW.139 per la Guardia Costiera", in *Coccarde Tricolori 2011*, pp. 118-121.

Given the recent constitution of the Coastal Guard's aerial component, a process of reorganisation and renovation is underway, and it is intended to optimise and to rationalise available resources, and, then, starting a new programme of purchases, which will allow to the AW-139GC to replace the fleet of AB-412s. The final intention is to increase the uniform and pervasive distribution throughout the country and to ensure effective coverage in SAR activities.

1.5.3 The State Forestry Corps

The helicopters of the State Forestry Corps are used for the prevention and the detection of forest fires, for direct interventions against fires, for the transport of personnel and equipment, for the coordination of other aircraft, and as a guide for squadrons on land with their engines off. Furthermore, the helicopter group supports the execution of other institutional tasks of the State Forest Corps, such as civilian protection and public rescue services, environmental monitoring, anti-poaching, criminal policing, and surveillance of the national parks and protected natural areas.[87]

The Forestry Corps have at their disposal an own helicopter fleet, made up of 37 aircraft, as follows: 12 NH-500s, 18 AB-412s, 3 AW-109Ns and four Erickson S-64Fs. While from 2009 to 2012 the S-64Fs were managed by the Department for Civilian Protection/Unified Aerial Operative Centre (Centro Operativo Aereo Unificato, COAU),[88] in 2013, after the state AIB aerial fleet was put under control of the Home Office/Fire Brigade Department,[89] the management of the S-64Fs also returned to the State Forest Corps.[90]

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[87] Italian State Forest Corps, *Il Centro Operativo Aereo (COA)*, http://www.corpoforestale.it/flex/cm/pages/ServeBLOB.php/L/IT/IDPagina/333.

[88] In February 2009, the State Forest Corps did initial an agreement which foresaw the management of the operational use of the S-64Fs by the Department for Civilian Protection, while exercise and maintenance activities would have remained responsibility of European Air Crane.

[89] Riccardo Niccoli, "La riorganizzazione della Protezione Civile", in *Coccarde Tricolori 2013*, pp. 110-113.

[90] Italian State Forest Corps, *Relazione sull'attività operativa del CFS nell'anno 2013*,

Overall, the forces are spread across all the country in the bases of Roma Urbe, Roma Ciampino, Cecina, Belluno, Pescara, Rieti and Lamezia Terme, and are deployed in strategic positions during the periods of greatest danger of forests' fire, according to the indications given by the Department for Civilian Protection's COAU.

The primary uses of the three AW-109Ns are the transport of personnel and equipment, the emergency intervention, as well as the general surveillance. Although it is equipped with a winch and emergency floats, the AW-109N can only carry out certain rescue operations, since on-board space is limited and no aerial rescuer is provided among the equipment.[91]

1.5.4 The Financial Police

The rotary-wing fleet is an essential part of the Aerial Service of the Financial Police, which in its turn is part of the organisation's more general aero-naval department. In the last years, the Financial Police has resigned the structure of its aero-naval department, with a subdivision between the high-sea component and the territorial component.

The high-sea squadron of helicopters is equipped with forces with a high discovery capability and a wider range of action in comparison to the forces of the terrestrial squadron. It responds to the new need to monitor the Mediterranean and its "sea highways," to ensure security of trade and to counter trafficking in human beings, as regards illegal immigration, and in illegal products, above all drugs.

The terrestrial squadron carries out security tasks in the territorial waters, as well as tasks related to economic/financial policing, typical of the Financial Police, as regards activities directly connected to the sea and the ports.

Since 2008, the Financial Police has been carrying on a programme for the renovation of the rotary-wing fleet that will see a 30% reduction

August 2013, http://www.corpoforestale.it/flex/cm/pages/ServeBLOB.php/L/IT/IDPagina/36.

[91] Riccardo Niccoli, "Nexus anche per la Forestale", in *Coccarde Tricolori 2010*, pp. 114-117.

in numerical terms and an aircraft composition based on two lines of aircraft, the AW-109N and the AW-139, compared to the current four.[92] The fleet is currently made up of the following aircraft types: NH-500, A-109, AB-412HP and AW-139.[93] The NH-500, which entered into service in 1973, is used at regional level for terrestrial reconnaissance, observation and coastal patrol, as well as for assistance to personnel and to the forces of the territorial departments. Twenty-five remain in service. The AB-412HP is mainly used by the deep-sea component, given its two sliding doors, which can be opened in-flight, its notable load capability and its complete avionic and mission equipment, which renders it ideal for the execution of search, rescue, and multi-role and sanitary transport missions. There are around 22 of such aircraft, which are also used in sea missions for activities connected to maritime policing, assistance and signalling, safety and rescue at sea, and ecological and environmental policing.

Overall, as it can be seen equally from the characteristics and type of use of the aircraft of the Financial Police, the Aerial Service's operations cover various sectors, from the economic control over the country to the monitoring of the coasts and the deep sea. Nevertheless, it should not be forgotten that the surveillance and the protection of collective goods, such as archaeological relics and the artistic and environmental patrimony, number among the functions carried out by the organisation.[94]

Two versions of the A-109 aircraft exist: A-109A-II, and AW-109N. Therefore, the latter is intended, together with the AW-139, to progressively replace the NH-500, the A-109A-II and the AB-412HP lines. The Financial Police has ordered 18 so as to extend various operational capacities over the national territory, such as NVG and Instruments Flight Rules (IFR) flight, for patrol and surveillance missions, above all at sea,

[92] Riccardo Niccoli, "I nuovi elicotteri della Guardia di Finanza", *Coccarde Tricolori 2010*, pp. 96-101.

[93] Italian Financial Police, *La flotta aerea*, http://www.gdf.gov.it/GdF/it/Specializzazioni/Servizio_Aeronavale/La_componente_Aerea/La_flotta_aerea.

[94] Interview with Colonel Alessandro Carrozzo, "Nuovi elicotteri e tecnologia, il futuro del Servizio Aereo della Guardia di Finanza", in *Helipress*, 29 May 2014, http://www.helipress.it/schede-280.

making better use of the particular characteristics of the aircraft, which is distinguished by its Fiar-Bendix 1500B/Plus search radar,[95] and its SeaFLIR II system.[96]

Finally, the AW-139 is used in SAR missions both at sea and in the mountains, widening its range of use to cover maritime patrol, exploration, search, rescue, sanitary transport and logistical transport.[97] As of March 2014, two models had been delivered, the first in 2008, in basic transport configuration, and the second in January 2011, whereas the total requirement could be around 20-25 aircraft.[98]

1.5.5 The National Fire Corps

The operational use of the Aerial Service of the National Fire Corps can be divided into two main categories: interventions in case of disaster and interventions to carry out the Corps' normal institutional rescue services.[99] In the former case, the aircraft intervenes to carry out reconnaissance of the areas affected by the disastrous event, including the use of video imaging systems installed on board the helicopters, to carry out emergency interventions in areas difficult to be accessed, to coordinate rescue operations, and, finally, to transport specialised personnel and rescue materials. In the latter case, the helicopters are normally used for the rescue of persons in dangerous situations, for the urgent transport of sick and injured people, for the search for lost persons, for the survey and measurement of radioactivity, and, finally, for cooperation in particular interventions carried out by provincial command squadrons, in which aerial forces can be of use, in order to render them more timely and effective.[100] The National Fire Brigade Corps has been the first state administration, after the Navy, to use the helicopter to carry out its insti-

[95] The radar is installed in the nose rather than on the belly, which also improves the aircraft's aerodynamic performance.

[96] Riccardo Niccoli, "I nuovi elicotteri della Guardia di Finanza", cit., pp. 96-97.

[97] Riccardo Niccoli, "Guardia di Finanza", in *Coccarde Tricolori 2013*, pp. 149-151.

[98] Riccardo Niccoli, "I nuovi elicotteri della Guardia di Finanza", cit., p. 100.

[99] Italian Fire Brigade, *Gli elicotteri nel Corpo Nazionale dei Vigili del Fuoco - La storia*, http://www.vigilfuoco.it/aspx/page.aspx?IdPage=2073.

[100] Ibid.

tutional role of urgent technical relief and first aid assistance. The rotary-wing component is indeed a determinative element in operations related to rescue and monitoring of the territory, above all in the event of a disaster.[101]

The management of the aerial component of the National Fire Corps is entrusted to the Office for the Aerial Service of the Central Technical Service of the Department of the Fire Brigade, Public Rescue, and Civilian Defence (Ufficio per il Servizio Aereo del Servizio Tecnico Centrale del Dipartimento dei Vigili del Fuoco, del Soccorso Pubblico e della Difesa Civile), which is responsible for the 12 NEC currently deployed across the country in Arezzo, Bari Palese, Catania-Fontanarossa, Roma-Ciampino, Genova, Bologna, Pescara, Salerno-Pontecagnano, Alghero, Varese-Malpensa, Torino-Caselle and Venezia-Tessera. Operationally, the NEC report to the Fire Brigade's regional inspectors, while logistically, they report to the provincial commands. In the case of a particular event, they are alerted and coordinated by the central structures.

The Fire Brigade's helicopter fleet is made up of 41 aircraft in three lines: the AB-412, the AB-206, and the AW-109.[102] The first 12 AB-412s entered into service in 1984, while other ten aircraft were delivered between 2003 and 2004; equipped with IFR flight avionics and a winch with a capability of 270kg, they often operate with Speleo Alpinistico Fluviali (SAF) nuclei, exploiting the load capability of around ten equipped men. The 14 light AB-206 aircraft are mainly used for flights connected to reconnaissance, monitoring, personnel transport and liaison. As is the case for the majority of the police and public rescue au-

[101] As stated by Article 6 of Law No. 996/1970, in order to carry out tasks related to urgent technical interventions in the case of natural disaster or catastrophe, the Ministry of the Interior "may make provision through the National Fire Brigade Corps, whose organisation includes specially-equipped mobile departments for immediate use, and helicopter nuclei." Furthermore, for first aid assistance to populations affected by a natural disaster or catastrophe, the Ministry of the Interior "may make provision, through the public rescue departments of the National Fire Brigade Corps and the emergency intervention assistance centres, for the initial aid to populations". Cf. Law No. 996 of 8 December 1970, "Norme sul soccorso e l'assistenza alle popolazioni colpite da calamità - Protezione civile", http://www.normattiva.it/uri-res/N2Ls?urn:nir:stato:legge:1970-12-08;996.

[102] Riccardo Niccoli, "Vigili del Fuoco", in *Coccarde Tricolori 2013*, pp. 155-156.

thorities, the Fire Brigade's helicopter fleet is also the subject of a renovation and modernisation programme; the programme is intended to maintain the operational capability of the rotary-wing fleet, without however increasing the number of aircraft lines. Indeed, the AW-109 is intended gradually to replace the AB-206 line, while a certain number of AB-412s will continue to be at the service of the Corps.[103] Of the five aircraft available, three are of the AW-109E Power type, the fourth was ceded to Civilian Protection and then returned, while the last, an A-109S Grand, has been delivered to the Genoa flight department.

1.5.6 The helicopter fleet of the Italian Civil Security

The composition and use of the aerial component, including the helicopter one, by Civilian Protection in the course of the AIB campaign merits separate discussion. Following the conversion into law of decree-laws no. 59 and 79 in July and August 2012,[104] the aerial service of the Department for Civilian Protection has undergone significant changes at both the operational and organisational levels, with a view to the optimisation of resources. On the one hand, the state forces of the aerial fleet utilised to put out forest fires will continue to be coordinated by the Department for Civilian Protection's COAU. On the other hand, the guidelines for the reorganisation have foreseen the reassignment of the Department's fleet to other state entities and bodies. For example, the Canadair fleet has been ceded to the Home Office, specifically the Department of the Fire Brigade, Public Safety and Rescue, and Civilian Defence (Dipartimento dei Vigili del Fuoco, della Pubblica Sicurezza e Soccorso, e della Difesa Civile), which will ensure technical coordination and operational efficiency over the national territory for extinction activities, making use of the Fire Brigade's Aviation Centre Operative Room (Sala Operativa Centro Aviazione Vigili del Fuoco, SOCAV). The state's anti-fire fleet cannot operate without the presence and the use of helicopters belonging to various state administrative entities, such as the Forest Corps, the Fire Bri-

[103] Interview with engineer Salvatore Demma, "Il punto sul Servizio Aereo", in *Coccarde Tricolori 2010*, pp. 106-109.

[104] Specifically, Law No. 100 of 12 July 2012, and Law No. 131 of 7 August 2012.

gade, and the Armed Forces. For the AIB campaign, aircraft can be used for the following five different types of activity:[105]

1. Reconnaissance/surveillance: one or more aircraft, actually or remotely controlled, acquire information concerning one or more fires underway, or carry out post-fire surveys to evaluate developments and/or the effects or damage caused.
2. "Armed" reconnaissance: this involves the use of aircraft in AIB configuration; to carry out this, beyond reconnaissance, the aircraft must be equipped with the capability for direct intervention on the fire. Such activities are carried out for limited periods, in particular situations and in high-risk areas.
3. Containment: the AIB aircraft has the objective of taming the fringe of the fire, limiting its development, or orienting it in certain directions. Furthermore, the use of retardant substances is foreseen, which, by limiting the fire, allow to extinguish it more quickly, thereby optimising resources.
4. Extinction: the typical activity of an AIB aircraft, aimed at operating on the fire until it is put out.
5. Drainage: this refers to the extinction of the last active embers or combustion phenomena, even without the development of free flames. This activity is usually carried out together with on-land squadrons, although only those aircraft not involved in the initial extinction activities are used.

Overall, the state's AIB fleet is composed of the following:

- 19 Canadair CL-415s, whose ownership has de facto passed to the Fire Brigade Department, but whose operational management and technical maintenance are assigned until 2015 to INAER Italia, a company forming part of the Spanish group INAER. The contract foresees a minimum availability of six aircraft for the winter period, rising to ten in the intermediate seasons, up to 14 for the summer.
- Eriksson S-64 helicopters, owned by the State Forest Corps and lent

[105] Italian Civil Protection, *Procedure per il concorso della flotta aerea dello Stato 2013*, 27 June 2013, http://www.protezionecivile.gov.it/resources/cms/documents/Direttiva_Procedure_AIB_2013.pdf.

to Civilian Protection in 2009. For many years, techno-operative management has been the responsibility of the private company European Air Crane (EAC), but as a result of the cuts to resources that are part of the spending review, it is possible that such management will return to the Forest Corps.[106]

- Aircraft belonging to other administrative entities of the state – Army, Navy, State Forest Corps, National Fire Brigade Corps and the Port Authorities – used temporarily by the Department for Civilian Protection for AIB. In this context, the AB-412, the AB-212 and the AB-205 are among the rotary-wing forces most often utilised for anti-fire activities, after the Eriksson S-64. An often-determinative role is played by the CH-47 of AVES that, for example, was used during the 2012 AIB campaign. For the specific anti-fire function, the CH-47 is equipped with a 5,000 litre tank, known as "Smokey," and can reaching a cruising speed of around 300km/h, with autonomy of two and a half hours.

1.6 THE DUAL-USE HELICOPTERS' OPTION

Undoubtedly, the Italian context outlined presents some problems, as well as room for improvement, as regards the rationalisation of the helicopter fleet of the Armed Forces and its more effective management.

In this context, considering the three traditional roles for the use of helicopter by the Armed Forces, i.e. Combat, Combat Support and Combat Service Support, it could be imagined that the dual helicopter could be used for Combat Support and Combat Service Support tasks. Indeed, Combat tasks necessarily require "characteristics of intrinsic protection" from threat, characteristics whose conception starts from the design phase.

In determining what sort of platform to use in order to carry out the

[106] In the same way, the contract for the Air Tractor aircraft used by Air SP&A, which expired in 2012, has not been renewed as a result of the cuts to resources implemented in the wake of the spending review. See Riccardo Niccoli, "La riorganizzazione della Protezione Civile", cit., pp. 110-113.

above-mentioned roles, some preliminary considerations have to be made.

Protection, at least "passive" protection, is certainly one of the main aspects that distinguishes a "military" from a "civilian" helicopter. It is necessary, indeed, that the basic design responds to various needs: the provision of intrinsic "ballistic" protection, for example through tolerance to damage from reduced-calibre projectiles, normally non-explosive; or the minimisation of environmental "detectability" in terms of footprint, be that acoustic, radar, or infrared, so as to render the helicopter less detectable. As far as "active" protection is concerned, such needs include the ability to host with relative ease systems able to detect and to combat threats by means of devices certified for plug-in. Differently from "passive" protection, "active" protection can be inserted through specific kits able to detect and combat threats.[107] For example, the AB-212 helicopter in Italy was created with civilian standards and now constitutes a Combat Support helicopter, on which active self-defence systems have been installed.[108]

The evolution of conditions in the operational theatre has necessarily made the protection of troops more important,[109] protection that can, however, vary in relation to the level of risk that is intended to be accepted. Indeed, those who decide upon operations are called upon to evaluate and to decide to what extent to accept a certain level of risk for human life. In Italy, due to various political and cultural factors which are beyond the scope of this study, the acceptation of an appreciable level of risk is problematic. This has certain important consequences, as regards the forces intended to be used, above all in relation to the protection systems connected to them,[110] and this is the reason why in Italy it is unthinkable not to endow aircraft with the highest level of protection.[111]

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[107] Interview, 7 February 2014.

[108] See also Vito Dell'Edera, "La protezione dei mezzi dell'Esercito", in *Pagine di Difesa*, 21 March 2007, http://www.paginedidifesa.it/2007/rivmil_070321.html.

[109] Interview, 12 March 2014.

[110] Interview, 7 February 2014.

[111] Interview, 21 February 2014.

Beyond the indispensable nature of protection, weight and load capability play an equally important role,[112] to be taken into the utmost consideration in the eventuality that it is decided to configure a dual helicopter that is able to carry out military tasks. On the hypothesis that the maximum weight at takeoff is 100, the "base weight," i.e. the weight of the "naked" helicopter without load or fuel, could indicatively be 60%. Calculating the crew and personal equipment, the "operative weight" increases to a level, also hypothetical, of 70%. Therefore, there remains only 30% for fuel, useful load and any mission systems necessary for operations in non-permissive environments. These include, for example, "ballistic" protection, which goes from 200kg to 300kg for an 8-tonne transport helicopter, to which has to be added "active" protection, shifting from 100kg to 150kg, and possible auxiliary tanks, adding a further 100kg or 150kg. Overall, mission systems account for a further 10%. There remains, therefore, indicatively, only 20% for fuel and useful load, a quantity that would be insufficient for military purposes and missions.

Further elements to be considered are the capability for landing on different types of terrain, "maintainability" on the battlefield, and the range of temperatures, altitudes, and conditions of use. As regards the first element, civilian standards are orientated to landing on level, uniform, and hard terrains, and as a consequence the undercarriage is not, as a rule, intrinsically prepared for landing in muddy, unusual, or difficult arenas, such as an Afghan clearing or a ship's bridge. As regards "maintainability" on the battlefield, this implies that maintenance cannot require particular equipment or precautions. In this case, a civilian helicopter should be designed with certain adaptations, including the incorporation of a ladder to access the fuselage, or the limitation of the number of tools necessary for maintenance. Finally, the range of conditions of use is extremely important, because, for example, in the Afghan theatre the temperature of the components can reach 70 degrees when the helicopter is left on the take-off area in a state of alert. In this case, it is necessary that the components are able to resist and to function safely.

[112] Interview, 12 March 2014.

In conclusion, the elements listed above constitute certain characteristics to be evaluated to ensure that a helicopter is designed from the beginning as dual, i.e. able to respond to the demands of different users, including the Armed Forces, the public safety and rescue authorities, and civilian users. Technological progress achieved in the civilian field in terms of performance, reliability, robustness, silence, and safety, already provides an improved departure-point where on building a design that responds from the beginning to military requirements as well. For example, the possibility of planning open structures, which allow for appropriate system plug-ins or components necessary to satisfy the demands of military operations, should be considered.

The option of the dual helicopter opens up interesting perspectives for the Italian Armed Forces. Indeed, among the most advantageous aspects of such a perspective is the great availability of ready-to-fly forces, as a rule over 80%, a percentage higher than in the case of aircraft designed exclusively for military purposes. Furthermore, the production of the platform on a larger scale and for a greater number of clients, counting on the catchment represented by the civilian market, would allow for a more efficient and less expensive supply of spare parts, and a lower cost also in terms of logistic support. This is particularly important insofar as the cost of the entire life-cycle of the helicopter amounts between two to four times the purchase cost of the platform, meaning that savings in this context could be significant, and these could compensate the expenditure necessary to install mission systems for Combat and Combat Support tasks on the helicopter.

2.
The French Case Study

Jean-Claude Allard

French government's helicopter fleet totalizes 581 aircraft, 481 for Armed Forces and 100 for Security Forces (Gendarmerie, Police and Customs). Within the Ministry of Defence (MoD), the Army is the main operator with around 70% of the fleet. Moreover, Army Aviation (Aviation Légère de l'Armée de Terre, ALAT) has the overall responsibility for the initial training of Armed Forces and government agencies aircrews.

Several issues should be highlighted. The first issue is the constant decrease of the Armed Forces fleet total strength, from 481 aircraft as of 2013 to 392 by 2019. Secondly, one third of the 2019 fleet will be composed of last generations military helicopters (Tiger and NH-90), giving an improved fighting power to ALAT and Navy in spite of shortcuts. Third point, because of the need to replace the remaining legacy fleet, the MoD has set up a Joint Light Helicopter Program (Hélicoptère Interarmées Léger, HIL)[1] in order to define the future aircraft system. The HIL project had the ambition to develop, based on a dual-use platform, a family of aircraft whose different versions would permit to meet Services and government Agencies' multiple requirements. The problem is that, due to budget cuts and planning uncertainty for at least the next six years, this program has been delayed, so no replacement can be envisioned for the rest of the fleet during this period, with potential capability gaps. French government will have to stay tuned on helicopter issues

[1] French National Assembly, *Projet de Loi relatif à la programmation militaire pour les années 2009 à 2014 et portant diverses dispositions concernant la défense*, No. 1216, 29 October 2008, http://www.assemblee-nationale.fr/13/projets/pl1216.asp.

because as of 2010 more than one third of the current fleet will reach an average of 30 years of duty.

Finally, it should be underlined that the French military has developed a specific approach regarding military helicopters. Army combat doctrine relies on a "tactical and operative" three dimensional vision of the battlefield with a close and permanent integration between helicopters and ground combat systems.[2] For Navy and Air Force, helicopters are additional assets that provide specific and provisional support to their main combat systems (ships or combat aircraft). So the two latter have not a global helicopter doctrine but an ad hoc vision for each case.

2.1 THE ARMY: THE AVIATION'S DOCTRINE AND ITS OPERATIONAL EXPERIENCE[3]

French Army Aviation is the major player of French government helicopters' policy because of two reasons: the size of its fleet – ALAT is the main helicopter operator in France – and its unique role as Armed Forces and government initial training authority with the ALAT Initial Training Center in Dax. This training responsibility has been expanded with the creation of the French-German Tiger Training Centre in the historical ALAT Tactical Training Centre in Le Luc, followed by the set-up of the Joint NH-90 Training Centre in the same location.

Moreover, the role of ALAT as a core element of military art has steadily increased because of two trends. First, the conviction acquired since the Algerian war that helicopters could be a land forces' tactical masterpiece if they are committed in operations with a tactical vision close to ground forces operating modes. The second key trend is the permanent technological advancements in different relevant fields: the field of night vision with Night Vision Goggles (NVG), infrared and thermic devices, which allow the use of weapons also by night; improve-

[2] Formerly "infantry" and "armour", now called "armes de mélée".

[3] Information in this chapter come from hand-on documents by and interviews with ALAT Directorate Commanding Officer and Staff Officers.

ments in the weaponry field with embedded and slaved gunnery, rockets and missiles; advancements in the field of digitalization and communication, allowing instant dissemination of digitalized tactical displays. These technological achievements have reinforced and validated ALAT tactical approach called "aérocombat."[4]

Combat missions

The ALAT has developed the concept of air-land integrated combat, that is to say the integration of helicopters within the land manoeuvre in combination and coordination with other military branches.

First of all, ALAT squadrons are supposed to manoeuvre, combat and fire like armoured or infantry squadrons, that means using ground features to optimally shield the helicopters from enemy observation and direct hits by means of elaborate day and night Nap-Of-the-Earth (NOE) flight. The second key element characterizing ALAT tactic is that, differently from fighter aircraft's pilots, helicopter crews have permanent cockpit delegation of authority for finding and identifying targets then accurately firing weapons. As a result, they are facing the same problems that their ground counterparts (armoured/infantry units), and they have to find the same solutions in terms of intelligence, cooperation and tactics, as well as to be protected against battlefield hazards.

Consequently, ALAT is looking mainly for manoeuvrability, a crucial parameter to fly aérocombat missions, and the capacity to embed military equipment. In this regard Electro-Optic/Infra-Red (EO/IR) suites, long-range or even stand-of weapons, and a self-protection capability are of primary importance. This is the raison why, in this first set of missions, there is an obvious need for military state-of-the-art combat helicopters whether it is for attack, Close Combat Attack (CCA), air assault, and tactical or in-theatre logistic transport.

Nevertheless, it is important to note that ALAT tactical doctrine has

[4] Centre de Doctrine et d'Emploi des Forces (CDEF), "The Tactical Third Dimension", in *Doctrine*, No. 14 (January 2008), http://www.cdef.terre.defense.gouv.fr/content/download/3672/54254/file/doctrine14us.pdf; "Army aviation combat operations", in *Doctrine tacquique*, No. 22 (March 2012), http://www.cdef.terre.defense.gouv.fr/content/download/4024/57668/file/Doctrine22us.pdf.

been developed and implemented from the very beginning using civilian platforms like the Sud-Aviation Alouette, later Gazelle families as attack aircraft, and Puma family as tactical transport aircraft. This is a proof that dual-use helicopter can be suitable for Aérocombat if they are agile enough for NOE flight and if they can technically evolve to meet military standards. Currently, specific military platforms have been developed and fielded with the Attack Helicopter (AH) EC 665 Tiger family and the Tactical Transport Helicopter (TTH) NH-90 Caiman.

AH and TTH cooperation

Actually, in the ALAT doctrine both AH and TTH platforms are committed in combat missions. It is obvious for Tiger, it should be also clear for NH-90, whatever the tasks are: air assault missions, tactical transport, logistic transport, Medical Evacuation (MEDEVAC). For the ALAT, all these tasks take place in non-permissive environments.

In the ALAT doctrine, AH and TTH helicopters work together in combined tactical operations. The TTH could be used as Flying Command Post (FCP), mobile Forward Arming and Refuelling Point (FARP), be tasked to transport AH protection teams or emergency repair teams, and to carry on MEDEVAC. Attack helicopters are responsible to provide intelligence, fire support and air-to-air or air-to-ground protection to TTH during air-assault missions, as well as during logistic missions or any other task within the operational theatre.

So, both platforms should have the same capabilities in terms of speed, range, night and adverse conditions flight, flight envelope and ship-borne capability in order to be deployed on the same conditions in theatre.

Operations lessons learned

Aérocombat doctrine has been continuously developed and improved since the 1960s during several operations. Operation “Harmattan” in Libya, operation “Serval” in Mali, and operation “Licorne” in Ivory Coast have given overarching examples of what can be achieved with that doctrine in asymmetric warfare, guerrilla warfare, urban warfare, peace-enforcing operation, and other civilian tasks which could be easily carried out with the military know-how and helicopter technical capabilities.

Operation "Harmattan" is the French participation to North Atlantic Treaty Organisation (NATO) Unified Protector Operation in 2011 in Libya. At that time France committed an Helicopter Strike Squadron (HSSq) composed of 18 helicopters. The fighting teams were composed of two Tiger (with 30mm turret-mounted gun and 68 mm rockets) for reconnaissance and CCA, 3 or 2 teams of 2 Gazelle for destruction tasks (with HOT missile) and two Puma, one as FCP for the Air Mission Commander (AMC), one for Immediate Extraction or Personal Recovery (IMEX) team. The teams took off at night from the Naval Task-Force fifteen nautical miles off Libyan coasts, and found their way to their "fighting box," flying at 10 to 30 meters above sea waters. The "strike box" is a space of around 20x20 kilo-meters in which the squadron could operate freely during two to four hours to search and destroy enemy according to aérocombat doctrine. The strike boxes were between 30 and 60 kilo-meters into Libya. The whole operation was completed by night and flying NOE.

Being dual-use helicopter platforms Gazelle and Puma, did very well in Libya, as previously during operation "Desert Storm" in Iraq (1991) and Operation "Enduring Freedom" (2002-2009) in Afghanistan. During the "Desert Storm" Operation, they were never committed at night, due to their poor night vision flight systems. Within Operation "Enduring Freedom" night operations increased to a 50% of overall activities, to reach 100% in Libya.

The first conclusion is that improving flying and striking conditions at night is one of the key priorities for any future helicopter with a dual-use ambition. That implies to be NVG compatible, to have high-definition EO/IR sensors, improved with image fusion, laser designator, Target Acquisition and Designation Sight/Pilot's Night Vision Sensor (TADS/PNVS). The second conclusion is the requirement for self-protection system, particularly "detect and protect," against small arms fire and missiles. In Libya, Tiger provided detection and protection, Puma and Gazelle only protection. Tactics ensured a combination of capacities.

The ALAT was committed several times in amphibious operations, in Lebanon, Ivory Coast, Liberia, Timor, Former Republic of Yugoslavia, whether it be for peace-enforcement, peace-making or peace-keeping operations. Helicopters have also a major role to play during Non-combatant Evacuation Operations (NEO) from the sea, for example Operation "Li-

bage" in Lebanon in 2006 with a Landing Helicopter Dock (LHD) and seven TTH, or operation "Providence" in Liberia in June 2003, with more than 500 people airlifted by Cougar helicopters within a day from Monrovia to LHD Orage, located twelve nautical miles off the coastline.

Operation "Balbuzard Noir" in 1995 offers another example of what could be a long-range amphibious operation hundreds of kilometres inland. An air-assault operation under fire was conducted with Puma protected by Gazelle to land an infantry company and a mortar platoon onto Mount Igman in the suburb of Sarajevo, after a 200 kilo-meters raid flying not higher than 100 meters. An intermediate FARP had to be established to refuel Gazelle convoy protection platform, short of range and endurance.

Operation "Serval" took place in Mali as of January 2013. Beginning with the commitment of two Gazelle to stop a terrorist raid towards the Malian capital Bamako, the following phases of the operation relied largely on helicopters for strike as well as for transportation. Operation "Serval" was in fact a three phases operation. The first phase started from Bamako to repel terrorist groups northward and to seize bridges on the Niger river and Timbuktu crossroads, with an operational theatre's depth of around 700 kilometres. The second phase was aimed to conquer and then monitor and secure the northern part of Mali, a theatre of operations stretching 500 kilometres from east to west, and similarly from Timbuktu northward to Kidal. The last phase objective was to capture the terrorists' last remaining bastions within a 300 kilometres radius circle around Kidal, including Ifoghas mountains.

As French Armed Forces are to be deployed in Central Africa, it is worth noticing that the 1,000 soldiers-strength force is supposed to be ready to act everywhere in theatre. While Bouar in the north-west is only 300 kilometres away from the capital city of the Central African Republic, an important strategic town at the crossroads between Chad and South Sudan such as Birao – where some rebels come from – is 800 kilometres far away from Bangui. Therefore, air-mobility is once again a key asset. France's constant strategic involvement in Africa advocates for military capabilities including long range air transport, whether it be for in-theatre attack tasks or tactical transport or pre-deployment movements.

To shorten this pre-deployment phase, France has Africa based rapid

reaction troops (four locations in four different countries) with any available long range capability assets. For example, ALAT Cougar have been assigned to Forces Françaises au Gabon (FFG) in Libreville in replacement of short-legs Puma, in order to offer highest helicopter air lift capabilities in terms of range and useful load. In December 1999, at the very beginning of the Ivory Coast crisis, two Cougar flew 1,200 kilometres from Libreville to Lome (Togo), in order to be ready to enter Ivory Coast theatre 600 kilometres away, to support French troops in Abidjan. This in-fly pre-deployment was decided because fixed-wings cargo were tasked to troop transport. But the main reason was cargo loading and unloading delays, also considering the time for dismantling some parts of the helicopter (blades, landing gear), which put the solution out of the operational schedule's requirements. From a French point of view, range and easy air-transportability is mandatory to provide rapid reaction solutions. The new Air Force air-cargo A400M will obviously shorten the air-transportability list of requirements, but the need should still be kept in mind.

Another conclusion is linked with the fact that Africa remains the most likely theatre of operation for Armed Forces, therefore local geographical and meteorological parameters should be carefully studied and taken into account. Those parameters have an impact on flight conditions, for example in terms of in-flight visibility restrictions, brownout, tropical storm. They request operational preventive actions, and technical solutions (including weather radar and near-field observation systems).

They have an impact on ground-based aircraft too. During Operation "Serval," two Puma have been severely damaged after being blew-down by an high speed sub-tropical wind. Main issues with Puma are high centre of gravity and tiedown securing system to be improved. Last but not least, these conditions drastic impact on the life-cycle of platforms and components, through erosion by sand, grit and rain.

Training missions

As previously said, ALAT is in charge of conducting initial training of government pilots, mainly from Armed Forces and Gendarmerie. Other government agencies usually recruit great part of their crews among former Armed Forces pilots.

The need for initial training is around 20.000 hours of flight. Since 2008, this is provided at the ALAT Initial Training Centre through a Private Finance Investment (PFI) contract signed with a consortium called Helidax (INAER Helicopter France and Défense Conseil International). Thirty-six EC 120B fitted with specific equipment for military training, including NVG and NOE training, are used to these tasks. They will remain in service for more than twenty years. Here is a good example of dual-use helicopter "niche," or even an outsourcing opportunity.

Tactical training is conducted either by the ALAT Tactical Training Centre, plus French–German Tiger Training Centre and Joint NH-90 Training Centre, or at regimental level. This training level is conducted through a mix of synthetic and flight training.

Flight training on last generation helicopters like Tiger or Caiman is a very expensive option, while of course being mandatory for operational purpose. The last Loi de Programmation Militaire (LPM) 2014-2019 states that ALAT pilots are supposed to fly 180 hours per year. Unfortunately, due to technical availability of the aircraft, to several deployments during the last years and, above all, due to budgetary constraints,[5] pilots fly less than 130 hours per year, including operational and combat flying hours.[6]

The ALAT is well aware that this problem will be a burning issue in the future when the bulk of the fleet will be composed by efficient, but costly to operate, Tiger and NH-90.[7] Therefore, Army advocates for a helicopter less expensive to operate, that could be widely and freely used for operational training. This platform will have a wide range of missions: training helicopter, public service tasks, disaster relief missions, but also and mainly, non-permissive operations in coordination with Tiger and Caiman according to Aérocombat doctrine. This last task requires speed and range equal to Tiger's ones, and any equipment necessary to fly in a non-permissive environment.

[5] In spite of LPM training targets, budgets for maintenance and fuel are not sufficient to pay 180 hours.

[6] For more information on budget issues see "Annex 3. The French case study: costs analysis".

[7] Ibid.

These requirements lead Joint Staff to set up the Light Joint Helicopter (Hélicoptère Interarmées Léger, HIL) program, which paves the way for a dual-use helicopter solution. Currently and to a certain extent, SA 342 does this job, but a more modern, powerful, protected and roomy aircraft is needed.

Public service missions and disaster relief missions

The ALAT plays also an important role to reinforce Home Secretary agencies when dealing with public order, Search and Rescue (SAR), disaster relief operations, or any other mission in which ALAT fleet and crews could provide a valuable contribution. The TTH are of particular interest for SAR, evacuation, logistic transportation or specific tasks like firefighting, and helicopters like SA 342 could provide a useful set of capabilities to search a devastated area, to monitor railways or highways in case of terrorism threat, for VIP transport and other tasks.

In addition, ALAT will carefully define its technical requirements for HIL in order to get an helicopter compatible with civilian or disaster relief missions, because of two reasons. First, not to be compelled to use sophisticated NH-90 for this task. Second, to be able to take part to these missions which are of high value in terms of media visibility, ALAT crews' sense of utility to the French society needs and nation's gratitude.

2.1.1 Overview of the fleet

Army aviation fleet embed a total of 314 helicopters, including SA 342 Gazelle, AS Tiger, SA 330 Puma, AS 732 Cougar, EC 725 Caracal and NH-90 Caiman. Some of these helicopters are commissioned in other Services too.

Attack Helicopters (AH)

The EC 665 Tiger is a 6,6oo kg class attack helicopter designed for day and night combat missions including attack, ground fire support, escort, armed reconnaissance and air-to-air combat.

Two different configurations are fielded in ALAT: Attack and Protection Helicopter (HAP) with 30mm turreted gun, rockets and air to air missile capacity; Attack and Destruction Helicopter (HAD) with

30mm turreted gun, rockets, air to ground missile, and air to air missile capacity.

Operational systems are comprised of: gyro stabilized Roof Mounted Sight (RMS) with TV camera, thermal imagery with electronic zoom, laser range finder, laser designator, laser spot tracker (up to 4 targets), an Helmet-Mounted Sight/Displays (HMSD) for pilot and gunner enslaving both RMS and 30 mm turret-mounted gun, a Digital Map Generator with a Battlefield management system, an Identification Friend or Foe (IFF) Transponder/Interrogator and High Frequency (HF)/Datalink providing mission overlays, target photos, record and display of IR/TV sensor images, radio data link managements.

The elder helicopter in the ALAT fleet, the SA 342 Gazelle, is a 2,2 metric tons platform which has been for years the spearhead of ALAT combat efficiency, from Operation "Epervier" in Chad in the early 1980s to Operation "Serval" in Mali in 2013. The SA 342 has being progressively replaced by Tiger, but some SA 342 will be fielded until 2030. They do not require large transport aircraft to be deployed, and they have lower operating costs and require less mechanical support than the Tiger. Therefore, they are perfectly suited for low intensity conflicts, providing accurate fire support to ground troop.

Tactical Transport Helicopters (TTH)

The ALAT uses them mainly for air assault as well as logistic transport or medical evacuation in various theatre of operations, ranging from wartime operations to peace-keeping or humanitarian missions.

The elder helicopter in the ALAT transportation family, the SA 330 Puma, is still flying due to the important delays for the delivery of the NH-90 helicopter. From a total of 90 platforms in 2013, 43 have been upgraded with radar warning receivers, additional communications, and a digital map system. They are expected to transport soldiers until 2030.

AS 532 Cougar is the military name for civilian AS 332 Super-Puma twin-engine utility helicopter from Eurocopter. A 8,600 kg class helicopter derived from the SA 330 Puma family, it is basically a dual-use aircraft providing medium size utility airlift with internal (3,800 kg) and external (4,500 kg) payloads capabilities, or 15 to 20 troop and 2 pilots. Air Force operates Cougar too.

EC 725 Caracal is a long-range (250 nautical miles radius) tactical transport helicopter developed from the Super-Puma/Cougar family for military use. A twin–engine platform it is the military version of the EC 225 civilian helicopter, a 11.000 kg class helicopter with internal (5,540 kg) or external (4,750 kg) payloads capabilities or 20 troop and 2 pilots. Specifically developed for Special Forces, Personnel Recovery (PR) and Combat Search and Rescue (C-SAR) operations, the most demanding mission in terms of range and endurance, it offers a 6h30 maximum endurance and 600 kilo-meters mission radius. It features a good set of weapons: 2 × 7.62 mm FN MAG machine guns mounted within forward left and right windows, pod-mounted 20 mm cannon. It is the only TTH with such equipment and weaponry. Some Air Force examples have additional Air Refuelling capability.

The NH-90 Caiman is a helicopter in the 9-10 metric ton class designed for tactical transport (TTH) and anti-submarine warfare (NATO Frigate Helicopter, NFH). It is a fly-by-wire and all-composite construction helicopter with the highest crashworthiness standards. Equipped with a large cabin, a rear ramp, weather radar and forward looking infra-red, the NH-90 helicopter is capable of carrying 2 pilots, 2 loadmasters and 18 combat troops up to 900km at speeds of up to 300km/h. It features a fully integrated weapon system enabling the helicopter to fly in the most demanding operational conditions by day or night. The NH-90 TTH is fitted with a complete self-protection suite and a NATO interoperable communication system for international operations. It can operate from ground bases or military ships. The Navy operates the naval version (NFH).

2.1.2 The evolution of the Army Aviation fleet

From the very beginning ALAT has developed a military fleet derived from what the constructor Eurocopter could offer in terms of civilian platforms. The SA 340 Gazelle, a true civilian aircraft, is a typical example of this kind of product which has been militarized step by step, up to become the spearhead of ALAT combat capacity for many years. Success of TTH SA 330 Puma is based on an arrangement between military requirements and industrial interests. While being a very good aircraft, it was not a true weapon system with simple and useful solutions for battlefield is-

sues. For example it suffers from not having a rear ramp for easy cargo handling, from not being correctly protected against small fire arms or missile and other battlefield hazards, as well as for not having weapons system on board. Puma and Gazelle, have been continuously improved to reach better military standards and have been praised by ALAT for decades. But it is also worth to stress that in the meantime ALAT continuously try to solve technical shortage with tactical improvements. This twofold approach is the key to aérocombat current success.

By the end of the current LPM[8] around 2019, the ALAT fleet will be down to 255 helicopters. Nonetheless ALAT, thanks to its unique and successful tactical doctrine, will remain the main military operator. In any case, this is one of the few operational capacity in the Army not that damaged by the drastic cuts occurred in the French defence budget.

This decrease will mainly apply to attack helicopter fleet, that will decrease towards 140 aircraft. But ALAT combat fleet will gain a noticeable increase in fire power and a better adverse weather and day/night combat capability with 59 EC 665 Tiger and 81 SA 342 Gazelle. It is worth noting that by 2013, 39 Tiger have been fielded. Around 14 of them have been deployed to various theatre of operations: Afghanistan from 2009 to 2013, Libya in 2011, and Mali from January 2013. Tiger remains the main ALAT weapon system for the next twenty years. The SA 342, an helicopter designed in the 1980s, will stay in service until 2030.

The ALAT is very much focused on having such a duo as Tiger and Gazelle, that means a heavy firepower platform and a more light but lethal one. According to an ALAT commander, the Gazelle is easier to deploy by air or sea, has a sufficient firepower and is perfectly suited to asymmetric warfare. Moreover, its cheaper operating cost makes it the perfect mean for tactical training, while waiting for the future HIL, which should take over this role.

The transportation fleet, or to say it better the tactical transport and air assault helicopter fleet, will decrease from 130 to 115 aircraft. But

[8] French National Assembly, *Loi relative à la programmation militaire pour les années 2014 à 2019 et portant diverses dispositions concernant la défense et la sécurité nationale*, No. 1168, 18 December 2013, http://www.assemblee-nationale.fr/14/dossiers/loi_programmation_militaire_2014-2019.asp.

once again, it will have tremendous new capacities offered by 68 NH-90 Caiman complemented by 26 refitted AS 732 Cougar and 8 EC 725 Caracal. However, a handful of old SA 330 Puma will stay in service.[9]

In conclusion, after the post-Algerian war generation aircraft – Initial Operational Capacity (IOC) of SA 300 dates back to 1962 – the ALAT has developed a new generation of combat and air assault rotary wing aircraft perfectly suited to military operations in low intensity as well as high intensity context. At this stage, and considering the foreseeable French economic and budgetary situation for the coming years, it can be said that a new step down is the only change that could happen during the next 10-15 years. Even the pending issue of developing a successor to SA 342 through the HIL Program has reached a deadlock.

2.2 THE NAVY: DOCTRINE AND OPERATIONAL EXPERIENCE[10]

The most important characteristic of French Navy is its permanent responsibility pertaining to two different fields: the military field with the maritime warfare missions and the maritime surveillance field with the "coast guard" missions. In each case, helicopters are not considered as a coherent operational tool designed to develop a specific air-to-sea manoeuvre beside a naval force. They are seen as an individual force multiplier tool for the vessel on which they are shipped. Navy's helicopters have four main tasks: Anti-Submarine Warfare (ASW) and Anti-Surface Warfare (ASUW) part of Maritime Warfare Operations (MWO) in which helicopter are individually and closely link to the vessel for their manoeuvre; Maritime Surveillance Operations (MSO) in which helicopter is to conduct its own manoeuvre, alone or in coordination with other ves-

[9] French National Assembly, *Défense: Préparation et emploi des forces: forces terrestres*, Avis de la commission de la défense sur le projet de loi de finances pour 2014, No. 1433, Vol. IV, 10 October 2013, p. 12, http://www.assemblee-nationale.fr/14/budget/plf2014/a1433-tIV.asp.

[10] Information in this chapter come from hand-on documents by and interviews with Navy Staff except technical data.

sels or aircraft and Special Forces operations in which they are part of joint unit. The Navy's helicopter force is organised under the organic command of AmiraL commandant l'AVIAtion (ALAVIA), but each ship Captain exercises the operational command of the helicopter deployed on his board. Consequently, Navy is opposed to any joint operational organisation which could break this operational link.

Maritime warfare operations take place within several different environments: air, sea, seaside and submarine. Consequently Navy warships have to monitor and fight onto these different areas simultaneously. For that purpose, ship-borne helicopters are part of the warship combat system, providing them with long-range fighting capability and enhancing their overall efficiency.

ASW mission is one of the most basic mission for Navy because of two reasons: the increasing submarine activity over the oceans, and the vital need for the aircraft carrier group or the ballistic missile submarines to be protected when at sea against submarine threat. Ship-borne helicopter offers the capacity to enlarge ASW area coverage for submarine detection and destruction.

For ASUW, ship-borne helicopters offer long-range reconnaissance, detection and over-the-horizon missile guiding capacity. This mission could be widened to convoy merchant ships, to monitor threatening small boats and to fight them if necessary, mainly during anti-piracy operations. From 2008 to 2013, Navy helicopter have arrested 42 pirates boats in the Indian Ocean in the context of multinational operations against piracy.

Maritime Surveillance Operations is a Coast Guard mission which fall to Navy backed by Customs Agency and, to some extent, by Gendarmerie. It is under Navy coordination by the Préfet Maritime, an high ranking Navy Admiral. These missions are carried out either by ship-born helicopters on Surveillance Frigates (Frégate de Surveillance, FS) or by ground-based aircraft (six air bases), with a large panel of tasks including maritime SAR, territorial waters monitoring – including aids to navigation, fisheries law enforcement, marine environmental protection – and homeland security tasks like interdiction of drug or any other product. These missions could be extended to international water, for example for drug interdiction. Indeed, Navy helicopters are good at go-fast boats interdiction. During the last five years, they seized 30 go-fast boats with 20 metric tons of drug.

Additionally, Navy helicopters are to support Special Forces (SF) for any ship-borne or amphibious operation by means of tactical transport, intelligence, close combat support or counter-terrorism tasks. In that context, Navy helicopters took part in several operations to free hostages or boats in the Indian Ocean under SF operational command.

2.2.1 Overview of the fleet

Mirroring this twofold responsibility, Navy has developed a twofold fleet with combat helicopters (ASW, ASUW and SF) and support helicopters, the latter being dual-use platforms. But reality is more complex with different micro-fleets fielded over the years to fill emerging gap or needs without a truly overall plan. In addition to these unwanted fits and starts procurement policy, Navy operates some leased helicopters.

Combat Helicopters fleet[11]

The combat helicopters fleet is composed of 42 aircraft, scattered across three type of platforms.

The WG13 Lynx is a forty years old helicopter for both anti-submarine and anti-surface warfare. As for ASW, Lynx ship-borne on ASM frigates F70 type is fitted with a sonar and two torpedoes. As for ASUW, being their task reconnaissance and intelligence, they are fitted with Infrared camera and a tactical situation display with TITUS data-link. The old Lynx is scheduled to fly until 2023 when its last mother ship F70 will be decommissioned. For that purpose, 12 out of the 17 fleet strength are to be renewed according new air regulation and equipped with a modern combat system (tactical situation display and L11 data-link).

AS565SA Panther is a twenty years old 4,2 metric tons class derived from civil Eurocopter AS365 Dauphin used for ASUW with surveillance and intelligence tasks. It can also perform general purpose missions at sea, mainly logistic tasks owing to its 1,600 kg sling capacity and his electrical hoist. Navy Panther are not armed. Their contribution to

[11] Data from Navy Staff and Airbus Helicopters (former Eurocopter) website, http://www.airbushelicopters.com.

ASUW is their range, a surface radar, infrared device for detection, and L11 data-link with the mother ship giving them the capacity to search for potential threat and warn far away from the task-force or the carrier group. Their range is their best weapon system.

NFH 90 Caiman helicopters are part of the incoming Navy combat system composed of the 11 new generation Multi-Missions European Frigates (FREMM) with ASW capabilities (9 FREMM/ASW) and air-defence capabilities [2 Air-Defence Frigates (Frégate de Défense Aérienne, FDA)]. They offer ASW capacities with a sonar device and two torpedoes. Twenty-seven Caiman are to be operated by Navy onto the 15 FREMM/FDA, and 14 out of them could be equipped with an ASW suite. The NFH has a range of 900 km and a maximum endurance of five hours. This should be a basic performance for ASUW/ASW mission.

Support Helicopters fleet

There are kinds of helicopters in this fleet, but many different versions of each of them. On the one hand, two versions for the ageing SA316/319 Alouette III are in service, a fifty years old light helicopter tasked for search and rescue missions on board aircraft-carrier, or for providing helicopter support for logistic vessels. They are also used for training. Surprisingly, they are bound to duty until 2025-2030. On the other hand, three version of the SA365N/F/N3 Dauphin, once again a dual-use helicopter used as a search and rescue platform for aircraft-carrier and to support logistic vessels. But their primary mission is maritime surveillance operation. They are ground-based ready to intervene for any mission related to territorial water monitoring.

2.2.2 Rotating unmanned aerial vehicle[12]

Navy planned to field as of 2020 a rotary Unmanned Aerial Vehicle (UAV) on board its main vessels (Aircraft carrier, LHD, FREMM and FS). Army is associated to this project with regard to amphibious doctrine

12 Stéphane Dugast, "DRONE: Système Embarqué de Reconnaissance Vecteur Aérien Léger (SERVAL)", in *Actu Marine*, 24 July 2013, http://www.defense.gouv.fr/marine/actu-marine/drone-systeme-embarque-de-reconnaissance-vecteur-aerien-leger-serval.

whose ashore operations are under Land Component Command (LCC) operational control responsibility under a joint operational command. Only off-the-shell procurement are considered for this project. In the general framework of the Système de Drone Aérien pour la Marine (SDAM) project, a Schiebel Camcopter S100 has been put on trial for 2 years (2012-2013) on board l'Adroit Offshore Patrol Vessel (OPV). These trials codenamed SERVAL (Système Embarqué de Reconnaissance Vecteur Aérien Léger) aimed at define the operational requirements and options of the future SDAM. During the trials S100 flew more than 150 hours and made more than 200 landing (day and night) and took part to live operations [fisheries law enforcement; migration monitoring (with the European Agency FRONTEX); anti-piracy operations (UE ATALANTA operation)] in the Indian Ocean, East Asia seas and Mediterranean sea as well. The sea trials validated integration of a Vertical Take-Off and Landing UAV (VTOL UAV) with a surface vessel and of the UAV sensor data with the ship's Polaris combat management system in real time. The trials were over by January 10, 2014. A further test round will take place on board a class-La Fayette frigate, to test integration on combatant vessel.

During year 2014, DGA and Navy should define their operational requirements and develop discussion with British Navy to explore any possible cooperation. Future SDAM is likely to be larger than the S100, and carry multiple sensors including maritime surveillance radar.

2.2.3 Future perspective

As of 2019-2020 the 27 Caiman will be the core of the Navy ASUW/ASW combat systems. Three of them will be deployed ashore for MSO. The crucial issue for the Navy is the replacement of the ageing legacy fleet which could not be envisioned before the end of the current LPM due to the sleeping HIL program. The Navy needs would be not less than 47 new generation helicopters for MSO and its large panel of mission. As there is few hope to field their first example before 2025-2030, the Navy is well aware that multiple gaps will occur within its very wide panel of tasks. It is worth noting that during the last decade some gaps have been filled with second hand helicopter procurement. So Navy is also waiting

HIL with requirements for:

- maritime-configuration with folding rotor blades and wheeled landing gear;
- maritime search and rescue capability (automatic hovering system, winch);
- ASUW capability (L11 data-link, ASUW missile);
- piracy and drug interdiction capacity (marksmen on board, machine gun);
- HIL should be also certified for Instrumental Flight Rules (IFR), night vision-goggle compatible, IR equipped, and operated by a single pilot.

2.3 THE AIR FORCE: DOCTRINE AND HELICOPTER FLEET

Air Force operates a fleet of 83 helicopters composed of 42 AS 355N Fennec, 23 SA 330 Puma, 7 AS 532 Super Puma, and 11 EC 725 Caracal. For Air Force global doctrine, helicopters are not really seen as a coherent combat system. They are employed in specific "niches" where fixed-wing aircraft are not efficient (lower air-space policing) or to support air-power operations (C-SAR). In addition, Air Force is contributing in Armed Forces General Support and Public Service mission and Special Operations missions. So, there is no overarching helicopter doctrine but ad hoc technical and tactical criteria for each task. These criteria are developed below.

In the general framework of Air-Defence missions, helicopters are tasked to police day or night the national lower air-space against offending low-speed Light and Ultra-light Aircraft. They could also be tasked to protect temporary restricted air-spaces. These tasks are performed in a permissive environment but coercive assets are on-board with two marksmen, equipped with a 12mm-calibre gun and a sniper rifle respectively. For mission in a non-permissive environment Fennec has provision to be fitted with a 20mm gun pod.

The AS 355N Fennec is a twin-engine civilian helicopter, with a fast

cruise speed of 133 knots, a MTOW (Maximum Take-Off Weight) of 2,6 metric tons, a day and night capability with night vision goggles and an infrared camera is in charge. The AS 355N are based all-around national mainland and overseas territory in order to provide a quick reaction capability. The mission could last on average two hours within a 300 kilometers radius.

The main issue with Fennec is range, speed and obsolescence. For that reasons, Air Force is part of HIL program with specific requirements for air-policing missions:[13]

- a four/five metric tons aircraft;
- increased range and speed to meet average light aircraft speed (150 knots), and long endurance to patrol restricted air-spaces;
- day and night capability with EO/IR multi-sensor and a live video link with National Air Operation Centre or AWAC (Airborne Warning and Control System);
- provision for pod or door mounted gun.

A dedicated squadron is in charge of C-SAR with Puma and Caracal. These two platforms are at the same standard of their ALAT counterparts. Air Force Caracal have an additional in-flight refuelling capability which is vital for C-SAR, having Caracal only a 500 km radius of operation, thus shortening the range of fixed-wing operations they are to support. French Air Force first deployed the Caracal in a combat capacity in Afghanistan, subsequently during NATO-led operations in Libya and then in Mali. C-SAR squadron could be also tasked with PR missions. On a peacetime daily basis it can also be tasked for SAR missions in support of Security Forces.

Caracal will stay on duty for decades, but Puma replacement will be a harsh problem for the Air Force, because its needs are not exactly covered by HIL option 1 program. Nevertheless, as Air Force C-SAR squadron has a NATO certification, future helicopters should meet NATO requirements. Main parameters are:

- speed, range and endurance;
- more than 15 passengers and two stretchers;

[13] Interview with Air Force Staff Officer.

- provision for any self-protection suite against Small Arms Fire (SA-FIRE) and missile;
- day and night capability, accurate and redundant navigation systems.

Air Force helicopters are deployed overseas, either on national territories such as French Guyana or New Caledonia, or on overseas bases like Djibouti and Abidjan, for Armed Forces General Support and Public Service. This covers a large variety of tasks: VIP mission, SAR, PR, troop or cargo transport. All these tasks are performed either by AS 355N Fennec Puma, Super Puma or Caracal. Onto these territories they could also be tasked for public order mission in cooperation with Gendarmerie. Best example is in French Guyana where gold smuggling interdiction or protection and surveillance of the Centre Spatial Guyanais (CSG) are the daily missions of five Puma and four Fennec.

Mission profile is more or less the same as that for ALAT, Navy or Gendarmerie when committed in the same environment. On the national territory operations take place in a permissive environment, not far from air bases and with all the necessary logistical support. The overseas environment could be more demanding. For example gold smuggling interdiction missions could face semi-permissive environment as smugglers could be in possession of firearms.

From time to time, Air Force helicopters could also be deployed with ALAT for tactical transport missions in-theatre in cooperation with ALAT, be in Afghanistan (1 to 3 Caracal), Mali (1 Puma) or Central Africa (1 Fennec).

2.4 THE SPECIAL FORCES

Most of Special Forces (SF) helicopters are part of an ALAT battalion composed of Tiger, Gazelle, Cougar and Caracal. Navy and Air Force specialized on their own some helicopters and crews for Special Forces operations, which operate in cooperation with ALAT under SF command.

Special Forces' helicopter missions follow more or less the same pattern of ALAT aérocombat missions: same theatre, same non-permissive

and very harsh environment, same requirements for range, transport capability, self-protection, with a particular emphasis on accurate navigations aids, command and control, and up-to-date military equipment. Special Forces are leader in terms of technical and tactical improvements.

2.5 THE NATIONAL GENDARMERIE[14]

Beside Police, Gendarmerie is a police force formerly part of the Ministry of Defence and subordinated since 2009 to the Ministry of Interior (Ministère de l'Intérieur). Its personnel, the gendarmes, and platforms retain a military status. With a budget of 25 million of euro the Groupement des Forces Aériennes de la Gendarmerie (GFAG) pays 19,000 flying hours for its 56 helicopters.

Gendarmerie is in charge of police missions around the countryside and towns with less than 10.000 inhabitants, that is to say the major part of French national territory. Consequently, Gendarmerie operates 56 light utility helicopters which are dispatched by small teams – one or two aircraft each – all around the mainland territory in 23 locations and 6 overseas locations. A special effort is devoted to mountains areas which are covered with 7 teams and 10 helicopters, and seaside which is covered with 8 teams and 15 helicopters. Obviously, those teams are not entirely devoted to mountains or sea SAR operations and take part in all the range of Gendarmerie missions. Mission range never exceeds an average 300 kilo-meters radius, and less than 200 kilo-meters if it is a rescue mission in the mountainous areas. In this case it is the endurance which should prevail.

The Commander of the Forces Aériennes de la Gendarmerie (CFAG) retains the organic command of all the helicopter force, being in charge of doctrine, training, budget, logistic, flight safety, and maintenance. The

[14] Information in this chapter come from hand-on documents by and interviews with the Groupement des Forces Aériennes de la Gendarmerie (GFAG)/Commanding Officer and Staff Officers.

operational command is delegated to regional commanders located at the Gendarmerie regional commands.

2.5.1 Missions and operational experience

The helicopter teams support Gendarmerie during its mission related to national security duties, like public order, criminal investigation, and search and rescue operations.

Public order covers the following operations: traffic monitoring and road safety on the national roads network; daily intelligence collecting and crime prevention; policing all major events like demonstrations, ceremonies, large public gathering; convoying and protecting government members during their travels; urban violence monitoring. Criminal investigation covers intelligence gathering, criminal enquiries, search of criminals. These missions require specific equipment to operate day and night, to gather evidence and information by means of video, cameras and any other devices. According to judicial procedures everything ought to be recorded.

Concerning SAR operations, Gendarmerie is responsible not only for SAR but also for surveillance and inquiries in mountainous or maritime areas and all around national territory. This responsibility is shared with another Ministère de l'Intérieur agency, the Sécurité civile.

All these missions are conducted by specialized gendarmes, being helicopter crews in charge of the aeronautical part of the mission. Therefore, helicopters should offer at least two to three passengers seats and give them room to operate their equipment. For SAR operations, helicopters should be fitted with some specific equipments. Nevertheless, Gendarmerie helicopters have a basic equipment which are standard requirements for any policing mission.

2.5.2 Overview of the fleet

The fleet is composed of 56 Light Utility Helicopters (LUH): 26 AS 350 BA B1 or B2 single-engine, 15 EC 145 twin-engine, 15 EC 135 twin-engine. Gendarmerie helicopter fleet is typically in the high-end of the LUH category. Basically, they are civil helicopters fitted with specific

equipment to match missions requirements. The AS 350 is a 2,250 tons class helicopter with a capacity of 1 pilot and 5 passengers or 1 pilot plus 2 doctors plus 1 stretcher and a 1ton useful load. The EC 135 offers a 2,950 tons maximum weight with a useful payload of 1,495 ton and seats for 8 persons on board including 1 or 2 pilots. The EC 145 has 12 seats for pilots and passengers and a 1.793 tons payload for a 3,585 tons maximum takeoff weight.

All these helicopters are equipped with comprehensive integrated avionics suite for advanced navigation and communication. They could be operated day and night with night vision goggles. They also feature a suite of multiple mission sensors including an EO/IR system with two colour High Definition TeleVision (HD TV) cameras – one with a X 20 magnification, one with a "spotter capability" or a X40 magnification providing the capacity to read a car license plate from 2 kilometres – and an infrared camera with a continuous zoom. The suite could transmit real time video to command posts or to man-portable mobile sets. Gendarmerie is the only French military or security force to operate this high value video system.

An additional infrared searchlight is used to search and monitor events by night and provide an additional helper for night operations. A winch system with a lift capacity of 272 kg is featured on each aircraft for disaster management, SAR missions and mountain rescue operations.

2.5.3 Future perspective

The ageing legacy fleet of AS 350 Ecureuil was to be replaced by 37 EC 135 by 2014 for a total value of 200 million of euros. As of 2012, only 15 EC135 have been fielded when the Ministry suspended the contract because of budgetary constraints. Gendarmerie will have to make it through until around 2020 because, due to budget cuts, there is very little hope to have this contract going on again. Moreover, government could take the opportunity to decrease the fleet every time when any AS 350 have to be decommissioned. Gendarmerie is going to face a helicopter capability gap in the next future.

It should be noticed that EC 145 have been fielded between 2002 to 2013, and EC 135 between 2006 to 2012. Considering that their duty

lifetime is between 20 and 30 years, as of 2020 a decision should be taken to implement their replacement by 2030. This is the reason why CFAG is a member of the MoD steering group of the HIL program, even if he has not yet taken a formal decision to join this program. Gendarmerie is sharing a lot in terms of operational needs, as well as budget difficulties, with both MoD and Sécurité Civile, therefore all these agencies count on the HIL program fragile outcome.

The 4-5 metric tons class of this future aircraft is very convenient for Gendarmerie which begs for a medium/light helicopter (4/5 metric tons) with a transport capacity of around 6 to 10 gendarmes. In addition of basic operational equipment currently featured on its helicopters that will have to be updated, Gendarmerie specific requirements for any future program are: Low noise footprint as they have to fly over inhabited areas; Improved fuel consumption and reduced maintenance costs; Twin-engine machine with maritime capability; Automatic flight control system, IFR certification including aRea NAVigation-Global Navigation Satellite System (RNAV-GNSS) capability; A door-mounted machine-gun capacity for self-protection and interdiction missions.

2.6 THE CIVIL SECURITY AGENCY[15]

The Sécurité Civile (SC) helicopter group has 22 bases in mainland France and its overseas territories. This network complements more or less Gendarmerie footprint, and they have the same requirements in terms of mission radius capability.

The SC missions are primarily Emergency Medical Services (EMS), SAR and maritime SAR, with additional tasks for fire fighting – i.e. surveillance and monitoring – for land and maritime surveillance and Coast Guard missions. Being a Minister of the Interior agency, SC could also be tasked with law enforcement missions in support of Police units – currently only 2% of the SC activity.

[15] Information in this chapter come from hand-on documents by and interviews with Sécurité Civile Senior Officer (Ministry of the Interior).

The current fleet has been fielded between 2002 and 2011 with a plan of at least 20-25 years of active duty. It is quite sure that the fleet will stay at this level, if not slightly downsize due to current economic conditions in France.

The SC has a fleet of 35 EC 145 FR, well fitted for EMS while it can accommodate 4-5 persons including crew and 1 or 2 stretchers. Its rear clamshell doors allow easy straight-in loading of the stretchers. It can be operated both night and day thanks to its IFR-equipment and night vision goggle compatibility. As for Gendarmerie EC 145, a winch system is set up on each aircraft for disaster management, SAR missions and mountain rescue operations. As their basic task is EMS, they do not need yet additional equipment like EO/IR sensor or search light.

Some years ago a study was conducted with the aim to define requirements for a more powerful aircraft, around ten metric tons and 15 passengers, for fire fighting including fire-fighters transport or water delivery, or overseas maritime SAR. The conclusions were clear: a ten tons helicopter is too expensive in terms of procurement as well as operating costs. Moreover, most of the hospitals landing spots could not accept this kind of helicopter. With EMS mission out of the scope, this kind of helicopter could not satisfy multipurpose criteria. Considering budget issues, the idea has been definitively cancelled. The MoD will continue to support fire fighting operations during summer time with its Puma family (Army and ALAT "Hephaestus" Operation) and take over maritime SAR missions in overseas territories (Navy and Air Force).

2.6.1 Future perspective

Since 2009, the Ministry of Interior operates two agencies helicopter fleets, Gendarmerie and SC, with some overlaps in terms of missions. Even if progresses have been made in terms of territorial responsibility, this situation is currently checked by a group of experts in order to make proposals for improvement. A report should be delivered to the Ministry in early 2014. Future choice could have important impacts on organization, equipment policy and strength of the fleet in order to reduce overlaps and inefficiency.

While not being formally part to Joint Staff HIL program, SC and Gen-

darmerie are members of the program steering group. The SC is also keeping a close eye on the helicopter market. Both SC and Gendarmerie will probably be compelled to join HIL program which could become a governmental program. For both agencies, any decision regarding future helicopter generation should take place before 2020, in order to have commissioning by 2025. Basic HIL feature seems well fitted for SC and Gendarmerie supposed requirements.

2.7 THE CUSTOM AGENCY[16]

Customs (or Douanes) as a Minister of Finance agency have developed a limited helicopter fleet with 4 AS 355 and 5 EC 135. They undertake more or less the same kind of missions as Gendarmerie and SC, except EMS and mountains rescue, but with a special focus on boundaries monitoring and smuggling interdiction. Technically, their requirements are similar to Gendarmerie and SC needs. The EC 135 are fielded to replace AS 355, they feature a day-night stabilized multi-sensor system (EO/IR) and a NVG capability.

2.8 THE DUAL-USE HELICOPTERS' OPTION

Before addressing the option of dual-use helicopters is necessary to have a clear view of the level of coordination among Services, and between Ministry Defence and other government agencies, regarding helicopter issues. As far as procurement is concerned, Joint Chief of Staff in coordination with Procurement Defence Agency (Délégation générale pour l'armement – DGA) is the decision level.

[16] Information in this chapter come from hand-on documents by and interviews with Customs Senior Officer.

2.8.1 The decision making process under a joint force command

Established in 2008, the Joint Helicopter Command (JHC) has been disbanded by mid-2013. The CIH did not have overall command of the various helicopter assets of the three services. Its mission was to improve interoperability by standardizing tactics, techniques and procedures and to coordinate operational tasking among the services in support of Joint Staff Operation Centre. This arrangement proved to be a bureaucratic idea, because within each service helicopters are first of all fully part of its specific way of fighting. It was not necessary and even counterproductive to keep helicopters apart from the fighting system they are operationally part of. We can quote Navy with its ASUW/ASM doctrine relying on the frigate/helicopter ASUW/ASM tactical systems; Army with its aérocombat doctrine relying upon close integration between helicopter and ground forces manoeuvre, Air Force and C-SAR units, and so far and so on. In fact, from an operational point of view, the Joint Staff Command needs to have a global vision only to answer to those tasks which are not fully part of military responsibility, as for civilian and disaster relief missions, which are not daily issues.

Nevertheless, an effort has been done to strengthen synergies among services and even with other government agencies in terms of training or Maintenance, Repair and Overhaul (MPO), air safety and security, air worthiness, air regulations, procurement under joint agencies responsibility. In particular, regarding MPO single Services and Gendarmerie retain responsibility for maintenance, while repair, overhaul, and procurement for spare parts are centralized under competency of a Joint Agency called Structure Intégrée de Maintien en condition opérationnelle des Matériels Aéronautiques de la Défense (SIMMAD). Concerning air safety and security, air worthiness and air regulations a State Aviation Safety Authority (DSAE), under the Ministry of Defence authority is in charge of regulations for aircraft airworthiness, air traffic, airspace and airport management, aircrew training rules and aircraft operating rules. If procurement is a technical act under the Délégation Générale pour l'Armement (DGA) responsibility, Joint Chief of Staff has authority over Services to coordinate their requirements and is the final decision-maker. As budget are constrained, this power will be exercised strictly.

For example, the HIL project has been stalled recently, it is not included in the multiyear budget planning (LPM 2013-2019).

2.8.2 The joint force procurement and dual-use helicopters

French government helicopters fleet is currently composed of a legacy component and a new generation component, both for combat, military utility-related tasks or public service tasks. Note that for the next twenty years, Helidax contract will provide a dedicated fleet for training tasks.

The new generation fleet is composed of two types of pure military aircraft. The AH Tiger which is the main weapon system of Army Aviation and Special Forces (Special Forces AH are operated by the ALAT) and the TTH/NFH NH-90 for Army Aviation and Navy. By the end of the current LPM 2014-2019, 60 AH Tiger, 24 naval version of NH-90 – the post-2019 final target of which is 27 – and 38 Army version of NH-90 – the final target is 68 – will be in service.

The legacy fleet ranges from 2 metric tons light helicopter (SA 342) to 8 metric tons helicopter (Puma). The heavy lift helicopter (13 metric tons) Super Frelon was disbanded in 2010 after 44 years of duty under Navy roundel. The LPM 2014-2019 does not plan to replace the legacy fleet and even to think about doing it before 2019.

In between there is a kind of "mid generation fleet" with refitted TTH AS 532 Cougar, last generation EC 725 Caracal and LUH EC 145 and 135. The overall main trend to this fleet is a cut down by 23%.

Heavy Lift Helicopter (HLH)

After having considered buying an off-the-shelf heavy lift helicopter, on 2007 France signed with Germany a joint declaration of intent to set up an HLH program with an in-service intended date of around 2020.[17] France is not equipped with this type of aircraft, having favoured tactical transport fleet in coherence with ALAT aérocombat doctrine. Following the agreement, the Joint Staff of the two countries have set up a

[17] See EDA, *Annual Report 2009*, p. 6, https://www.eda.europa.eu/docs/documents/Annual_Report_2009.

Common Staff Requirement (CSR) which has been finally transferred to European Defence Agency (EDA) by 2009.[18]

Meanwhile Germany has decided to retrofit a total of 82 CH-53G/GS helicopters that will be kept on duty until 2030, as did United Kingdom with its CH-47 fleet. For its part France has not dedicated budget in the LPM to develop a HLH program or to procure off-the-shell HLH to fill the gap until EDA program's outcome. Considering that the UK has not signed for EDA heavy lift program, there could be some doubts on the viability of this project.

Nevertheless, the need for heavy lift is crucial for the kind of operations French Armed Forces are committed in: outstretched theatres of operation such as Mali, Central African Republic, Chad and harsh environmental condition like Afghanistan, with underdeveloped ground lines of communications and air transportation facilities infrastructure, modern way of wagging war with high operations tempo and on-time logistic support – Mission Critical Time Sensitive (MCTS) concept. To sum up, HLH program is crucial for operations and repulsive for budgets, but funding has the lead.

Joint Light Helicopter (HIL) programme

This is a very complex French Armed Forces helicopter project. While being codenamed "Light Helicopter Project" it could make room for aircraft ranging from 4-5 metric tons to 11 metric tons. For this program, France will be looking for dual-use helicopter solutions.

It was a complex issue to find out a common solution for difference services, due to the diversity of tasks and missions that should have been covered by the project. Therefore, three options have been proposed. Each of them is supposed to be coherent with:

a) Army requirements for a Light Helicopter in order to take over SA 342 tasks like reconnaissance, tactical training, in theatre logistic transportation and general purpose tasks;

[18] See EDA, *EDA and Commission to work closely together on research*, 18 May 2009, https://www.eda.europa.eu/info-hub/news/2009/05/17/EDA_and_Commission_to_work_closely_together_on_research.

b) Navy requirements for a larger range of platforms to take over aircraft-carrier pilot rescue, coastal surveillance, maritime surveillance, piracy interdiction, smuggling interdiction and ship-to-ship logistic transport. These tasks being currently covered by a fleet ranging from Alouette III to Panther;
c) Air Force requirements for air policing, air base protection, SAR, and logistic transport. These tasks being currently covered by a fleet of Fennec, Puma and Super-Puma.

The ambition was to encompass in a single program the technical and operational requirements of the three Services to renew their legacy fleet. But budget cuts slacken off the program. HIL program which was part of the former LPM 2009-2014 which envisioned a budget for "a 4 metric tons class helicopter program" with "188 aircraft to be commissioned from 2018 on" has been cancelled from the current LPM 2014-2019.

In 2013 the Joint Staff has handed over a report that is supposed to map out best suited options (three options). The first option would be a unique 4-5 metric tons class platform (HIL) which will be specifically equipped according to Services requirements. The aircraft should be an off-the-shell dual-use helicopter to be customized.

The second option should better take into account Services requirements, giving them a larger range of possibilities. This option will remain centred on a 4-5 metric tons off-the-shell dual-use helicopter (HIL), covering 70% of the needs. It could be flanked by a light off-the-shell dual-use helicopter and a 10 metric tons class helicopter, ideally NH-90 Caiman or EC 725 Caracal for fleet standardization purpose.

The third option will sweep away the idea to find a common agreement. Each Service will be free to opt for any off-the-shell product meeting its requirements. This will not be an option for Army which, in any case, plans to buy the 4-5 tons class HIL. In that case, Navy will certainly reinforce its NH-90 fleet and Air Force its EC 725 fleet as far medium helicopter are concerned. But they will still have requirements for some light helicopters for air policing and SAR missions.

But no decision should be expected for this program before the end of the ongoing LPM 2014-2019. Consequently, even with an off-the-shell

dual-use helicopter as common platform, fielding into service of the aircraft will not occur before 2025-2030. During that period, legacy fleet will slowly and steadily decrease to reach 2019 targets shown before.

But the studies made by Joint Staff and DGA are still relevant for the future and carefully kept in mind. They are looking for a single platform with the following main characteristics: versatility, capacity to embed any required military equipment, capacity to be operated in permissive or semi-permissive environment with provisions for evolving to the harshest non-permissive environment standards.

Whatever the option (see before "the three options"), and the aircraft chosen within each option, the request will be for the last version of off-the-shell dual-use helicopters. Basic platform should feature:

a) civil airworthiness standards;
b) low operating and maintenance costs, low noise footprint, improved fuel consumption;
c) twin-engine with automatic flight control system, IFR certification including RNAV (GNSS) capability, up-to-date navigation systems, NVG compatibility;
d) specific devices to enable flight in conditions of degraded visual environments, such as in dust during brownout, in snow or in very low light. These are current military requirements, but there could become in a few years a dual-use basic requirement for civilian operators too, as did NVG flight this last decade for EMS.

Provisions for Government's missions in a permissive environment are to be ready to take on all the range of missions with any devices and suite needed for SAR (radar, winch, etc), small teams tactical transport (fast-rope), reconnaissance and surveillance (multi-sensors EO/IR with direct video-link).

Provisions for Government's missions in a semi-permissive environment include equipments for coercive action (marksmen, light machine gun). This seems to be within a dual-use platform capabilities.

Finally, concerning provisions for non-permissive environment two points should be made. First, for military use and adapting to modern battlefield conditions, future helicopter should feature survivability, suitability for tactical flight and manoeuvrability, low observability, low

vulnerability to projectiles, crashworthiness. Second, future helicopters should be ready to receive specific devices providing a high survivability to small arms and missiles direct hits. A self-protection system will be mandatory. It will certainly have to rely on suppressive fire system based on a door-mounted machine-gun and Threat Warning Equipment/Missile Launch Detection System coupled with chaff and flare dispenser suite.

Even if the program has been postponed for at least 6 years or more, one additional study is planned to begin by mid-2014 in order "to check for the interest of a dual-used platform" and to "find the best and less costly solutions for future HIL pilots and engineers' training."[19] This € 0.3 million study will provide additional information to make a decision on the future HIL program for the next LPM (post 2019).

The concept and use of dual-use helicopter

The concept of dual-use helicopter could have two interpretations. From an operational point of view, it could be understood as the will to task Armed Forces for civil missions and, vice-versa. In reality this is a single way concept, only Armed Forces are dual-use entities because aircraft, crews expertise and status allow it, which is not the case for civil government agencies' aircraft. This operational aspect leads to the second, technical, interpretation of dual-use platforms.

From a technical point of view, which is the subject dealt with in this study, the question is to define how a civil platform could meet military requirements. In the French case, history shows that all so called "military" helicopters owe much to civil designed platform. This history is not yet finished, with Armed Forces eagerly looking for savings by evolving off-the-shell platforms procurement. This could be a win-win bargaining process between military and manufacturers, providing the military equipment integration costs are get under control.

In this context, two ideas are worthy to consider. First, instead of designing a civil aircraft that will have a long and costly process to be mili-

[19] Avis n°13-218871, in *Bulletin officiel des annonces des marchés public (Boamp)*, 24 December 2013, http://www.boamp.fr/avis/detail/13-218871/officiel.

tarized, to design a platform according to basic military requirements, in terms of assets technical compatibility, provision for additional equipment, etc. Then, to remove, case by case, everything which is not in accordance with customer requirements. This is not so easy to do, and NH-90 story gives a good example as customization had led to some 45 variants acknowledged by NHI. But NH platform can host these variants without major refit. Secondly, to have a new way of thinking helicopter design with a twofold approach. First, to design a skeleton around the aeronautical components, which are the basic requirements for an aircraft: basically it would be an helicopter that could fly but without any cargo. Then, build a removable cargo pod which could be customized for operators' requirements or mission purpose (transport of passengers or fret, EMS, Command Post, or any other mission).

Finally it should be underlined that the growing costs of military helicopters programs reinforced the idea in the French MoD that any future additional needs should be meet with an off-the-shelves dual-use joint helicopter. Moreover the idea is to have a real synergy between civil and military even in terms of air regulation. The State Aviation Safety Authority (DSAE) has been set up and tasked for the purpose to develop military regulation in order to comply as much as possible with civilian rules (aircraft airworthiness, air traffic, airspace and airport management, aircrew training rules and aircraft operating rules) and, the ALAT training centre is training military pilot according to the International Civil Aviation Organization (ICAO) rules. So the ground is ready to have better synergies between military and civilian operators, except, of course, for military operational matters.

3.
The British Case Study

Douglas Barrie

If the ubiquity and utility of the UK's military rotary wing forces have been highlighted in recent conflicts involving British forces, then residual strains and tensions have been apparent concerning the acquisition, operation and size of the helicopter fleets required.

Combat operations in Iraq, Afghanistan and Libya underscored again the value of a rotary capability across a swathe of roles. However, as ongoing operations understandably became the overriding priority, longer term planning and budgeting were to suffer, including in the rotary arena, exacerbating underlying issues with Britain's military helicopter fleets. Short-term fixes put in place in an attempt to address urgent operational requirements were often at the expense of coherence in the longer-term programme. This state of flux was compounded by the cumulative effects of three defence reviews and two revisions of defence industrial strategy over the past 15 years.

A unifying thread of the 1998 Strategic Defence Review was the increased emphasis on an expeditionary strategy reflected by the growing stress on tri-service structures, and the developing doctrines of the three forces. The direction of travel continued in the Conservative-Liberal Democrat coalition government's 2010 Strategic Defence and Security Review, though in more constrained financial circumstance:

> our future forces, although smaller than now, will retain their geographical reach and their ability to operate across the spectrum from high-intensity intervention to enduring stabilisation activity.[1]

[1] UK Prime Minister, *Securing Britain in an Age of Uncertainty: The Strategic Defence and Security Review*, October 2010, par. 2.10, https://www.gov.uk/government/publica-

In the past ten years military rotary wing strategy has been the focus of at least three reviews: the 2004 Future Rotorcraft Capability,[2] the 2009 Future Rotary Wing Strategy[3] and, following a change in government, 2011-12's Defence Rotary Wing Capability Study.[4] The capstone of the Future Rotary Wing Strategy was the move to four core fleets of Chinook, Wildcat, Merlin and Apache helicopters, an aim that was kept in the follow-on Defence Rotary Wing Capability Study. While the former envisaged fleets of around 70 of each core type, the latter study was to erode these planning assumptions.

The UK's 2005 Defence Industrial Strategy (DIS) paper,[5] the single most lucid unclassified exposition of London's military equipment needs and industrial policy, described the Future Rotorcraft Capability (FRC) as intended to identify a

> strategy that maximised the capability that could be delivered from available funding. The FRC programme was directed to explore opportunities to use each helicopter type to deliver more than one capability, reduce the number of types of helicopters in-service and promote off-the-shelf solutions, limiting unique UK requirements to the essential in order to drive down costs of ownership.

The Future Rotorcraft strategy identified three broad combat helicopter

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tions/the-strategic-defence-and-security-review-securing-britain-in-an-age-of-uncertainty.

[2] UK Ministry of Defence, *Future Capabilities: Government Response to the House of Commons Defence Committee's Fourth Report of Session 2004-05*, July 2005, Recommendation 30, https://www.gov.uk/government/publications/future-capabilities-government-response.

[3] Bob Ainsworth, "Future Rotary Wing Strategy", in *House of Commons Debates*, Vol. 502, Part 16, 15 December 2009, http://www.publications.parliament.uk/pa/cm200910/cmhansrd/cm091215/wmstext/91215m0002.htm.

[4] Nick Harvey, "Rotary Wing Capability Study", in *House of Commons Debates*, Vol. 546, Part 12, 12 June 2012, http://www.publications.parliament.uk/pa/cm201213/cmhansrd/cm120612/wmstext/120612m0001.htm#12061239000177.

[5] UK Ministry of Defence, *Defence Industrial Strategy. Defence White paper*, December 2005, pp. 90-94, https://www.gov.uk/government/publications/defence-industrial-strategy-defence-white-paper.

capability areas for the UK: Attack, Find, and Lift for both the land and maritime domains. The challenges that were to defeat the DIS were not in crafting and expounding policy, but in securing the needed procurement budgets, research and development funding, and the requisite buy-in from a variety of stakeholders to meet the strategy's aspirations. The eventual follow up was the far thinner, in every sense, "National Security through Technology" released in February 2012.[6]

In the military rotary arena a mix of procrastination, revision and short-term fixes may now have been supplanted, finally, with a credible medium-to-long term plan. Four types will form core of the British armed services rotary capacity: the Boeing CH-47 Chinook operated by the air force, the AgustaWestland Merlin, operated by the Navy, the AgustaWestland Lynx Wildcat fielded by the Army and the Navy, and the Boeing AH-64 Apache attack helicopter in service with the Army. The Puma will remain in the air force inventory until 2025. While all of the British military's front line types are dedicated military designs, dual-use helicopters have and continue to be used for both training and some niche utility roles.

3.1 THE BRITISH ARMED FORCES

The UK military deployments in Iraq, Afghanistan and Libya revealed shortcomings and areas of weakness. Some of these were predictable. In the public eye, the UK rotary capability during the Iraq campaign, codenamed Operation Telic, was associated not with what could be delivered, but rather with what could not. The shortfall in lift capacity became a well-publicised and vexing issue for politicians and senior offic-

[6] UK Ministry of Defence, *National Security Through Technology: Technology, Equipment and Support for UK Defence and Security*, February 2012, https://www.gov.uk/government/publications/national-security-through-technology-technology-equipment-and-support-for-uk-defence-and-security-cm-8278--2. See also Guillaume Steuer, "Liaison 16 sur Rafale: retours d'expérience", in *Air & Cosmos*, No. 2114 (29 February 2008), pp. 20-23.

ers.[7] The amount of rotary tactical lift made available to support Operation Herrick in Afghanistan was the focus of similar concern.[8]

This issue was symptomatic of a wider and more-long term malady affecting the country's military rotorcraft capability. While recently the outlook has improved markedly, there continue to be problematic areas. Also, the rotary arena remains potentially charged politically, a continuing echo of the 1986 clash between the Prime Minister Margaret Thatcher and Defence Secretary Michael Heseltine over the fate of British helicopter manufacturer Westland which resulted in the latter's abrupt resignation, and the coining of the term the "Westland effect".

Although the value of rotary capability in the respective services is not disputed, until the last few years it has suffered through the lack of champions at the most senior military levels. It is noteworthy that currently the Royal Navy and the Royal Air Force are headed by aircrew with a rotary wing background. Air Chief Marshal Sir Andrew Pulford, Chief of the Air Staff, was the first rotary rather than fixed-wing pilot to lead the service, while Admiral Sir George Zambellas, the First Sea Lord and Chief of the Naval Staff, began his military career as a helicopter pilot.

Within the single services rotary wing capability has rarely, if ever, been the priority. On occasion, it has even provided a pool of funding to be drawn upon when savings were required within the overall defence acquisition programme. Single service agendas in a succession of tough defence reviews also often placed the rotary community at a disadvantage – for example the £1 billion plus defence budget cut in 2004.

All three arms of the British military continue to operate rotorcraft. The Army Air Corps operates the AgustaWestland Apache AH1 in the attack role, Westland Lynx AH7/9A and Aerospatiale Gazelle in the utility role. The Royal Air Force fields the Boeing Chinook HC2/2A/3/4, AgustaWestland Merlin HC3/3A and Airbus Helicopter Puma HC1/2 in the lift role, and AgustaWestland Sea King HAR3/3A for search and rescue. The Royal Navy's Fleet Air Arm operates the AgustaWestland Lynx

[7] See declassified extracts from a report dated October 2005 of a visit to Iraq by General Mike Jackson, http://www.iraqinquiry.org.uk/media/48836/smj-report-oct-05.pdf.

[8] House of Commons Defence Committee, *Helicopter Capability. 11th Report of Session 2008-09*, 16 July 2009, pp. 8-9, http://www.publications.parliament.uk/pa/cm200809/cmselect/cmdfence/434/434.pdf.

HMA8/9A, AgustaWestland Merlin HM1/2 and AgustaWestland Sea King Mk4/5/7. Each service is in the midst of fleet replacement or the introduction of upgraded variants of types already fielded, with a continuing emphasis on multi-role capability. The latter is driven by the desire to offset reducing platform numbers, the result of long term funding pressures, by increasing the utility of those types that remain or are being introduced into service.

3.1.1 Joint forces' structure

Since 1999 "battlefield helicopters" and "air assault forces" from the three services have been operated under the banner of the Joint Helicopter Command (JHC).[9] All of the Army Air Corps regiments come under the aegis of the JHC, as does the air force's Support Helicopter Force and the Navy's Commando Helicopter Force. The JHC is a component of Army Head Quarter, while the command chain runs back into the parent services of units allocated to the joint command for personnel decisions such as postings and promotions.

The creation of the JHC was one of the recommendations of the then Labour Government's 1998 Strategic Defence Review, a study intended to better align the UK's military capabilities with its foreign policy ambitions and security needs in a post-Cold War environment. One rationale for the establishing the JHC was to make better use of available resource, in part a recognition of a shortfall in rotary capacity, and to avoid duplication of effort. The UK financial watchdog National Audit Office, in discussing the JHC, noted that it was "estimated" that during the military operation in Bosnia in 1996 the separate Services "deployed some 40 per cent too many helicopters […], often duplicating facilities, particularly combat service support."[10] The JHC was an element also of a

[9] House of Commons, "The Strategic Defence Review White Paper", in *House of Commons Research Papers*, No. RP98/91, 15 October 1998, p. 25, http://www.parliament.uk/briefing-papers/RP98-91.pdf.

[10] UK Ministry of Defence, *Battlefield Helicopters*, House of Commons 486 Session 2003-2004, 7 April 2004, par. 2.6, http://www.nao.org.uk/report/ministry-of-defence-battlefield-helicopters.

broader emphasis within the 1998 defence review on "jointery" across the services, intended to meet better the emerging demands of expeditionary warfare with the creation of Joint Rapid Reaction Forces and supporting headquarters.

The SDR was intended as a policy-led review to recast Britain's defence posture to one more appropriate to the emerging security environment. The comparative stasis of the Cold War was being replaced by a dynamic and difficult to predict international environment placing different demands on the country's military, security and foreign policy-makers and their capabilities. The wars of the first decade of the 21st Century served to reinforce and compound the challenge. The Defence Ministry's 2010 "Future Character of Conflict" paper qualified the emerging "battle-space" as: congested, cluttered, contested, connected, and constrained.[11] A context ideal for rotary wing.

3.2 THE BRITISH ARMY DOCTRINE

The Army has long adhered to a "manoeuverist approach": at its simplest a focus on applying "strength against vulnerability" across the spectrum of land warfare. A fundamental building block of the manoeuverist approach is the combined arms group. The Army's 2012 Future Land Operating Concept describes combined arms operations as integrating a

> range of complimentary capabilities available in the land force. These combined capabilities increase fighting power to deter, coerce or ultimately disrupt, defeat or destroy adversaries. Land forces must maintain an appropriate mix of fighting power to deal with crises and conflicts that affect the UK's national interests. However, the land force will invariably operate with air and sea power in the future battle-space.[12]

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[11] UK Ministry of Defence, *Future Character of Conflict*, Report in DCDC Strategy Trends Programme, February 2010, par. 24, https://www.gov.uk/government/publications/future-character-of-conflict.

[12] UK Ministry of Defence, *Future Land Operating Concept*, DCDC Joint Concept Note

Army's rotary capability falls within two of its four main land force elements: Combat and Combat Support – the others being Combat Service Support and Combat Command Support. The Army defines Combat elements as "those that engage adversaries directly" including "attack aviation units," while Combat Support "provides indirect firepower and other essential operational assistance to combat elements."[13] The Army Air Corps Apache AH1 attack helicopter is considered a Combat element, while its Lynx units are part of Combat Support. In broad terms, the Air Force's Chinook and Merlin transport helicopters would also be considered as Combat Support assets contributing to air manoeuvre forces. Air manoeuvre forces

> exploit the mobility of aircraft to provide reach and agility and hence depth or speed of reaction. Air manoeuvre forces include attack, support and reconnaissance helicopters [...]. Their actions should be closely integrated with all forms of air power.[14]

Within Army doctrine Air Manoeuvre forces can "find, fix, strike and exploit" and includes "close combat attack, providing responsive and intimate fires in close support." Close combat attack, sometimes referred to as close combat support, is viewed by some Army rotary specialists differently to the more widely known Close Air Support (CAS) used by the RAF, in that engagements can be carried out at extremely close ranges between friendly forces and the enemy.

3.2.1 The Army's Aviation

The Army's rotary attack capability is based on its two regiments of Apache AH1. In 1991 the Defence Ministry had agreed Staff Target (Air) Cardinal Point Specification 428 to procure an attack helicopter "off the

2/12, May 2012, par. 307, https://www.gov.uk/government/publications/joint-concept-note-2-12-future-land-operating-concept.

[13] UK Ministry of Defence, *Army Doctrine Publication (ADP): Operations*, November 2010, par. 413 (b), https://www.gov.uk/government/publications/Army-doctrine-publication-operations.

[14] Ibid., par. 414(3c).

shelf." This was followed in 1993 by an invitation to tender which was to attract six bid teams. The result was hardly surprising, with the Apache picked, an outcome which the Army was delighted with. In 1990 it was clear there were those within the Army who already favoured the Apache to meet its attack helicopter requirement. Along with final assembly by Westland in the UK the WAH-64, as it was to be known, was to use Rolls-Royce Turbomeca RTM322 engines rather than the General Electric T700 turbo-shaft engine to increase the UK content and to make the presentation of the choice more palatable politically. The RTM322 also offered better performance than the GE power-plant then available.

While the Ministry had originally hoped to purchase upward of 90 attack helicopters, it was to order eventually 67 Apache, all fitted with the rotor-head mounted Longbow millimetric-wave radar. During the procurement process there was consideration of only equipping some of the AH-64s with the radar. Analysis showed the value of accepting a fewer number of overall platforms if each had a greater combat potential. As of the end of 2013, 65 of the original 67 Apache remain in the inventory, of which 48 are in the "forward fleet." The Defence Ministry had hoped originally for an In-Service Date (ISD) of December 1997, however this was to slip eventually to January 2001, as the result of planning, budgetary, training and technical reasons. The ISD was defined as the delivery of nine production standard helicopters. The Initial Operational Capability was declared in October 2004 and British Apaches were deployed to Afghanistan in 2006 and Libya in 2011.

Although the Army had operated the Lynx/TOW combination in the anti-armour role it had no doctrine for a dedicated attack helicopter and this had to be developed. Since the Army had begun thinking about a dedicated attack helicopter the strategic landscape had changed: Soviet tank-heavy operational manoeuvre groups would no longer be the primary threat. The first combat deployment of the Apache AH Mk1 would be against forces armed with AK-47 semi-automatic weapons and other light systems, rather than the original threat baseline of Soviet heavy armour.

The British Apache AH1 was to arrive into operational service too late for the invasion of Iraq in 2003, although consideration was given to its deployment later during the British deployment as part of the Multi-

National Division (South East of Iraq). Instead, the decision was taken to use the Apache in support of the Operation Herrick in Afghanistan in 2006. Reflecting the changed security environment and the diverse nature of potential threats now faced by the military, the Apache were deployed into a counter-insurgency environment. What had been anticipated as a security and stabilisation operation, however, deteriorated rapidly into a series of bloody battles with British forces spread thinly over a large area of Helmand province. Fighting with the Taliban was particularly fierce in Now Zad, Musa Qala, Sangin, and Gereshk.[15]

The AH1s primary anti-armour weapon was the AGM-114K variant of the Hellfire, since its introduction into service this has been supplemented by the purchase of the AGM-114N/N1 versions of the missile. The latter has a warhead optimised for attacking structures and bunkers rather than for the defeat of armour, reflecting the widening roles the Apache was being used for. Along with its weaponry, missiles, complemented by a gun and unguided rockets, the Apache was also fitted with an updated radar and electro-optical sensor suite. These were to prove their value in the intelligence, surveillance and reconnaissance role, even if the combat environment was not that envisaged originally. Since being first deployed in 2006 the Army has sustained 8 AH1s in theatre as part of Operation Herrick.

The British Apache's second combat deployment saw it used to engage more traditional threat platforms, with Libya Soviet-era armoured vehicles amongst the targets destroyed during the Western intervention in the 2011 civil war, codenamed in UK Operation Ellamy. Reflecting its versatility the AH1 was also used to engage surface maritime surface targets during the campaign.[16]

The Operation Ellamy deployment, however, meant the AH1s being operated from HMS Ocean in the maritime power projection role. The UK had carried out sea trials with the Apache to ensure it could operate safely from the sea, while also developing a maintenance regime to off-

[15] Antony King, "Understanding the Helmand campaign: British military operations in Afghanistan", in *International Affairs*, Vol. 86, No. 2 (March 2010), pp. 311-332.

[16] Craig Hoyle, "Libya: British Army details Apache success", in *Flightglobal*, 8 July 2011, http://www.flightglobal.com/news/articles/-359298.

set the worst impacts of the corrosive marine environment. There remain, however, some problem areas, not least of all the Apache's ditching characteristics, and a difficulty with safe egress for the aircrew.[17]

The Libyan deployment required that the AH1 be operated in a more demanding air defence threat environment. While most of Libya's air defences were ageing Soviet-era systems, they did exist in considerable numbers. Libyan forces also operated a vehicle-mounted version of the 9K338 Igla-S (NATO codename SA-24 Grinch) surface-to-air missile, a modern and capable man-portable air defence system (MANPADS). There were several SA-24 shots taken against AH1s, fully testing the AH1s defensive aids system, known as HIDAS. None of the missile firings were successful.

Operation Ellamy provided the JHC with an opportunity to deploy a maritime tailored air group concept to include the AH1. The force consisted of five Apache, two Lynx Mk7, two Sea King Mk7 ASAC, as well as two US HH-60 for combat search and rescue. Several issues were to become apparent as a result of the AH1s first operational deployment at sea, including the lack of specialist deck handling for the type. While work has been done to allow AH operation at sea, it is not "marinised". There were also challenges in getting the AH1s into the air tasking order efficiently.

Future Apache

The Defence Ministry is now in the throes of considering how to address obsolescence with its AH1 fleet,[18] a situation that is compounded by the US move from the D to the E standard of the AH-64. The US Army declared IOC for the AH-64E in November 2013. During 2013, the British Apache Capability Sustainment Programme (CSP) was looking at a variety of options with regard to its Apache fleet with the aim to sustain an attack helicopter capability out to 2040. Initially, six options were considered, including doing nothing with the present fleet and replacing with a new helicopter. This could be a "vanilla-flavour" AH-64E or one

[17] Craig Hoyle "UK eyes Apache modifications after Libyan experience", in *Flightglobal*, 26 October 2011, http://www.flightglobal.com/news/articles/-363865.

[18] Patrick Allen, "Upgrades needed to maintain Apache as 'bedrock' of British Army", in *Jane's Defence Weekly*, 5 July 2013.

modified with the UK HIDAS. Another option was that of refurbishing up to 60% of the line replaceable unit from the AH1 and integrating these on a new 64E green airframe. Irrespective of the decision, likely sometime in 2014, the fleet is anticipated to fall in the near term to 50 airframes, as 15 are likely to be mothballed by 2015.

The attractions of commonality with the US E fleet may well also see the RTM322 replaced by a variant of the GE engine it displaced with the original British selection in 1995. While supporting sovereign industrial capacity was deemed of importance in the initial decision to buy a US platform, despite the procurement having been meant to be "off the shelf," as of early 2014 the indications were this was unlikely to become an issue with the CSP. Rolls-Royce divested its share of the RTM programme to French partner Turbomeca, removing any direct British interest in the power-plant at the prime level.

Alongside the choice between a US and a European power-plant the UK Defence Ministry is also considering future armament requirements for the attack helicopter. A US incumbent, the Lockheed Martin AGM-114 Hellfire, could be replaced by a European weapon, the MBDA Brimstone 2.[19] The latter is a dual-mode guidance variant of the Brimstone, itself based on the Hellfire airframe, and developed to meet the second element of the RAF's Selective Precision Effects At Range family of requirements. The AGM-114R is the alternative to the Brimstone 2. This version of the Hellfire utilizes multi-purpose warhead intended to defeat a broad target set. The AGM-114R relies on semi-active laser guidance, while the Brimstone 2 uses both SAL and millimetre-wave radar.

Lynx developments

The complement to the Army's future attack helicopter is the Agusta-Westland AW159 Lynx Wildcat being developed to meet its Battlefield Helicopter Reconnaissance Requirement. The Wildcat forms a common airframe baseline also for the Royal Navy's Surface Combatant Maritime Rotorcraft Requirement (SCMR).

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[19] Gareth Jennings, "MBDA scores five-from-five in Brimstone 2 tests", in *Jane's Missiles & Rockets,* 20 October 2013.

In keeping with many of the UK's other rotary projects over the previous two decades, the Lynx successor effort proved far from straightforward, with the Army programme in particular being delayed significantly. When Westland received seed funding for the programme in 2001 a projected ISD for the Army requirement, then known as the Battlefield Light Utility Helicopter (BLUH), was 2006.[20] As the project progressed this was eventually to become 2014. For the Army Wildcat Mk1 the in-service date is defined as four helicopters at readiness to deploy. The Wildcat Mk1 will take on the roles of the Lynx AH7 and Lynx 9A as well as some tasks previously fulfilled by the Gazelle. These will include limited movement of troops and materiel, intelligence surveillance and reconnaissance, force protection, and command and control.

Irrespective of the 2001 Defence Ministry assessment that identified the then Future Lynx option as the "best" approach to meeting both Army and Navy requirements, only after the conclusion of the 2004-5 Future Rotorcraft Capability study the government decided to pursue a single-source acquisition. Formal contract award was announced in June 2006 for 40 BLUH and 30 SCMR with an option for a further five each. Justifying the decision in 2007, the then Defence Secretary Bob Ainsworth said:

> The through-life military capability, cost and risk of various mixes of different helicopter types was assessed. These mixes included options that used different aircraft types to deliver the Land and Maritime capabilities now contracted to be provided by Future Lynx.[21]

This analysis concluded that, alongside other investments arising from the FRC programme, the delivery of the British Army's Battlefield Re-

[20] UK Ministry of Defence, *The Major Projects Report 2011*, House of Commons 1520-I, Session 2010-2012, 16 November 2011, pp. 47-48, http://www.nao.org.uk/report/ministry-of-defence-the-major-projects-report-2011.

[21] Bob Ainsworth, "Helicopters: Procurement", in *House of Commons Debates*, 13 December 2007, col. 776W, http://www.publications.parliament.uk/pa/cm200708/cmhansrd/cm071213/text/71213w0005.htm.

connaissance Helicopter (BRH) and the Royal Navy's Surface Combatant Maritime Rotorcraft (SCMR) through a single helicopter type (Future Lynx) provided the best combination of through-life military capability, cost and risk.

Further changes in procurement numbers meant the Army would receive only 34 of the Wildcat Mk1, only a third of what was originally hoped for. Various arguments have been deployed to justify the reduced numbers, but the reduction in Army Wildcat Mk1 numbers appears to has been driven primarily by funding constraints.

At the end of 2011 a further possible shift in numbers was suggested with the Wildcat AH1 number to fall to 30, though up to a further eight Army Wildcats were to be bought at the Light Assault Helicopter (LAH) standard.[22] The requirement for a small attack-capable rotary wing platform for the UK Special Forces, once the Lynx is withdrawn, remains open, and the Wildcat is an option to fulfil this need.

While no detail has been forthcoming on what would constitute the LAH standard, the baseline AH model for the Army would include a forward looking infra-red, laser range-finder and laser designator, and the ability to hand off target location and range via a secure data modem. Defensive armament would be provided by door-mounted machine guns. Army plans in 2013 were to have four squadrons of the Wildcat AH1, and a shared operational conversion squadron with the Navy. A limited number of Gazelle are planned presently to be retained until 2018, being used in Northern Ireland and at BATUS in Canada. A forward fleet of 24 Gazelle helicopters continue to be operated.

Lynx Urgent Operational Requirements

The delays to the Lynx successor combined with performance shortfalls in the extant fleet resulted in the defence ministry pursuing an upgrade to the Lynx Mk9 to support operations in Afghanistan. The "hot" environment of Iraq and the "hot and high" nature of Afghanistan placed demands on the then in-service variants of the Lynx that were some-

[22] UK Ministry of Defence, *The Major Projects Report 2012*, House of Commons 684-I, Session 2012-2013, 10 January 2013, p. 196, http://www.nao.org.uk/report/ministry-of-defence-the-major-projects-report-2012.

times beyond its operating envelope. The Lynx AH9 could not be deployed during the summer months in Afghanistan prior to a change in engine. The Army, however, had no option but to field the type in theatre given the pool of resources it had available.

> The installation of up-rated engines to the entire Lynx Mk 9 fleet has allowed these helicopters to operate in Afghanistan during the summer months, providing for the first time a Light Helicopter capability on a year round operational basis

noted the Defence Ministry in written evidence to the Parliament's Defence Select Committee in 2011.[23]

Four Lynx and six Chinook provided the rotary lift for the initial deployment of 16 Air Assault Brigade to Helmand in southern Afghanistan in 2006. It was soon to become apparent that the level of rotary lift provided initially was inadequate. In the short term additional helicopters were deployed and flying hours increased, while at the end of 2008 the Ministry funded an Urgent Operational Requirement (UOR) to replace the Lynx's Rolls Royce Gem turboshafts with the more powerful LHTEC CTS800N. Initially, twelve of the 22 AH9As were converted, with a decision taken later to upgrade the remainder given the performance improvement.

The increased power and performance allowed the Army to employ the Lynx AH9A for tasks in Afghanistan that it had not previously been able to be used for. The engine change provided the Lynx with the ability to carry a 0.5 inch heavy machine gun and more capable communications. Escort and overwatch tasks supporting Chinook, Merlin and Sea King helicopters, along with command and control missions, have been successfully carried out using the AH9A since it was first deployed into the Afghan theatre in April 2010. The escort and overwatch tasks would previously have required the Apache. The Lynx AH9A has not yet been

[23] House of Commons Defence Committee, "Written evidence from the Ministry of Defence", in *Operations in Afghanistan, 4th Report of Session 2010-12*, Vol. I, 17 July 2011, par. 22.2, http://www.publications.parliament.uk/pa/cm201012/cmselect/cmdfence/554/554.pdf.

taken into the Defence Ministry's core equipment programme, and as of early 2014 it remained a UOR. The planned out of service date is 2018, though there has been speculation the type might be retained in service as a Special Forces platform.

3.3 THE ROYAL AIR FORCE (RAF) DOCTRINE

Speed, reach and agility are identified as key characteristics of air power in the RAF's British Air and Space Power Doctrine (AP3000)[24], descriptors well suited to military rotary aviation, while air mobility is one of the four "fundamental air and space power roles." The other roles are control of air and space, intelligence and situational awareness, and attack.

> Support helicopters are the lynch pins of tactical mobility […]. They are the fundamental enablers of ground manoeuvre, adding speed and surprise and allowing forces to leapfrog difficult terrain and bypass ground threats

notes AP3000, adding that "support helicopters are invariably in great demand and short supply.[25] An area of doctrinal friction, resulting arguably from a doctrinal absence, was that of air-land, or land-air, integration, which became apparent during Operation Telic in Iraq during 2003 and was also manifest during the early stages of Operation Herrick in Afghanistan. Project Coningham-Keys was established in 2003 as tri-service effort to institutionalise the air-land integration lessons offered by Operation Telic. In turn the project led to the establishment of the Joint Air Land Organisation, embedded in Air Command HQ at High Wycombe, to more closely integrate air and land.

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[24] Replaced in July 2013 by: UK Ministry of Defence, *UK Air and Space Doctrine* (JDP 0-30), https://www.gov.uk/government/publications/uk-air-and-space-doctrine-jdp-0-30.

[25] UK Ministry of Defence, *British Air and Space Power Doctrine*, AP3000 Fourth edition, 2009, p. 44, http://www.raf.mod.uk/rafcms/mediafiles/9E435312_5056_A318_A88F14CF6F4FC6CE.pdf.

3.3.1 RAF support helicopters

The bulk of the UK's medium and heavy support helicopters are drawn from the RAF. The Puma HC1/HC2 and the Merlin HC3/3A provide medium lift, with the Chinook HC2/2A/3/4 fulfilling the heavy lift requirement. All three fleets are in a period of transition. The Chinooks are being brought up to the HC4 standard, with a further 14 HC6s being purchased. The Puma is in the midst of a service life extension programme, and the Merlin are to undergo a conversion programme and transfer to the Navy to meet maritime and littoral lift needs. All of the projects have had their controversies.

The Chinook entered service with the air force in 1980 and the type is presently anticipated to remain in service until 2040. The RAF will eventually have an inventory of 60 Chinooks, 46 HC4s and 14 HC6s. The type is presently operated by three squadrons all based at RAF Odiham. The Chinook provided a fundamental operational capability in Afghanistan, used for troop and equipment transport and for casualty evacuation. Two of the type were lost as a result of operations in Afghanistan, though with no fatalities. One of the helicopters was hit by a rocket-propelled grenade, but aircrew skill and the robustness of the airframe meant the damaged Chinook was able to be flown to safety.

Along with a hard earned reputation for toughness, the Chinook has also the less laudatory attribute of being associated with one of the poorest Defence Ministry acquisition projects for many years.[26] Eight of 14 HC2A helicopters ordered in 1995 were re-specified as the Mk3 to meet special operation requirements. A litany of programme management and oversight failings meant that, although delivered in December 2001, it wasn't until a decade later that the helicopter finally began to be used by the air force. Lamentable in itself, this became even more serious when it contributed to the lack of overall rotary heavy-lift available for operations in Iraq and Afghanistan, placing greater strain on the operational inventory and crews than would otherwise have been necessary.

[26] See, among others, UK Ministry of Defence, *Chinook Mk3 Helicopters*, House of Commons 512 Session 2007-2008, 4 June 2008, http://www.nao.org.uk/report/ministry-of-defence-chinook-mk3-helicopters.

The Chinook fleet is also the focus of a number of ongoing upgrades, the two largest of which are Project Julius to fit a predominantly digital cockpit, and an engine upgrade with the introduction of the Honeywell T55-L-714A. As with the Lynx AH9A development, the up-rated engine provides performance improvements in Afghanistan.[27] The Chinook projects will also re-baseline much of the fleet that at its most diverse reputedly had 17 different "standards" of helicopter in the inventory. Supporting such a variety of standards over any length of time would be inefficient, and expensive. The cockpit avionics suite for the Julius upgrade is also being fitted to the Chinook HC6, the first of which was flown in April 2013. The implementation of Project Julius and the engine change had to be managed carefully given the operational demands on the Chinook fleet and the tautness of rotary lift availability. The Mk4 was deployed to Afghanistan in November 2012, following its release to service in May of that year. Prior to Afghanistan, the HC4 was part of the rotary support for the security operation for the London 2012 Olympic Games.

The HC3, sometimes referred to as the HC3R, is also likely to go through the overall upgrade programme – post modification it would be known as the HC5. In the medium term, the air force would have an inventory of 38 Chinook HC4 (Mk4), 8 Chinook HC5 (Mk5) and 14 HC6 (Mk6). The increase of Chinooks that the air force will operate has to be viewed against two additional factors: the increase is less than previously planned, and the RAF land lift capacity in terms of overall airframe numbers is being "reduced" by the transfer of the 25-strong Merlin HC3/3A fleet to the Royal Navy.

When the then Labour Government announced in December 2009 the outcome of its Future Rotary Wing Strategy, a key element of this was the acquisition of an additional 24 Chinook helicopters 22 additional airframes and 2 attrition purchases to cover losses in Afghanistan. Announcing the outcome of the study work, the Defence Secretary Bob Ainsworth told the House of Commons:

[27] See, among others, the interview to Patrick Allen, Group Captain Dom Toriati, RAF Chinook Force Commander, in *Jane's Defence Weekly* 16 October 2013.

> The strategy's priority is support to operations, and through it we will deliver, by 2016, an increase of some 40 per cent in the number of helicopters suitable for deployment in hot and high conditions, such as Afghanistan. […] Delivery of these aircraft will not only mean more aircraft able to operate in the kind of conditions seen in Afghanistan but also a significant increase in the overall lift capacity of our helicopter fleet.[28]

Optimistically Ainsworth suggested that by 2013 ten of the new-build Chinooks would be delivered. The first Mk6 arrived in the UK only in January 2014.

Nor indeed would the number be sustained. The May 2010 General Election resulted in a Conservative-Liberal Democrat coalition government. The Labour Government had begun preparatory work for a defence review, and this was continued, though with a wider scope, by the coalition. The government cast the Strategic Defence and Security Review partly as an effort to redress what Defence Secretary Liam Fox described as "a defence programme undermined by a £38 million black hole."[29] He bemoaned that a fundamental review had not been carried out for 12 years, though the previous government publications included "The New Chapter" to the 1998 defence review in 2002, a Defence White Paper in 2003, and the Defence Industrial Strategy in 2005. Post 2005, the political focus militarily was on the escalating level of combat British forces were involved in Afghanistan, resulting in unsurprising but debilitating short-termism.

The coalition government announced the outcome of the SDSR in October 2010 including a purchase of additional Chinooks. The review stated that "12 new Chinook helicopters" were to be purchased

> to increase battlefield mobility from land and sea, operating alongside Merlin medium lift helicopters to move personnel and

[28] Bob Ainsworth, "Future Rotary Wing Strategy", cit.

[29] Liam Fox, "Defence Transformation", in *House of Commons Debates*, Vol. 531, Part 189, 18 July 2011, col. 643 ss., http://www.publications.parliament.uk/pa/cm201011/cmhansrd/cm110718/debtext/110718-0002.htm#11071817000001.

> equipment quickly over long distances. This rationalised fleet will be easier and more cost-effective to support and will deliver significant operational advantage.[30]

While Prime Minister David Cameron told the Commons that the review was "not simply a cost-saving exercise to get to grips with the biggest budget deficit in post-war history,"[31] there was no pretence that it was not a cost-saving exercise. The cut in Chinook numbers, despite previous criticism from Conservatives while in opposition over the lack of rotary lift, reflected the government's intent to curtail defence expenditure as part of a cross-departmental austerity programme. The order for the additional helicopters was placed finally with Boeing in August 2011, and totalled 14, not 12 as in the SDSR. The discrepancy may have been down to how the two attrition purchases were considered. An initial operational capability is due in early 2015 with delivery of all 14 expected by the end of that year.

Light Blue Merlin

While the 2009 rotary wing strategy gave with one hand, it took away with the other with regard to the air force rotary fleet. As part of the restructuring, the RAF Merlin HC3/3A fleet was to be transferred to the Navy as a replacement for the latter's Sea King Mk4s. The decision turned on its head a 1995 procurement choice to split the air force's "medium" transport fleet between the Chinook and the Merlin. The Medium Support Helicopter procurement was a microcosm of the clashing imperatives that have too often bedevilled UK military rotorcraft projects. Staff Requirement (Air) 434 emerged in 1992 to bolster the air force's existing inventory of Chinooks with additional airframes. The procurement choice was between buying more Chinooks or acquiring a support variant of the EH Industries EH101 anti-submarine helicopter, development of which was being funded by the British government. In

[30] UK Prime Minister, *Securing Britain in an Age of Uncertainty*, cit., par. 2.A.10.

[31] David Cameron, "Strategic Defence and Security Review", in *House of Commons Debates*, Vol. 516, Part 54, 19 October 2010, col. 797, http://www.publications.parliament.uk/pa/cm201011/cmhansrd/cm101019/debtext/101019-0001.htm#10101928000003.

announcing the eventual decision then Secretary of State for Defence Malcolm Rifkind said:

> The Government have concluded that a high priority should be placed on enhancing the tactical mobility and flexibility of our forces in the changed strategic environment. The Army has an operational need for additional support helicopters to enable it to meet its current and its prospective tasks.[32]

The "need for additional support helicopters" was to become a familiar refrain in the following decade. Even after the initial procurement, March 2007 saw the government purchase of further six Danish Merlin helicopters, known as the HC3A in the RAF, as part of its overall effort to bolster still inadequate rotary lift.

In the early 1990s, within the military there were differing approaches to fulfilling rotary lift needs, with some advocating acquiring greater numbers of a smaller class of helicopter rather than additional medium lift, while there were also suggestions of an Army interest in taking on the rotary support role from the air force. Rifkind justified the decision thus:

> We have concluded that, bearing in mind the increasing importance of retaining flexible forces, there would be advantage in operating a mixed fleet of utility EH101 and Chinook support helicopters. Following the parallel negotiations, we have therefore decided to procure 22 utility EH101 support helicopters and a further eight Chinook HC mark II aircraft. […] The EH101 is a modern design and offers advantages of operational flexibility. Those include commonality with the Royal Navy's Merlin helicopter, which will be of particular significance in land and sea-based operations. The EH101 will also provide a middle lift option between the Chinook and the Lynx light support helicopter, which will remove the need to replace Wessex with a new helicopter. The additional Chi-

[32] Malcolm Rifkind, "Medium Support Helicopter", in *House of Commons Debates*, Vol. 256, 9 March 1995, col. 461, http://www.publications.parliament.uk/pa/cm199495/cmhansrd/1995-03-09/Debate-1.html.

> nooks are required because some large loads can be carried only by that aircraft, which is a reliable and capacious helicopter, proven in Royal Air Force service. In addition, we are procuring a further six replacement Chinooks to maintain the current fleet, taking into account expected attrition losses.[33]

The Chinook element of the decision was to lead to the HC3 debacle for the Special Forces.

The Merlin was an "exquisite" design optimized to meet the original blue-water anti-submarine requirement to counter the Soviet threat perceived. The helicopter's three-engine configuration provided redundancy to allow continued operation in the event of a single engine failure. This however came at a weight and cost penalty. The selection to meet the Medium Support Helicopter was not popular unanimously within the air force, where the Chinook was liked.

Less than a decade after the Merlin HC3 entered RAF service in 2001, the decision was taken to rationalize the air force rotary lift inventory, the argument that had been overruled some sixteen years previously with the original decision to introduce the type into the air force inventory.

Puma

Consideration of a successor to the RAF's Puma began in the late 1980s, and after 20 years plus of deliberation the Defence Ministry has emerged with only an interim solution, at best.

Operated by two squadrons, the Puma entered the air force inventory in 1971. It is used for tactical lift providing troop and materiel transport. The Puma fleet is presently in the midst of a service life extension programme, that extends the out of service date to 2025.

The most recent Ministry effort to secure a long-term successor to the Puma was its Future Medium Helicopter project. This effort, however, was cancelled as a result of the 2009 Future Rotary Wing Strategy, and the funding redistributed amongst other elements of the future rotary programme.

[33] Ibid.

Announcing the Puma element of the strategy, Defence Minister Ainsworth told the House of Commons:

> The £300 million Puma life extension programme, which will deliver a step change in the aircraft's capability, will proceed, delivering vital battlefield lift capability for operations alongside Chinook until at least 2022. Beyond the retirement of Puma, we intend that the Ministry of Defence will operate four broadly equal-sized core helicopter fleets comprising Chinook, Apache, Wildcat and Merlin, with much smaller niche fleets for specialised roles. As a result of the measures set out above, we do not intend to proceed with the future medium helicopter competition.[34]

The niche fleet reference was a likely recognition of the preference British Special Forces have had for the Puma. With a smaller footprint than the Chinook, it offered easier operation in an urban environment, and the two side-door egress and entry was preferred by some to the large rear ramp of the Chinook. During Operation Telic Pumas were stationed in the Iraqi capital of Baghdad, with one of the detachment tasks to support special forces.

In keeping with an often ad hoc approach to fleet management, the Puma inventory was bolstered by the acquisition of six ex-South African Air Force airframes in 2002. The reason is the Ministry looked to manage the Puma until its then envisaged replacement was acquired, through what was known as the Support Amphibious Battlefield Rotorcraft (SABR). This project was intended to replace the Puma in RAF service, transport Sea Kings in the Navy, and search and rescue Sea Kings in both services. SABR was the result of the combination in 1999 of the air force's Future Support Rotorcraft and the Navy's Future Amphibious Support Helicopter.[35] By the end of 2013 seven HC2s had been returned to the air force, with all of the 24 to be upgraded back in air

[34] Bob Ainsworth, "Future Rotary Wing Strategy", cit.

[35] "RN/RAF support helicopter programmes merge", in *Flight International*, 13 October 1999, http://www.flightglobal.com/news/articles/rnraf-support-helicopter-programmes-merge-57122.

force inventory during the course of 2015. A similar upgrade to the Navy's transport Sea Kings, however, was shelved.

3.4 THE ROYAL NAVY DOCTRINE

The Royal Navy's "British Maritime Doctrine" argues that to meet national defence and security goals a balanced and "full spectrum" Navy continues to be required.[36] The Navy considers that it provides

> the backbone of the UK expeditionary capability by maintaining a maritime task force of naval air, surface, sub-surface, amphibious and associated joint assets that are capable of operating in the open ocean and gaining access to a contested littoral.[37]

In this context, the Fleet Air Arm is viewed as an "essential element of maritime power," covering the primary roles of "anti-submarine warfare, anti-surface warfare, troop carrying, airborne surveillance and area control, and search and rescue."[38]

A key element of the Navy's future expeditionary capability are two Queen Elizabeth-class aircraft carriers. "The Government believes it is right for the United Kingdom to retain, in the long term, the capability that only aircraft carriers can provide – the ability to deploy air power from anywhere in the world," argued the 2010 SDSR.[39]

The first ship, HMS Queen Elizabeth, is due to begin sea trials in 2017. The class will embark the multi-role Merlin Mark 2 helicopter which will be used to deliver both intelligence, surveillance, target acquisition and

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[36] UK Ministry of Defence, *British Maritime Doctrine* (JDP 0-10 Fourth Edition), August 2011, par. 324 ss., https://www.gov.uk/government/publications/jdp-0-10-british-maritime-doctrine.

[37] UK Ministry of Defence, *Future 'Black Swan' Class Sloop-of War: A Group System*, Joint Concept Note 1/12, May 2012, par. 117/D, https://www.gov.uk/government/publications/joint-concept-note-1-12-future-black-swan-class-sloop-of-war-a-group-system.

[38] UK Ministry of Defence, *British Maritime Doctrine*, cit., par. 333 ss.

[39] UK Prime Minister, *Securing Britain in an Age of Uncertainty*, cit., p. 5.

reconnaissance, and air-space management. The Navy's Maritime Doctrine Paper suggests that

> in the littoral manoeuvre, special forces or expeditionary roles, the Queen Elizabeth Class may carry a mixed air group comprising Chinook and Merlin support helicopters, Wildcat and Apache attack helicopters in support of a Lead Commando Group or other embarked landing force. This tailored air group can be shaped to provide either a strike focus with the ship carrying up to 36 Lightning II aircraft, or to act more as a landing platform helicopter with greater numbers of support and attack helicopters.[40]

3.4.1 The Royal Navy's Fleet Air Arm

The Royal Navy has to manage the replacement or upgrade of all of its rotary wing inventory within the Fleet Air Arm over the course of this decade, partly the result of decisions being deferred or previous helicopter capability plans being overturned. Its Merlin HM1 anti-submarine warfare fleet is in the process of being upgraded to the Merlin HM2. Its Lynx Mk8 maritime attack and utility helicopter will be replaced by the Wildcat HMA1. The Sea King Mk4 transport of the Commando Helicopter Force will be replaced by the Merlin Mk3/4, and the Sea King Mk7 Airborne Surveillance and Control helicopter will be replaced from 2020 with a new platform. The Sea King Mk5 search and rescue helicopter is to be withdrawn with the role surrendered to the commercial sector.

The Navy took delivery of the first five of the planned 30 Merlin HM2 helicopters in July 2013,[41] with the upgrade aimed at addressing obsolescence issues and intended sustain the platform's capabilities until the planned out of service date of 2029. The upgrade programme is primed by Lockheed Martin and includes the introduction of a new glass cockpit and an improved combat system. The HM2 is also aimed at making re-rolling of the Merlin easier, for tasks such as casualty evacuation or

[40] UK Ministry of Defence, *British Maritime Doctrine*, cit., par. 346 ss.

[41] Richard Scott, "UK receives first upgraded Merlin helos", in *Jane's Defence Weekly*, 24 July 2013.

troop transport. The increased flexibility will likely be welcome given that the Merlin ASW fleet is being reduced in size since not all of the HM1 are to undergo the upgrade.

The 2009 Rotary Wing Strategy scrapped the Future Medium Helicopter project, which would have provided a successor to the Sea King Mk4, and instead identified that the RAF's Merlin HC3/3A be transferred to the Navy. All Sea Kings were to be withdrawn from service by 2016.

The first unit to operate the Merlin HC3/3A, 846 Naval Air Squadron, is due to stand up during the course of 2014, while a navalised version of the HC3, to be known as the HC4/4A, is meant to be available from 2017.[42] Fleet Air Arm air and ground crew have been training with and jointly operating the Merlin HC3 with the air force since 2011-12. The modification programme would address obsolescence on the HC3/3A while also introducing folding rotors and tail boom to make the helicopter more ship suitable. As of the end of 2013, the conversion project had yet to be given Defence Ministry final approval.

Maritime power projection

As already mentioned, at the heart of the Royal Navy's future capability for power projection is the Queen Elizabeth-class aircraft carrier. Yet it has been the cause also for some considerable heartache, because of its cost, the nature of the aspiration inevitably been highly political, and a lightning-rod for the land versus maritime air power fundamentalists. In rotary terms the carrier will be capable of embarking and operating all of the Navy's helicopter types, and is intended to be able to carry the Army's Apache attack helicopter and the RAF Chinook.

The delays to the new-class of carrier have provided the Navy with some headroom, but it has still been unable to align fully the need to replace the Sea King MK7 Airborne Surveillance and Command (ASAC) helicopter with the introduction of a successor capability. The replacement effort was delayed further in the 2012 Planning Round of defence expenditure, as the government pursued a balanced defence budget. The

[42] Patrick Allen, "Royal Navy Stands down Sea King Training unit", in *Jane's Defence Weekly*, 16 December 2013.

MK7 is the latest iteration of surveillance radar-equipped Sea Kings going back to the first two airborne early warning helicopters in 1982. Several upgrades over the course of three decades have seen its capabilities broadened greatly, including in the Mk7 a ground moving target indication mode which proved of utility when the type was deployed to support operations in Afghanistan.

The replacement capability is being procured through what is known now as the Crowsnest programme, and previously as the Maritime Airborne Surveillance Capability. The latter looked at both rotary and fixed-wing options for airborne early warning and command and control. The eventual carrier configuration, and more fundamentally cost issue, were to rule out a fixed wing platform. Crowsnest is now envisioned as a role-fit kit for use with any HM2 airframe, ten of the kits are expected presently to be acquired with four to be available by 2020 and a full operating capability by 2022.[43] The first aircraft carrier, however, will enter service in late 2017, with the second to follow in 2019. The Navy will be without an organic airborne surveillance and ISR platform from 2016 until 2020.

Maritime Utility and Attack: Lynx Wildcat

The other rotary type that alongside Merlin will form the Navy's two long-term helicopter fleets, following the withdrawal of the Sea King, is the Lynx Wildcat HMA1. The Wildcat will replace the Lynx HM8 in the maritime attack and utility roles, while also providing a light multi-role platform for a range of other tasks including ISR, anti-piracy and policing. The Lynx HM8 is operated from Navy frigates and destroyers, and the Wildcat HMA1 will be operated from the Type 26 frigate, the first of class of which is due to enter the inventory in 2021. The Type 26 will also be capable of operating the Merlin. In keeping with the often scant appearance of coherence in the overall British rotary programme, securing a successor to the Lynx HMA8 was a more drawn out process than necessary. While the initial gate approval element of the Ministry's pro-

[43] Richard Scott, "UK seeds Crowsnest assessment work", in *Jane's Defence Weekly*, 18 April 2013.

curement process was reached in September 2002 for the Surface Combatant Maritime Rotorcraft, it was not until 2006 that the demonstration and manufacturing contract was let. Unlike the Army, however, which originally had ambitions to replace its Lynx fleet beginning in 2006, the Navy had always looked to the second decade of the century for a HMA8 replacement.

As part of its multi-role capability, the naval Wildcat will be capable of carrying the Future Anti-Ship Guided Weapon Heavy (FASGW[H]), the replacement for the Sea Skua missile. The missile is being developed by MBDA, with the project jointly funded by UL and France. The French version of the missile, known as Anti-Navire Legere, will replace the AS15TT. The in-service date of the FASGW-Heavy has been delayed as a result of difficulties in aligning British and French funding requirements and the formal launch of the project. Currently, it is not expected to be available until the start of 2018 at the earliest, rather than in 2015 as hoped originally. Complementing FASGW(H) is a smaller weapon to meet the FASGW (Light) element of the Royal Navy requirement. This is due to be met by the Thales Lightweight Modular Munition now in development.

Unmanned Rotary Capabilities

There is also interest in the potential of unmanned rotary systems within the military. The Northrop Grumman MQ-8 Fire Scout was part of the company's unsuccessful bid for the Watchkeeper requirement, awarded to Thales with a fixed wing UAV in 2005, while the Rotary Wing Unmanned Air System project is a research effort into the utility of a multi-role rotary UAV in the maritime environment.

In the context of the Tactical Maritime Unmanned Air System (TMUAS) project, in August 2013 AgustaWestland has been awarded a $3,6 million contract from the UK Ministry of Defence for a Rotary-Wing Unmanned Air System (RWUAS) Concept Capability Demonstrator (CCD) programme. The RWUAS CCD will be used for the development of concepts of operations (CONOPS), the impact of training and support necessary for TMUAS, its integration with ship safety management and embarked aviation assets including the AW-159 Lynx Wildcat and Merlin helicopters. The aircraft proposed by AgustaWestland as CCD is the

PZL-Swidnik Solo, Rotorcraft Unmanned Air System/Optionally Piloted Helicopter (RUAS/OPH) variant of the SW-4 helicopter that will be used for shipboard launch and recovery demonstrations. The helicopter will act as a concept for large and small maritime UAS operations, to define long-term requirements, and to demonstrate operational requirement.[44] The UK MOD plans to complete the CCD programme by March 2015 and to provide the Royal Navy with the RWUAS after 2020.[45]

3.5 SEARCH AND RESCUE: THE RAF AND ROYAL NAVY

Were ever a project to be ill-named it was the UK Search and Rescue Helicopter Harmonisation (SAR-H) effort, begun in 2005 to provide a follow capability once the RAF's Sea King HAR 3 and the Royal Navy's Sea King Mk5s are withdrawn from service. Controversial from the outset for a variety of reasons, the project was littered with mishaps, culminating in 2011 with the government being forced to cancel the contract with the winner of the competition as a result of "irregularities." On 16th December 2010, the Transport Minister Philip Hammond had to reveal to the House of Commons that the decision was on hold until the issue had been "clarified." A revised competition begun in November 2011, resulted in Bristow Helicopters emerging as the winner in March 2013 to provide UK search and rescue under a contract to be managed by the Maritime and Coastguard Agency.

From the outset moving the UK rotary search and rescue provision into private sector had proved divisive, an issue compounded by the aim of using the Private Finance Initiative (PFI) mechanism to support SAR-H. The extent to which PFI represents always best value for money remains contested. There was also suspicion that the move was motivated

[44] David Olivier, "The UK Rotary-Wing Unmanned Air System Takes-Off", in *Indian Defence Review*, 25 November 2013, http://www.indiandefencereview.com/?p=13451.

[45] "UK MoD moves ahead with RWUAS trial for Navy", in *Naval Technology*, 26 July 2012, http://www.naval-technology.com/news/newsuk-mod-moves-ahead-with-rwuas-trial-for-navy.

by the desire to avoid the direct procurement cost of having to purchase a replacement helicopter for the SAR role.

A less tangible, but nonetheless notable point, was that as the military continued to reduce in size then its points of contact with the public grew fewer. The search and rescue function for both the air force and the Navy was a valuable public relations exercise and provided the taxpayer with visibility of the military making a worthy contribution to the wider community.

The debate was also conflated in some military and ex-military circles with the UK's lack of an adequate approach to Combat Search and Rescue. There has been for many years a British aspiration to field a genuine CSAR capability as part of its Joint Personnel Recovery doctrine, and development work and trials have been carried out from time to time. Funding to fulfil such an aspiration has never been available. For Operation Ellamy two US Sikorsky HH-60Gs were embarked on HMS Ocean for combat search and rescue support.

Bristow Helicopters was to emerge in March 2013 as the winner of a further competition, providing a total of 22 helicopters, 11 Sikorsky S92s and 11 AgustaWestland AW189 (including a spare of each type) at ten sites around the UK. The company will begin to provide SAR services under the contract from April 2015, for a ten year period. An aspiration to include serving military aircrew that was part of the SAR-H project was dropped.

3.6 TRAINING

The Defence Helicopter Flying School provides single-engine training for all three armed services, and follow on twin-engine training for air force and Navy crew. It is in the area of training that the British military has adopted a dual-use approach to the types operated. Single-engine training is provided by the Airbus Helicopter AS350BB Squirrel HT1, with the twin-engine requirement met by the Bell 412EP Griffin HT1. Thirty four Squirrel and 12 Griffin helicopters are provided under the deal.

The DFHS was established as a result of the 1994 Defence Costs Study and was part of a broader programme of restructuring. The train-

ing service began in 1997, with an industry consortium of Flight Refuelling Aviation, Bristow Helicopters and Serco awarded a 15-year contract. This included the provision of helicopters and 40% of the instructors, operations support staff and flight systems operators. FB Heliservices, as the training consortium is known, was acquired by Cobham plc in 2013.

The DFHS contract was extended to 2016 in 2012 when the ministry decided not delay the rotary training element of the Military Flying Training System as a cost savings measure. The 20-year contract was budgeted at £400 million. Some form of request for proposals for a follow-on to the DHFS contract, however, may emerge from the Defence Ministry by the end of 2014.

The adoption of dual-use types for in the training environment provides cost savings, and the military is looking to secure further benefits by down-loading greater elements of conversion-to-role training likely as part of any follow-on contract to the DFHS. This approach has the obvious attraction of reducing the amount of operational squadron frontline flying hours required for initial role training. There will almost certainly also be an increased use of synthetic training to support all elements of the flying syllabus.

The Griffin helicopters are split between the DHFS, where there are eight, with three others at RAF Valley, where it is used for search and rescue training. Two AW109s are also operated from RAF Valley in support of role-specific SAR training.

The Army also leases six Bell 212HP for rotary support in Brunei and Kenya, the type was also used in Belize until 2011, proving search and rescue, medical evacuation and transport. The type has also been used to provide training for third party nations at the DHFS. The Bell 412EP Griffin is also leased, with four aircraft used for RAF SAR, MEDEVAC, and transport at Akrotiri in Cyprus.

3.7 LAW ENFORCEMENT AGENCIES AND EMERGENCY SERVICES

Moving to the civil sector, in recent years the most notable development in the provision of rotary support to the emergency services resulted

from the outcome of a 2010 government paper, focused on options for shifting from a regional to national organization for some police functions.[46] The paper built on a 2009 report commissioned by the Association of Chief Police Officers, which concluded that a national air policing strategy should be pursued. England and Wales had 43 police forces that had either operated their own rotary support or worked in conjunction with other forces in their own region. The National Police Air Service (NPAS) began to come into effect in June 2012 and was intended to start rationalize the patchwork of ad hoc regional capacity, and to return significant cost savings. It is meant to be fully in place by 2015.

As part of the restructuring, the number of helicopter bases was to cut as were the number of helicopters available to the police. The number of bases was to fall from 30 to 22 with the number of helicopters reduced from 33 to 27, including three spares. The proposed reductions and bases losses inevitably raise concern within the wider user communities as to the risk there would be an erosion in the quality of service available, including in response time depending on the base location. A similar set of concerns were raised with regard to the SAR privatization. A pilot of the proposed structure was carried out in 2010, by bringing together five local forces in Operation Borderless. In 2011, four regions brought together their air support units into what is now known as the Central Region, in line with the NPAS recommendations. The move to a national strategy remains under scrutiny, with concern continuing to be voiced over reductions in support.

There is no equivalent to the NPAS for air ambulance services, nor are these supported by government funding in England or Wales. Instead, 18 charitable trusts support the operation of 34 air ambulances in England and Wales. The Scottish government funds two air ambulances, with a charitable trust supported helicopter beginning operation in May 2013. Bond Air Services is the largest provider of air ambulances, with Specialist Aviation Services and Sloane Helicopters also involved. In 2012, about 25,500 missions were carried out. The Airbus Helicopter

[46] UK Home Department, *Policing in the 21st Century: Reconnecting police and the people*, July 2010, Ch. 4, par. 52, https://www.gov.uk/government/collections/policing-in-the-21st-century.

EC135 and the MD Helicopters MD902 form the bulk of the types in service in the UK.

3.8 THE DUAL-USE HELICOPTERS' OPTION

Recent military operations have reinforced the value of rotary platforms as force multipliers and the worth of highly trained and committed personnel. The Joint Helicopter Command has addressed some of the problems that have previously hampered the delivery of a coherent rotary capability. However, short-term political horizons and single service agendas even over the past decade have continued to hinder on occasion crafting an optimum capability. Weaknesses that were exposed by the need to rely on the urgent operational requirement mechanism to provide a theatre entry standard of helicopter for combat operations.

The heart of the British military's future rotary capability over the coming decade and beyond will consist of the Chinook, Merlin, Apache and Wildcat, with smaller numbers of likely dual-use types for training or niche roles. The extent to which the Puma fleet is run on beyond the present OSD of 2025 remains to be seen, however there is no indication presently of a 1:1 fleet replacement with a new type. The Puma HC2 programme will cost to the ministry £260 million, while the conversion of the 25 RAF Merlins to meet naval requirements will require £330 million. The Project Julius upgrade for the existing Chinook fleet is priced at £240 million, while the additional 14 CH-47s will cost £841 million.

Stability within the main military fleets will mean that in the near-to-medium term there is little scope for the introduction of dual-use rotary types within the core of the services helicopter capability. Whether an opportunity emerges to meet a possible Puma successor, and perhaps to address the helicopter requirements of the Special Forces with a combined civil/military design remains to be determined. Were such an approach to be adopted then the type would be purchased off-the-shelf, given the comparatively small numbers to be acquired.

The shift to core fleets of four types only provides the basis for greater coherence, but sustaining adequate numbers within each of these four fleets will be of importance if the capability shortfalls of recent campaigns are to be avoided in the future.

4.
The Dual-Use Helicopters Perspective

Alessandro Marrone and Michele Nones

4.1 TECHNOLOGY: CIVIL, MILITARY, OR SIMPLY DUAL-USE?

The reflection about the role of dual helicopters should be placed in a wider context, marked by the change in the way of generating scientific/technological knowledge and innovation, by the breaking down of the traditional barriers between the civilian, military and security sectors,[1] and by the related implications both for final users and industry.

The starting point is the processes by which knowledge of a scientific and technological nature is created, accumulated and used. From the 1990s onwards, such processes have witnessed the growth of "generic," rather than "specific," modalities for the creation of knowledge, i.e. modalities that connect diverse sectors and that create scientific/technological heritages which can be used for a wide range of applications.[2] In some sense, the "design space," the space in which such processes take place, has become more open, being supported by a basis of more widely-shared knowledge:[3] the IT and telecommunications revolution was fundamental

[1] A detailed analysis of the security sector, and the market connected to it, is outside the scope of this study. For a treatment, see IAI, IRIS and University of Manchester, *Study on the Industrial Implications in Europe of the Blurring of Dividing Lines Between Security and Defence*, June 2010, http://ec.europa.eu/enterprise/sectors/defence/files/new_defsec_final_report_en.pdf.

[2] Andrew D. James (ed.), *The Future Impact of Security and Defence Policies on the European Research Area. Final Scientific Report*, May 2011, p. 29, https://sandera.portals.mbs.ac.uk/Portals/65/docs/D5.2-Final%20Scientific%20Report.pdf.

[3] See, amongst others, Rikard Stankiewicz, "The Concept of 'Design Space'", in John

in this sense, allowing for the sharing of information at both inter-sectoral and international levels. More in general, the development of electronics has played a prominent role in all sectors, both at the level of the technology of products and of the technology of process. The use of electronic components and devices has become widespread in all equipment and its production, while electronic systems have become increasingly more important in the fields of defence and security. The great mobility of human capital – scientists, technicians and entrepreneurs – seen in the global economy in the post-Cold War period and crucial to this process[4] has further accentuated this evolution, creating or reinforcing international networks between different centres of research and scientific/technological innovation, both public and private.

The general change in the process of creation, accumulation and use of knowledge of a scientific/technological nature certainly had an impact on the defence industry, which is traditionally marked by a high technological content. During the Cold War, research and innovation in the defence field were "vertically" integrated, from the supplier of components to the integrator of systems, and arranged exclusively for the satisfaction of requirements set by the committing government, while being isolated from Research and Technology (R&T) activities carried out in the civilian sector. With the end of the Cold War and the above-mentioned growth of generic modalities for the creation of knowledge, of which Information and Communication Technology (ICT) is one of the leading examples, restrictions on the international trade in arms systems and products with a high technological content were broken down or became less, and with them various barriers between the civilian and military sectors, as well as between the different national defence markets.[5] In Europe, the dividing line between the civilian, defence

Ziman (ed.), *Technological Innovation as an Evolutionary Process*, Cambridge, Cambridge University Press, 2003, pp. 234-247.

[4] See, amongst others, AnnaLee Saxenian, "The Age of the Agile", in Samuel Passow and Magnus Runnbeck (eds.), *What's Next? Strategic Views on Foreign Direct Investment*, Stockholm, ISA with UNCTAD and WAIPA, 2005, pp. 46-53, http://www.ischool.berkeley.edu/~anno/Papers/The_Age_of_the_Agile.pdf.

[5] On the opening of national markets and the international integration of the defence market, see, amongst others, Germano Dottori and Alessandro Marrone, "Il mercato

and security sectors became less clear and more permeable, with an increased convergence at the technological level between the three fields, and a certain overlap between the security and defence sectors.[6] Whereas in certain cases R&T and Research and Development (R&T) activities are more at the cutting-edge in the defence field, in other cases it is instead the civilian sector which is pushing the scientific/technological boundary, and there are many more connections between the two fields than in the past.

The actors in the defence market, both institutional actors on the demand side and industrial actors on the supply side, have sought in past years to adapt themselves to the new reality brought about by the change in the processes by which scientific/technological knowledge is generated. For example, various European governments have tried to put in place strategies to exploit technologies of civilian origin for military ends, and to promote synergy between the security and defence sectors.[7] In some cases, such as the UK, Germany and Italy, attempts have also been made to develop a national research agenda for the security sector. Governmental research centres in the defence sector have established relationships with the wider civilian and international scientific community, and the procurement agencies of the Armed Forces have given more thought to the acquisition of products of civilian origin, if not directly "off-the-shelf" purchases on the international market.

In this context, in the post-Cold War period, awareness has developed of the fact that technology in itself is neutral, i.e. that it is neither intrinsically "civilian" nor military: rather, it is its application that can fulfil purposes and activities of a civilian, security or defence nature. As observed with a spike of irony, but not without reason, by a senior Italian Army official, "even the canon is a dual technology, given that the one on the Gianicolo in Rome is used to strike midday".[8] The intrinsically neutral, or

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mondiale della difesa tra geopolitica e globalizzazione", in Claudio Catalano (ed.), *Baricentri: lo shift globale degli equilibri politici, economici e tecnologici?*, Rome, Finmeccanica Occasional Paper, October 2010, pp. 72-86, http://www.finmeccanica.com/documents/10437/7958427/body_OP_Baricentri_ita.pdf.

[6] Andrew D. James (ed.), *The Future Impact of Security and Defence*, cit., p. 30.

[7] Ibid., p. 31.

[8] Interview, Rome, 5 March 2014.

dual civilian-military, character of technology is particularly clear when technology is defined as a totality of theoretical and practical knowledge, know-how, ability and artefacts used to develop, produce and supply products and services.[9] The final products for users in the military, civilian or security fields can clearly be very different between themselves, but are supported by the same basis of scientific/technological knowledge.[10] Nevertheless, the "place of origin" of the technology, for example if it has been developed in the civilian or military field, influences to a certain extent the way in which it is spread and used.

Various attempts have been made in Europe to map the technological panorama, including in relation to the possible civilian-military applications of the various technologies. A first category of analysis can be found in the distinction made by certain experts between three technological levels as regards military procurement: platforms and integrated systems; subsystems; and components.[11] The most basic level, namely that of components, is the one nearest to the intrinsically neutral technological base, and in theory, is more greatly dual as concerns civilian or military applications. Vice versa, the highest level, namely that of platforms and integrated systems, being the one most connected to the requirements expressed by the Armed Forces, presents in theory a lesser dual character, being designed deliberately in order to satisfy those requirements. The level of subsystems is located mid-way between the two extremes.

A deeper analysis was undertaken in 2006, with the launch by the European Commission of a study entitled "Stakeholders Platform for Supply Chain Mapping, Market Condition Analysis and Technologies Opportunities" (STACCATO), whose final report developed a taxonomy

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[9] Robert A. Burgelman and Richard S. Rosenbloom, "Technology Strategy: An Evolutionary Process Perspective", in Robert A. Burgelman and Richard S. Rosenbloom (eds.), *Research on Technological Innovation Management and Policy. Vol. 4*, Greenwich and London, JAI Press, 1989, pp. 1-23.

[10] See, amongst others, John A. Alic et al., *Beyond Spinoff: Military and Commercial Technologies in a Changing World*, Boston, Harvard Business School Press, 1992.

[11] ECORYS, *Study on Civil Military Sinergies in the field of Security*, May 2012, pp. 10-11, http://ec.europa.eu/enterprise/policies/security/files/doc/study_ecorys_cimisos_final_report_en.pdf.

of technologies, which was then taken up by other studies carried out for the EU institutions.[12] In this taxonomy, the following categories of technology are considered particularly apt for use by military and security sector parties: 101 Light and strong materials, surface treatments; 104 Survivability and hardening; 106 Plasma technology; 107 Energy generation storage and distribution; 109 Optoelectronics: laser, optics and related devices; 114 Artificial intelligence and decision support; 119 Physiology science and medical technologies.[13] The following other categories of technology are held to be apt for use not only by military or security sector parties, but also by civilian users: 100 Structural materials/technologies and structural effects analysis, including the composite materials; 108 Photonic/optical materials and device technology, i.e. technologies for the generation, emission, modulation and individualisation of light; 110 Sensor technologies and components, from infrared sensors to optical or acoustic ones; 111 Electronic components, the combination of which is at the basis of the most complex electronic systems; 115 Simulation tools & softwares, used for training the personnel of different entities and institutions, military and civilian; 117 Information security technologies, which ensure the decryption and integrity of data; 121 Biotechnologies, in particular for the examination of biological agents, the execution of tests, and decontaminations; finally, the totality of Signal processing technologies (112), Information technologies (113), Computing technologies (116) and Communication technologies (118),[14] which have become the examples par excellence of fundamental technologies for a very wide range of applications in the civilian, security and defence sectors, especially in the last sector compared with "network enabled capabilities".[15]

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[12] STACCATO, *Executive Summary of the Final Report Study*, September 2008, http://pubblicazioni.iai.it/pdf/Economia_difesa/STACCATO_Final-Report-Executive-Summary.pdf.

[13] IAI, IRIS and University of Manchester, *Study on the Industrial Implications in Europe*..., cit., p. 77.

[14] Ibid., pp. 78-81.

[15] On the net-centric transformation of the Italian and European Armed Forces, see, amongst others, Michele Nones and Alessandro Marrone (eds.), *The Transformation of the Armed Forces: The Forza NEC Program*, Roma, Nuova Cultura, October 2012 (IAI Re-

More specifically, concerning these categories of technology, one can see a greater degree of interaction between the R&T and R&D activities carried out in the various sectors, with a transfer of technology from the military field to the civilian and vice versa – the so-called "spin-offs". The first type of spin-off – from the military to the civilian – has been widely studied, as well as rigidly regulated for reasons of national security, already during the Cold War, and boasts of among its examples Internet, which was initially developed at the request of the US Department of Defence as a network to connect the computers of the US' military installations; and the well-known Global Positioning System (GPS). The second type of spin-off represents a relatively recent phenomenon that gathered pace from the 1990s onwards, and which is still in evolution. At the beginning of the 2000s, certain academics were emphasising how the rhythm of innovation in a series of civilian sectors field had overtaken that in the military field, and that products developed for the former market were providing a better price-quality relationship than similar products developed specifically for military clients.[16] Today, one can argue that the transfer of technology from the civilian and security sectors to the defence sector depends on at least three factors: in the first place, the nature of the technology in question and the perception that military users have of it; furthermore, the capacity of companies, in particular those which do not belong to the defence industry, to propose such technologies to the Armed Forces; and finally, the strategies available to users in the security sector to get close to such technologies.[17] For example, in the case of ICT, the most cutting-edge technology is produced by civilian companies for the civilian market, but the Armed Forces of the principal NATO states prefer the integration of ICT in military equipment to be carried out by defence companies, which act therefore as prime contractor and avail themselves of civilian suppliers/ subcontractors. This was, for example, the case of the Falcon programme for

search Papers No. 5), http://www.iai.it/en/node/1387.

[16] Jordi Molas-Gallart, "Coping with Dual-Use: A Challenge for European Research Policy", *Journal of Common Market Studies*, Vol. 40, No. 1 (March 2002), p. 157.

[17] IAI, IRIS and University of Manchester, *Study on the Industrial Implications in Europe*…, cit., p. 90.

the modernisation of the telecommunications network of the British Armed Forces, managed by British Aerospace System, a defence company, with a crucial contribution from civilian partners, such as CISCO Systems. It is also the case of the combat aircraft F-35 Joint Strike Fighter, which is characterised precisely by an elevated net-centric capability, and which is produced by Lockheed Martin, but whose processor – its IT heart – is developed and produced entirely by Intel and no longer made "in house" by a defence company, as was still the case of the F-22 fighter jet. If, on the one hand, there is already the awareness on the part of the Ministries of Defence of a great number of NATO states of the need and the opportunity to integrate technologies – and companies – from the civilian and security sectors in military procurement programs, inter alia in order to acquire the results of technological research carried out by the more profitable global civilian market, there is equally a concern to ensure Security of Supply (SoS) and the "integrity" of the technology acquired,[18] in particular in terms of software that cannot be acquired sic et simpliciter from any old supplier on the market.

An attempt to map the spin-offs between the security and defence sectors was made by another study commissioned by the European Commission and published in 2012.[19] According to this study, despite the difficulty of gathering data on technologically-advanced R&T and R&D activities for reasons of both security and industrial competition, from the case studies examined it emerged that the highest number of spin-offs occurs in the sub-sectors of sensoristics, Command, Control and Communication (C3), network-enabled capabilities, and platform integration; other significant spin-offs occur as regards training & simulation, Chemical Biological Radiological Nuclear Explosive (CBRNE) protection, and protective clothing.[20] Spin-offs occur from the defence sector to the security sector, for example with technologies developed for military purposes used also in the fight against international terrorism, and vice versa. A great number of the spin-offs analysed by the study did not occur because the producing company had deliberately developed a

[18] Ibid., p. 92.

[19] ECORYS, *Study on Civil Military Sinergies in the field of Security*, cit.

[20] Ibid., p. 12.

technology that could have applications in both the security and the defence fields, but because the opportunity had been grasped to sell an already-available technology in another sector.[21] This is particularly the case of companies that, while operating in the security sector, also have a certain awareness of the defence sector, whereas the spin-offs from the civilian sector directly to the military sector are more limited. One should also note that today, the European defence companies present also in the civilian sector count on the profitability of the latter to finance research and development activities for dual technologies, from which the military sector also benefits.[22]

The various studies published on the issue are fairly unanimous in concluding that the greatest obstacles to spin-offs, and in general to the synergies between the civilian, security and defence sectors achievable through the use of dual technologies, occur on the demand side rather than on the supply side of this complex market. Indeed, the panorama made up of the Armed Forces, the law enforcement and emergency services authorities, and civilian/private parties is extremely fragmentary and diversified. In the first place, there is a difference of approach between military users and those from the security or civilian fields: the former are more used to setting requirements and to launching medium- to long-term procurement programmes that lead to the acquisition of products and platforms specifically designated to satisfy those requirements; the latter, on the other hand, are more likely to acquire "off-the-shelf" products on the market insofar as they have less stringent requirements or attribute greater importance to the price-quality relationship (and to the speed of the procurement process), rather than only to the performance of the acquired product. Secondly, there is a fragmentation on the demand side in the security field, for example between the various police forces and authorities responsible for law enforcement and emergency services, which makes it more difficult to achieve convergence of the requirements in this field with those of the defence

[21] Ibid., p. 13.

[22] Daniel Fiott, "The three effects of dual-use: firms, capabilities and governance", in *ISSUE Briefs*, No. 21 (July 2014), p. 3, http://www.iss.europa.eu/uploads/media/Brief_21_Dual_use.pdf.

field, where also there is often some differentiation, for example between the Air Force, the Navy and the Army. Thirdly, there remains a certain reciprocal diffidence between the experts and scientific communities of the different fields, and in particular between the civilian and military sectors, which is also the heir of the extended period of separation between the two fields that goes back to the Cold War.

In this context, beyond the above-mentioned national efforts to strengthen and exploit the synergies between the different sectors, one should note the role played by the various institutions of the European Union. The inclusion of the "security" theme in the European Commission's Seventh Framework Programme for the period 2006-2013, the main instrument of financing for scientific and technological research in the EU context, and the subsequent insertion of the Common Security and Defence Policy (CSDP) theme in the eighth framework programme, renamed in the meantime "Horizon 2020" (even if only as a Preparatory Action), show the desire of the Commission to contribute concretely to the synergy between the civilian, security and defence fields in Europe. This desire is testified also by various directives and communications adopted in recent years, among which the most recent in July 2013, entitled "Towards a more competitive and efficient defence and security sector."[23] At the same time, the establishment of the European Defence Agency (EDA) in 2004, and its strengthening as an EU institution by the Treaty of Lisbon in 2009, have created the embryo of a partner in the defence field for the activities carried out by the Commission in the civilian and security fields. Not by chance did the EDA and the Commission initial in 2011 a Framework Cooperation Agreement to coordinate their respective R&T and R&D activities, starting from certain sectors such as CBRNE. Furthermore, some of the EU's Structural Funds are now available for small and medium-sized enterprises (SMEs) that invest in dual-use technologies.

Overall, however, the role of the European institutions in this field remains limited, and set in a gradualist and medium-term perspective

[23] European Commission, *Towards a more competitive and efficient defence and security sector* (COM(2013)542), 24 July 2013, http://eur-lex.europa.eu/legal-content/en/TXT/?uri=celex:52013DC0542.

that has not achieved any leap ahead in quality in recent years. The investments so far granted by the Horizon 2020 programme to dual technologies have been reduced, and the European Council of December 2013, which tackled defence questions, made few commitments, vague and distant in time, as regards the investment necessary in both the dual and the strictly military fields.[24] This means that, without a change in attitude on the part of the various national and European actors, research in Europe in the dual and military fields will continue to suffer a lack of public financing.

4.2 COMMON ELEMENTS AND PECULIARITIES OF THE CASE STUDIES IN NATO AND EU CONTEXTS

The factors examined in the previous section have affected certain defence sub-sectors, such as airspace, electronics, sensoristics, and network-enabled capabilities, as well as niches such as that related to CBRNE, particularly strongly. Other fields have been similarly influenced to a lesser, or a different, degree.

In the case of helicopters, the case studies analysed – Italy, France and the United Kingdom – present both common elements and national specificities in the approach to the rotary wing, in particular as regards the possible role of dual helicopters.

Above all, from the three cases analysed, it can be seen that, in the face of a common tendency towards a reduction in rotary-wing fleets, a process of improvement in the operational capabilities of helicopter assets is taking place, and this is the fruit of the development of technologically more advanced and better-performing machines. This is evident from all three cases, but it is particularly clear in the French and Italian ones, where the rotary-wing component of the Armed Forces, in particu-

[24] On the decisions taken by the European Council of December 2013, and generally by EU and national actors in the defence field, see Alessandro Marrone and Alessandro R. Ungaro, *Actors in the European Defence Policy Area: Roles and Developments*, Turin, Centro studi sul federalismo (CSF), November 2014, http://www.iai.it/en/node/2331.

lar Army Aviation (Aviazione dell'Esercito), will undergo a noticeable contraction in quantitative terms: for example, under French military programming legislation, the number of aircraft will decrease from the 314 currently available to the Army to 255 by 2019. Likewise, in Italy, measures taken as part of the reform of the Armed Forces foresee a reduction in the Army's fleet from 250 to around 160 aircraft over the next ten years. In both countries, however, a reduction in numerical terms of the helicopter fleet appears to be accompanied by developments in the machines' operational and technological capabilities, for both those helicopters already in issue, and those that will be purchased.

A further common aspect concerns the law enforcement authorities and the emergency services. In each of the three countries, for example, the actors and competent authorities are multiple and diversified in different structures, thus determining inefficiencies caused also by the complexity of defining "who does what" in terms of competences, functions and territorial responsibilities. This has without doubt led to a certain degree of duplication in rotary-wing assets on the "demand" side, but, at the same time, it has contributed to the development of a significant market in each of the three countries, concerning the "supply" side, for example in terms of the portfolio of orders. The long-lasting European economic crisis has raised awareness among the political classes of the need to rationalise rotary-wing assets across the law enforcement authorities and emergency services. As a result, each country has followed its own path, sometimes adopting controversial and unusual methods such as the out-sourcing of national SAR functions to the private sector, as in the British case. More traditionally, France and Italy have found solutions within the public sector, for example by attempting to introduce a single helicopter for different agencies, with the aim of obtaining conspicuous savings and making the state law enforcement and emergency services "machine" more efficient and sustainable.

To this end, it should be noted that there is greater interest on the "supply" side than on the "demand" side: while the industry is well aware of the advantages in terms of efficiency and productivity of a reduction in the range of products and of the connected increase in production volumes – thereby lowering unit costs – as far as users/clients are concerned, one can still see a certain predilection for a "customisa-

tion" of the product on the basis of specific requirements, and with logistics and training that are to a certain extent dedicated and autonomous. As underlined in Chapter 1, it was only in 2009 that at the time Home Secretary launched a project for the harmonisation of the helicopter fleet of the law enforcement authorities and emergency services, a project that was not completed. However, the lasting reductions in defence budgets, and to a certain extent also in the funds for the law enforcement authorities, could lead in the near future to a rethinking of the above-mentioned predilection for "customisation," with a view to rationalise expenditure.

This said, the key question is what could be the approach of the three countries to the possible role of dual helicopters, in the light of the above-mentioned contraction, current and probably future, in national defence budgets, and the increasing attention being paid to operational, technological and industrial synergies between the civilian and military fields. The answer is not identical, insofar as orientations appear to vary between countries.

For example, 100% military aircraft, such as the Chinook, Merlin, Apache and Wildcat, will still represent the heart of the British Armed Forces' helicopter capabilities, while dual-use platforms will continue to be used especially for training tasks – see the Defence Helicopter Flying School case – as well as for utility tasks. The medium- to long-term tendency of the English seems to prefer a military approach, leaving little room for possible opportunities in the field of dual helicopters.

Going from one extreme to the other, French Army Aviation has historically relied on civilian-designed platforms developed and produced by Eurocopter, such as the SA-340 Gazelle and the SA-330 Puma, which have been "militarized" and equipped with time to the extent they have become the fulcrum of air combat capabilities for many years. The French rotary-wing fleet is currently made up of both legacy assets and a new-generation helicopter component of purely military design (AH Tiger and NH-90), and it carries out combat, military utility and law enforcement tasks. What is interesting for the purposes of this study is the programme for the acquisition of a four/five-ton helicopter, in relation to which France appears to be strongly intentioned to adopt a dual helicopter as a solution, with the intention of converging technical and op-

erational requirements of the three Armed Forces in a single joint programme, thus renovating part of the legacy fleet. The machine should be equipped with the following features: versatility; the capability to incorporate any military device considered necessary; and, finally, the capability for usage in permissive or semi-permissive environments, with the possibility of further developments allowing for deployment in non-permissive environments as well. Although there are various options on the table (the programme has indeed been postponed beyond 2019 for further reflection and in-depth analysis), the decision should be for an "off-the-shelf" dual helicopter, which in any case will not be in service before 2025-2030. It is possible that the increase in the costs of military rotary-wing programmes has made the dual option a better answer for future procurement needs. For example, in the context of training this is already clear, and certain analogies with the British case study can be detected, proving that the dual concept is of particular use in the training sector: the French consortium Helidax provides, and it will do so over the next 20 years, for the initial training of pilots through the use of civilian EC-120B helicopters specifically adapted for military training. Finally, the search for civilian-military synergy is visible also in normative terms: the Directorate for State Aeronautic Safety (Direction de la Sécurité Aéronautique d'État) has been established and empowered to develop military regulations that are, as far as possible, coherent and synergetic with civilian rules in terms of air-navigability, air traffic, air space and the management of airports.

Italy seems to be taking a middle way between the opposing positions of France and the UK towards dual helicopters, with interesting prospects for the Armed Forces. The case of the AW-139 appears paradigmatic. The aircraft is currently in use by the Air Force, which was the first domestic user to employ on the battlefield, and therefore to test a helicopter that can be described substantially as a dual one. The machine, denominated HH-139A, a militarised version of the AW-139 civilian platform, was originally chosen as an ad interim or "gap filler" measure while waiting for the purchase of a medium helicopter, in the eight ton class, as part of the Air Force's Medium Helicopter programme (Elicottero Medio dell'Aeronautica, EMAM). At the moment, the models at disposal are principally used for SAR tasks on the national territory,

and given the budget restrictions and the reduction in allocations applying to the EMAM programme as well, it is highly probable that the HH-139A will remain in service for some years to come, no longer filling its original "gap filler" role, but evolving as an aircraft in permanent and stable issue to the Armed Force. The discussion of the HH-139A revolves around the possibility of employment not only for SAR tasks on the national territory, but equally for more demanding missions, including in semi-permissive or non-permissive environments. On the one hand, the qualities and performance of the aircraft, which is already tested and in service with other national civilian and military entities, would appear to suggest a positive evolution towards other contexts and operations. For example, we should note the versatility ensured by the possibility to change quickly the aircraft's internal configuration to carry out diverse roles such as SAR, MEDEVAC and utility. On the other hand, however, a certain degree of caution seems still to subsist, above all among the Armed Forces, perhaps because they are used always to operate with other forces of military design, often of obsolete planning, but that over time have demonstrated reliability and safety. Nevertheless, if we compare certain machines used in the operational theatre – such as the AB-205 or the AB-212 – to more modern dual machines like the HH-139A, the former may well be of military conception, but are designed to 30- or 40-years old standards, which have by now been surpassed; the latter, instead, incorporate technological solutions that are a great deal more advanced, without affecting the "weight" component.

By way of demonstration of what has just been described, on the other side of the Atlantic, in the US, the AW119Kx commercial helicopter, built by Finmeccanica-AgustaWestland in their American premises in Philadelphia, is preparing itself to be one of the candidates to replace the US Navy's current helicopter fleet for training tasks.[25] Nevertheless, a helicopter of civilian conception by itself could potentially already satisfy the US Navy's particularly stringent training requirements at a notably lower cost than military aircraft, and without the need to make ad-

[25] Marcus Weisgerber, "AgustaWestland Pitches AW119 for US Navy Helicopter Trainer", in *Defense News*, 7 April 2014, http://www.defensenews.com/article/20140407/DEFREG02/304070033.

justments or substantial variations to the aircraft. As long ago as 2006, the US Army launched the acquisition of the Lakota UH-72, a helicopter for utility tasks of civilian derivation and produced by Airbus Eurocopter, of which more than 300 units are currently in service within the American Army.

Defence procurement developments in the US are relevant for European countries like Italy, which operate in international missions alongside Western allies and which participates in the Atlantic Alliance. NATO in its turn, and to a certain extent also the European Union are two actors that are contributing in different capacities to the reflection on how to make the helicopter a more effective, efficient, interoperable and deployable instrument, mainly through NATO's Helicopter Inter-Service Working Group (HISWG) and Joint Air Power Competence Centre (JAPCC), and the European Defence Agency (EDA).

The Atlantic Alliance's HISWG operates within the NATO Standardization Agency (NSA), and is one of the main fora for the development of the reference doctrine for the Armed Forces of the Member States, particularly for land forces. The main publication, fruit of the HISWG's labours, is ATP-49 "Use of Helicopters in Land Operations."[26] Furthermore, as recognised also by the JAPCC, operations in Iraq and Afghanistan have underlined the unique capabilities that helicopters are able to offer as force multipliers in asymmetrical operations theatres and others. Nevertheless, according to NATO's analysis, the lack in the Member States of rotary-wing assets and crews (above all in terms of tactical lift), which are capable of operating in extreme climatic and operational conditions, has gradually become clear.[27] With a view to strengthening NATO's helicopter capability, the JAPCC notes how international cooperation in the helicopter field is particularly hindered by the absence of

[26] NATO, *Use of Helicopters in Land Operations* (ATP-49(C) Vol. 1), March 2000, http://www.Navy.mi.th/navedu/stg/databasestory/data/laukniyom/ship-active/big-country-ship/United-States/ATP/atp49c1.pdf. See also Vol. 2, http://www.Navy.mi.th/navedu/stg/databasestory/data/laukniyom/ship-active/big-country-ship/United-States/ATP/atp49c2.pdf.

[27] NATO Joint Air Power Competence Centre, *Enhancing NATO's Operational Helicopter Capabilities. The Need for International Standardisation*, August 2012, https://www.japcc.org/?p=112.

"implemented international operational standardisation for helicopters."[28] Specifically, criticisms are expressed as regards capability and training, which have not been fully acquired or assimilated by a significant number of NATO Member States. A solution should principally be sought within those same Member States that should apply leverage to the interoperability issue in order to improve multinational rotary-wing operations.

In the strictly European context, the EDA plays the most significant role, facilitating and assisting cooperation between Member States in the field of defence. As long ago as 2009, Javier Solana, at the time the EU's High Representative, and head of the Agency since 2004, underlined the usefulness of helicopters for both the civilian and the military operations of the European Union, since they were able to offer flexibility of use, mobility and rapid response capability.[29] At the same time, however, certain important criticisms were raised, concerning not so much the availability per se of the machines on the European panorama, as their ability to be deployed outside the Old Continent in operational theatres where, for example, the orography or the lack of adequate security levels for communication networks lead to ever more requests for the employment of such assets. It was not by chance that, in November 2009, the EU Ministers of Defence approved the EDA's "Helicopters Training Programme" initiative, with the aim of increasing the short-term availability of rotary-wing assets for crisis management operations. In consultation with the Member States, the EDA identified various critical areas, such as lack of technical equipment and of logistical support, reserving particular attention for the training sector, insofar as it was considered to be a determinative element of such a deficit in capabilities. Indeed, a certain coherence and concordance seem to be emerged with what has been indicated at NATO level by the JAPCC. In brief, the HTP can be conceived as an "umbrella" programme aimed at allowing Member States to develop, consolidate and share best practices

[28] Ibid.

[29] Javier Solana, *Opening address at the EDA Conference "Helicopters - Key to Mobility"*, Brussels, 10 March 2009, http://www.consilium.europa.eu/uedocs/cms_data/docs/pressdata/en/esdp/106566.pdf.

in the helicopter field, and thereby to confront the challenges presented by current and future operations theatres. Among the EDA projects forming part of the "umbrella" HTP programme, it is worth mentioning the Helicopter Exercise Programme (HEP), agreement signed by 13 EU Member States in 2012.[30] HEP proposes evaluating the operational competences of European rotary-wing crews by means of, in the first place, a series of multinational exercises,[31] which are predicated on training carried out individually, jointly and in the operations theatre. Helicopter Tactics Symposia are the second pillar, and an integral part of the HEP programme. These represent an opportunity to share experience gained on the battlefield, and to develop common tactics, techniques and procedures through the consequential improvement of, and increase in the level of interoperability between the parties involved.

By way of illustration of the importance of duality in the European field, the EDA, in collaboration with the European Aviation Safety Agency (EASA), is furthermore active for what concerns the issue of certification as a fundamental matter, which has not yet been fully exploited in the search for synergies between the civilian and military fields. The grant of a civilian certificate is the starting-point for the later military certificate as far as the national authorities are concerned. The agreement concluded by the EDA and the EASA in June 2013 goes in this direction, and aims at the harmonisation of safety requirements for military aviation, above all as regards air-navigability.[32]

[30] Together with the HEP initiative, the "umbrella" HTP programme covers the following projects: Helicopter Tactics Instructors Course (EHTIC), Helicopter Tactics Course (HTC), Operational English Language Course (OELC), and, finally, Distributed Simulation.

[31] Such as, for example, GAP 2009 (France), Azor 2010 (Spain), Italian Call 2011 (Italy), Hot Blade 2012 (Portugal), Green Blade 2012 (Belgium), and Hot Blade 2013 (Portugal). Overall, between 2009 and 2013, 123 helicopters, 794 crews and around 5,000 technical support experts were used in the exercises.

[32] The case of the A400M, certified in civilian configuration by the EASA, is a classic example of this.

4.3 THE OPPORTUNITY OF DUAL-USE HELICOPTERS

When one compares the situation in the helicopter field in the three cases of study to the more general context of the scientific/technological innovation of the defence sector, one is struck by the low level of awareness of the opportunities presented by the possible use of dual-use technologies and platforms, i.e. the dual helicopter option. In order to understand these opportunities, it is necessary first and foremost to clarify what is meant by the term "dual helicopter."

The technological term "dual" refers to technology applicable for both military and civilian purposes. In this sense, a technology is dual when, starting from a common scientific/technological base, it is possible to switch its "configuration" and thus the nature of its purpose (either civilian or military) with timely and limited changes. Analogously, dual helicopters are not simply civilian helicopters used for military missions: they are platforms that, starting from the design phase, comply with certain standard, and are structurally prepared so as to be capable of being used by civilian, military or law enforcement entities with limited modifications or integrations. The common technological base, which is design-related and systemic, is ensured by the high standards achieved in the civilian market in order inter alia to comply with the extremely stringent safety and crashworthiness requirements set by national and international authorities as regards, for example, the following features: redundancy and duplication of systems to ensure safety in the event of the breakdown of certain key systems; Health and Usage Monitoring Systems (HUMS), which increase the safety of the helicopter by monitoring its most sensitive parts and which improve its overall management, because the information gathered on a regular basis are used to program the helicopter's maintenance making it more efficient; and avionics, Situational Awareness and man-machine interfacing, which benefit from the progress achieved in ICT in recent years in the civilian field that is more recent than the design and, in many cases, the production of the military helicopter fleet currently in service. Such a common technological base represents a leap forward in quality compared to military machines used for civilian purposes, or vice versa; we are talking about designing a dual helicopter ab origine, by preparing it

for an improved and more efficient optimisation for the uses that will be made of it in the military, civilian and security fields – and therefore for the missions that it will have to carry out.

Therefore, the crucial point is the evaluation of the dual helicopter option against the missions to be carried out in particular, but not only by the Armed Forces. In fact, if there is a common technological base, then this is sufficient and it does not present insurmountable obstacles; the questions to be answered concern the safety, effectiveness and efficiency of the use of dual helicopters in the various military missions. Certain general observations can be made as regards these three aspects.

In the first place, the safety aspect is double. On the one hand, it refers to the safety of the machine itself in its routine activities, in the absence of any external threat, and in this case – as previously argued – civilian standards are increasingly comparable to military ones, so much so that, at the European level, work is being done on the definition of hybrid certifications. On the other hand, by "safety" is meant active or passive protection from intentional threats, i.e. enemy fire in the theatre, from land or from the air, and in this case it is necessary to distinguish between the use of the helicopter in permissive, semi-permissive and non-permissive environments.[33] As a rule, the national territory is considered permissive, whereas permissive or semi-permissive environments can often be found in international missions, for example in cases of humanitarian assistance or peace-keeping missions conducted as the

[33] According to NATO terminology, a "permissive environment" is "an environment in which friendly forces anticipate no obstructions to, or interference with, operations. Note: A permissive environment does not necessarily imply absence of threat." *Vice versa*, by "non-permissive environment" is meant "an environment in which friendly forces anticipate obstructions to, or interference with, operations." Cf. NATO, *Glossary of Terms and Definitions (English and French)*, AAP-06 Edition 2014, http://nso.nato.int/nso/zPublic/ap/aap6/AAP-6.pdf. In the absence of a NATO definition of "semi-permissive", recourse can be had to the US definition, by which an "uncertain environment" is an "operational environment in which host government forces, whether opposed to or receptive to operations that a unit intends to conduct, do not have totally effective control of the territory and population in the intended operational area" (US Dept. of Defense, *Dictionary of Military and Associated Terms*, 8 November 2010 (amended 15 August 2014), http://www.dtic.mil/doctrine/new_pubs/jp1_02.pdf).

result of an agreement between the parties involved, but one can clearly also find oneself operating in non-permissive environments, such as in the case of Afghanistan. The issue to be kept in mind is that the optimisation work that has to be carried out on a dual helicopter, in order to ensure safety in permissive or semi-permissive environments, is less than that required for non-permissive environments. The size of this optimisation effort has clearly an impact also on the effectiveness and efficiency of the dual helicopter option.

As regards effectiveness and efficiency, four remarks should be made. Firstly, it depends on the mission: in the case of attack helicopters, and in general of helicopters used for "airmobile" or "aero-mechanised" operations in the Italian approach, for "air combat" operations as foreseen by French doctrine, or the British equivalent of the "manoeuverist approach," given the quantitative and qualitative significance of the optimisation necessary, the use of dual helicopters is less effective and efficient. Vice versa, for logistical and tactical helicopter transport missions, which do not bring the helicopters and their crews into ballistic contact with the enemy, the use of dual helicopters is more effective and efficient. Indeed, in the absence of combat tasks, there are fewer needs, such as those relating to arms systems, which require a greater optimisation and adjustment of the dual platform so as to make it fit for military purposes. Once certain requirements, regarding such things as load capacity and resistance to atmospheric and environmental conditions (in terms, for example, of temperature, altitude and the presence of dust), are met in the design phase, a level of effectiveness equal to, or greater than that of dedicated military machines can be achieved by dual helicopters with timely and limited modifications, for example as regards the undercarriage.

Effectiveness and efficiency are closely connected to the concept of balance between "high-end" and "low-end," i.e. the so-called "High Low Mix." As analysed in the individual case studies, the rotary-wing assets of France, the UK and Italy (though the argument is valid for almost all NATO Member States) are called upon to carry out a wide range of missions as regards intensity during their life-cycle, both genetic and com-

bat-related.[34] The missions in the upper part of the spectrum are high-intensity, "high-end," and tend to be carried out in non-permissive environments, and therefore impose more stringent requirements as regards, for example, the protection of the platform and the technological level of arms systems, which are usually associated with higher costs for the aircraft. Vice versa, "low-end" missions are located in the lower part of the spectrum, are usually conducted in semi-permissive (or permissive) environments, and are less ambitious as regards the requirements and the related technological level – and therefore less expensive. The concept of "High Low Mix" refers essentially to the maintenance of a balance between a capability, albeit not predominant, for high-end missions, and a capability, equally not marginal, for low-end missions. This allows to the aircraft adapted for low-end missions, and capable of carrying out the assigned task at a significantly lower cost as compared to the use of more advanced and expensive platforms, to be used for many types of missions, such as logistical and tactical helicopter transport, and of operational theatres, such as natural disasters, humanitarian crises, and support for pure peace-keeping operations and internal security activities. Clearly, high-end assets have to be maintained in service in sufficient quantity and quality, because, although missions in the upper part of the spectrum might be less frequent than those in the lower part, according to the nature of the international strategic context, they are certainly among the most important and risky for the Armed Forces, and require advanced capabilities that are ready for use.

Indeed, the preparedness for use, or "readiness," of rotary-wing assets has to be taken into consideration with a view to effectiveness and efficiency not over the very short term, with reference only to the moment of the platform's acquisition and the related cost, but rather over the medium to long term, in connection with the entire life cycle of the machine. In this perspective, it is probable that dual helicopters, which

[34] According to NATO terminology, intensity, technically defined as the "intensity factor", is the "multiplying factor used in planning activities to evaluate the foreseeable intensity or the specific nature of an operation in a given area for a given period. It is applied to the standard day of supply in order to calculate the combat day of supply". Cf. NATO, *Glossary of Terms and Definition*, cit.

can rely on a technological, design-related and systemic base that is common to the civilian sector, will guarantee greater availability and financial benefits, in terms both of spare parts and of maintenance and modernisation activities and services, thereby improving not only the readiness of the assets, but also the efficiency of the management of the helicopter fleet. Efficiency also depends on consumption per flight hour, in terms both of fuel and of the usage of the platform's components and systems. In a realistic scenario, rotary-wing assets spend the majority of their flight hours on low-end operations, utility missions, and crew training. To carry out such a high number of flight hours with a dual helicopter would turn out equally effective, and more efficient, in comparison to the use of a military machine, which might be more sophisticated and better-performing, but which might at the same time be "excessive" for these types of mission, and in a certain sense "wasted" – wastage that is not sustainable in times of lasting decline of European defence budgets, and of efforts to rationalise military expenditure and to make it more efficient.

Finally, the fourth and final remark, efficiency and effectiveness are inevitably also tied to the seniority in service of the vehicle, and the risk of obsolescence. The acceleration of technological innovation discussed in the preceding section, not only in the ICT field but also as regards, for example, composite materials and energy saving, accentuates the risk of obsolescence of aircraft designed and built 20 to 30 years ago. Obsolescence means a decrease both in safety and effectiveness, as much as the performance of the helicopter in issue is inferior to that of other new generation assets operated by allies or opponents, and in interoperability in international coalitions. Obviously, legacy assets can be, and indeed have been, subject to modernisation programmes to improve their standards, but such improvements cannot overcome certain structural limits of the aircraft, i.e. they cannot guarantee specific levels in terms of performance and safety, which have been achieved by more recent platforms. For example, to use a military helicopter which has been in service for some decades and which is obsolete in terms of conception, systems, characteristics and protection in a semi-permissive or non-permissive operations theatre means equipping that helicopter with self-defence systems which it originally did not have and that it was not

designed to have. All this can have a negative impact on performance insofar as load or engine capacity is then put under pressure in order to support the upgrade. Furthermore, the same modernisation becomes increasingly expensive, and therefore less efficient, in proportion to the age of the helicopter, technological process achieved in the interim, and the reach of the upgrade in the light of the standards or requirements of the operations theatre. Mutatis mutandis, a similar dynamic can be seen in the case of fixed-wing assets, and in particular fighter-bombers, in relation to which the significant use of aircraft designed and built in the 1980s or before, in international missions is rather like using a vintage car for every day movements, a usage that is certainly neither effective nor efficient.[35]

All this does not mean, obviously, refraining tout court from the use of dedicated military machines, for example for missions with a marked combat nature or in the upper part of the intensity spectrum, i.e. high-end. It is rather a question of looking at the matter in terms of maintaining an adequate rotary-wing capability, by means inter alia of the use of dual helicopters to deal with scarce and dwindling resources, which translate into a drastic reduction in the number of aircraft, as highlighted above in the French and Italian cases. This is made possible by a differentiation of aircraft by mission, expressed by the "High Low Mix," and therefore by a more effective and efficient use of these aircraft. Such a differentiation can also consist of different configurations of the same machine, if that machine is designed in such a way as to integrate the appropriate kits without excessive complication, whilst acknowledging that certain standards can only be met by means of an adequate ab origine dual helicopter design.

An approach of this kind implies two radical changes in the defence world. The first is a leap ahead in the nature of the relationship between the Armed Forces and industry, to move from the client-supplier duality to a true partnership. Such a partnership should consist of a frank and deep dialogue between the two parties, from the phase of the definition

[35] Vincenzo Camporini et al., *The Role of Italian Fighter Aircraft in Crisis Management Operations: Trends and Needs*, Rome, Nuova Cultura, March 2014 (IAI Research Papers No. 16), http://www.iai.it/en/node/2155.

of the military requirements onwards, in a negotiation of the costs of the procurement program which concentrates on the life-cycle of the platform in question and not only on the unit cost, in an effort on the part of industry to understand and to satisfy the requirements set by the military counterparty, and in an effort on the part of the military to temper those requirements through the considerations set out above regarding safety, effectiveness and efficiency. The second change concerns the very concept of crew security, and in general of military personnel in the discharge of missions in the operations theatre. Security, conceived as to include protection from the enemy, is not determined only by the level of protection that a given platform can theoretically provide, be that the helicopter itself or a terrestrial light armoured vehicle. Safety is determined, rather, by the package of conditions which, in the reality of the operational theatres are ensured for the discharge of the mission, and that include inter alia: the aircraft's safety standards, which today are absolutely comparable between the civilian and military fields; the readiness of the platform, which avoids having recourse to much less secure assets, or to leftovers supplied by lease or in some other manner by partners because the helicopter fleet available on paper is not so in reality (see the case of the Soviet-built helicopters used by NATO Member States for some years in Afghanistan); the non-obsolescence of the helicopter, which can therefore benefit from recent technological progress; its capability to connect to the other nodes in the military network, thereby ensuring better situational awareness and therefore greater chances of not being hit or shot down; and its use on the tactical, operational and strategic levels, which is connected to elements of procedure, doctrine, organisation and training.

In conclusion, the dual helicopter option represents an interesting prospect to ensure greater safety, effectiveness and efficiency in the use of rotary-wing assets by the Armed Forces, in the light both of recent dynamics in technological progress, and of the current limits on defence budgets. The exact shape of this prospect and, before that, its full understanding, requires deep, joint reflection and planning on the part of all actors involved.

Bibliography

Bob Ainsworth, "Future Rotary Wing Strategy", in *House of Commons Debates*, Vol. 502, Part 16, 15 December 2009, http://www.publications.parliament.uk/pa/cm200910/cmhansrd/cm091215/wmstext/91215m0002.htm

Bob Ainsworth, "Helicopters: Procurement", in *House of Commons Debates*, Vol. 469, Part 23, 13 December 2007, http://www.publications.parliament.uk/pa/cm200708/cmhansrd/cm071213/text/71213w0005.htm

John A. Alic et al., *Beyond Spinoff: Military and Commercial Technologies in a Changing World*, Boston, Harvard Business School Press, 1992

Patrick Allen, Interview, in *Jane's Defence Weekly* 16 October 2013

Patrick Allen, "Royal Navy Stands down Sea King Training unit", in *Jane's Defence Weekly*, 16 December 2013

Patrick Allen, "Upgrades needed to maintain Apache as 'bedrock' of British Army", in *Jane's Defence Weekly*, 5 July 2013

Analisi Difesa, *Accordo tra Esercito e Marina Militare per l'imbarco dei Mangusta*, 23 November 2012, http://www.analisidifesa.it/?p=1576

Pietro Batacchi and Eugenio Po, "AgustaWestland guarda al futuro", in *Rivista italiana Difesa (RID)*, n. 10/13 (October 2013), pp. 26-33

Piero Batacchi and Eugenio Po, "Difesa domani. Parlano i Capi di Stato Maggiore", in *Rivista italiana Difesa (RID)*, n. 6/13 (June 2013), pp. 25-43

Enzo Bernardini, *Hearing of the Head of the 2nd Dept of the General Command of Carabinieri Corps*, Senate Defence Committee, 11 June 2014,
http://www.senato.it/japp/bgt/showdoc/frame.jsp?tipodoc=SommComm&leg=17&id=772308

Antonio Bettelli, "La capacità aeromobile nel progetto di riordino dello strumento militare terrestre: punto di situazione e possibili sviluppi", in *Rassegna dell'Esercito*, n. 6/2013, pp. 30-39,
http://www.perseonews.it/index.php?option=com_content&view=article&id=3246

Luigi Binelli Mantelli, Hearing of the Chief of Defence Staff, joint sitting of Senate and Chamber of Deputies Defence Committees, 22 May 2013,
http://www.senato.it/service/PDF/PDFServer/DF/293457.pdf

Robert A. Burgelman and Richard S. Rosenbloom, "Technology Strategy: An Evolutionary Process Perspective", in Robert A. Burgelman and Richard S. Rosenbloom (eds.), *Research on Technological Innovation Management and Policy. Vol. 4*, Greenwich and London, JAI Press, 1989, pp. 1-23

David Cameron, "Strategic Defence and Security Review", in *House of Commons Debates*, Vol. 516, Part 54, 19 October 2010,
http://www.publications.parliament.uk/pa/cm201011/cmhansrd/cm101019/debtext/101019-0001.htm#10101928000003

Vincenzo Camporini et al., *The Role of Italian Fighter Aircraft in Crisis Management Operations: Trends and Needs*, Rome, Nuova Cultura, March 2014 (IAI Research Papers No. 16),
http://www.iai.it/en/node/2155

Alessandro Carrozzo, "Nuovi elicotteri e tecnologia, il futuro del Servizio Aereo della Guardia di Finanza", in *Helipress*, 29 May 2014,
http://www.helipress.it/schede-280

Centre de Doctrine et d'Emploi des Forces (CDEF), "Army aviation combat operations", in *Doctrine tacquique*, No. 22 (March 2012), http://www.cdef.terre.defense.gouv.fr/content/download/4024/57668/file/Doctrine22us.pdf

Centre de Doctrine et d'Emploi des Forces (CDEF), "The Tactical Third Dimension", in *Doctrine*, No. 14 (January 2008), http://www.cdef.terre.defense.gouv.fr/content/download/3672/54254/file/doctrine14us.pdf

Federico Cerruti, "Nuovo iter addestrativo per l'Aeronautica", in *Analisi Difesa*, 2 November 2013, http://www.analisidifesa.it/?p=6254

Vito Dell'Edera, "La protezione dei mezzi dell'Esercito", in *Pagine di Difesa*, 21 March 2007, http://www.paginedidifesa.it/2007/rivmil_070321.html

Salvatore Demma, "Il punto sul Servizio Aereo", in *Coccarde Tricolori 2010*, pp. 106-109

Germano Dottori and Alessandro Marrone, "Il mercato mondiale della difesa tra geopolitica e globalizzazione", in Claudio Catalano (ed.), *Baricentri: lo shift globale degli equilibri politici, economici e tecnologici?*, Roma, Finmeccanica Occasional Paper, October 2010, pp. 72-86, http://www.finmeccanica.com/documents/10437/7958427/body_OP_Baricentri_ita.pdf

Stéphane Dugast, "DRONE: Système Embarqué de Reconnaissance Vecteur Aérien Léger (SERVAL)", in *Actu Marine*, 24 juillet 2013, http://www.defense.gouv.fr/marine/actu-marine/drone-systeme-embarque-de-reconnaissance-vecteur-aerien-leger-serval

ECORYS, *Study on Civil Military Sinergies in the field of Security*, May 2012, http://ec.europa.eu/enterprise/policies/security/files/doc/study_ecorys_cimisos_final_report_en.pdf

EDA, *Annual Report 2009*,
https://www.eda.europa.eu/docs/documents/Annual_Report_2009

EDA, *EDA and Commission to work closely together on research*, 18 May 2009,
https://www.eda.europa.eu/info-hub/news/2009/05/17/EDA_and_Commission_to_work_closely_together_on_research

Elitaliana, "Un nuovo elicottero AW-139 per la Polizia di Stato", in *EliNews*, 17 December 2013, http://www.elinews.elitaliana.eu/schede-49

European Commission, *Towards a more competitive and efficient defence and security sector* (COM(2013)542), 24 July 2013, http://eur-lex.europa.eu/legal-content/en/TXT/?uri=celex:52013DC0542

Daniel Fiott, "The three effects of dual-use: firms, capabilities and governance", in *ISSUE Briefs*, No. 21 (July 2014),
http://www.iss.europa.eu/uploads/media/Brief_21_Dual_use.pdf

Liam Fox, "Defence Transformation", in *House of Commons Debates*, Vol. 531, Part 189, 18 July 2011,
http://www.publications.parliament.uk/pa/cm201011/cmhansrd/cm110718/debtext/110718-0002.htm#11071817000001

France. Cour des Comptes, "La conduite des programmes d'armement", in *Rapport public annuel 2010*, February 2010, pp. 48-51,
https://www.ccomptes.fr/Publications/Publications/Rapport-public-annuel-2010

French National Assembly, *Défense: Préparation et emploi des forces: forces terrestres, Avis de la commission de la défense sur le projet de loi de finances pour 2014*, No. 1433, Vol. IV, 10 October 2013,
http://www.assemblee-nationale.fr/14/budget/plf2014/a1433-tIV.asp

French National Assembly, *Loi relative à la programmation militaire pour les années 2014 à 2019 et portant diverses dispositions concernant la défense et la sécurité nationale*, No. 1168, 18 December 2013,

http://www.assemblee-nationale.fr/14/dossiers/loi_programmation_militaire_2014-2019.asp

French National Assembly, *Projet de Loi relatif à la programmation militaire pour les années 2009 à 2014 et portant diverses dispositions concernant la défense*, No. 1216, 29 October 2008, http://www.assemblee-nationale.fr/13/projets/pl1216.asp

Raffaele Fusilli, *Il ventennale della componente aerea della Guardia Costiera*, September 2008, http://www.avia-it.com/act/reparti/Reparti_settembre_2008/Il_ventennale_della_componente_aerea_della_guardia_costiera.pdf

Claudio Graziano, *Hearing of the Army's Chief of Staff*, joint sitting of Senate and Chamber of Deputies Defence Committees, 5 June 2013, http://www.senato.it/service/PDF/PDFServer/DF/293981.pdf

Nick Harvey, "Rotary Wing Capability Study", in *House of Commons Debates*, Vol. 546, Part 12, 12 June 2012, http://www.publications.parliament.uk/pa/cm201213/cmhansrd/cm120612/wmstext/120612m0001.htm#12061239000177

Craig Hoyle, "Libya: British Army details Apache success", in *Flightglobal*, 8 July 2011, http://www.flightglobal.com/news/articles/-359298

Craig Hoyle "UK eyes Apache modifications after Libyan experience", in *Flightglobal*, 26 October 2011, http://www.flightglobal.com/news/articles/-363865

IAI, IRIS and University of Manchester, *Study on the Industrial Implications in Europe of the Blurring of Dividing Lines Between Security and Defence*, June 2010, http://ec.europa.eu/enterprise/sectors/defence/files/new_defsec_final_report_en.pdf

Italian Air Force, *Schede aeromobili: HH-139A*, http://www.aeronautica.difesa.it/Mezzi/velivoliDotazione/Pagine/HH-139A.aspx

Italian Civil Protection, *Procedure per il concorso della flotta aerea dello Stato 2013*, 27 June 2013, http://www.protezionecivile.gov.it/resources/cms/documents/Direttiva_Procedure_AIB_2013.pdf

Italian Coastal Guard, *I mezzi: Elicottero AB-412*, http://www.guardiacostiera.it/mezzi/ab412.cfm

Italian Financial Police, *La flotta aerea*, http://www.gdf.gov.it/GdF/it/Specializzazioni/Servizio_Aeronavale/La_componente_Aerea/La_flotta_aerea

Italian Fire Brigade, *Gli elicotteri nel Corpo Nazionale dei Vigili del Fuoco - La storia*, http://www.vigilfuoco.it/aspx/page.aspx?IdPage=2073

Italian Ministry of Defence, *Documento programmatico pluriennale per la Difesa per il triennio 2013-2015*, April 2013, http://www.difesa.it/Amministrazionetrasparente/bilandife/Pagine/Bilanciopreventivoeconsuntivo.aspx

Italian Ministry of Defence, *Il Gen. Debertolis firma l'accordo per la cessione degli AB206 all'Argentina*, 25 June 2012, http://www.difesa.it/SGD-DNA/Segretario/Eventi/Pagine/IlGenDebertolisfirmal%27accordo.aspx

Italian National Police, *Le sedi dei Reparti volo*, updated 10 May 2013, http://www.poliziadistato.it/articolo/view/24324

Italian Navy, *La Marina Militare all'esercitazione "TWIST" con la Protezione Civile*, 25 October 2013, http://www.marina.difesa.it/Conosciamoci/Notizie/Pagine/20131025_twist.aspx

Italian Navy, Rapporto 2010

Italian State Forest Corps, *Il Centro Operativo Aereo (COA)*, http://www.corpoforestale.it/flex/cm/pages/ServeBLOB.php/L/IT/IDPagina/333

Italian State Forest Corps, *Relazione sull'attività operativa del CFS nell'anno 2013*, August 2013, http://www.corpoforestale.it/flex/cm/pages/ServeBLOB.php/L/IT/IDPagina/36

Andrew D. James (ed.), *The Future Impact of Security and Defence Policies on the European Research Area. Final Scientific Report*, May 2011, https://sandera.portals.mbs.ac.uk/Portals/65/docs/D5.2-Final%20Scientific%20Report.pdf

Gareth Jennings, "MBDA scores five-from-five in Brimstone 2 tests", in *Jane's Missiles & Rockets,* 20 October 2013

Antony King, "Understanding the Helmand campaign: British military operations in Afghanistan", in *International Affairs*, Vol. 86, No. 2 (March 2010), pp. 311-332

Matteo Marianeschi, "72° Stormo M.O.V.M. "Marcello de Salvia": la formazione per l'ala rotante", in *Aviation Report*, 16 February 2011, http://www.aviation-report.com/dblog/articolo.asp?articolo=162

Roberto Maroni, Statements by Italian Ministry of the Interiors on the forthcoming European programme for justice and home affairs (the so-called "Stockholm programme"), joint sitting of Senate Committees European Union Policies, Constitutional Affairs and Justice, 11 November 2008, http://www.senato.it/service/PDF/PDFServer/DF/216224.pdf

Alessandro Marrone and Alessandro R. Ungaro, Actors in the European Defence Policy Area: Roles and Developments, Turin, Centro studi sul federalismo (CSF), November 2014, http://www.iai.it/en/node/2331

Alfonso Mino, "L'Aeronautica Militare riceve i primi HH-139 per il rinnovo del SAR", in *Dedalonews*, 10 March 2012, http://www.dedalonews.it/it/index.php/?p=27091

Jordi Molas-Gallart, "Coping with Dual-Use: A Challenge for European Research Policy", in *Journal of Common Market Studies*, Vol. 40, No. 1 (March 2002), pp. 155-165

Stefano Monteleone and Chiara Rosati, "15° Stormo dell'Aeronautica militare: al servizio della comunità", in *Aviation Report*, 20 December 2012, http://www.aviation-report.com/dblog/articolo.asp?articolo=539

David Olivier, "The UK Rotary-Wing Unmanned Air System Takes-Off", in *Indian Defence Review*, 25 November 2013, http://www.indiandefencereview.com/?p=13451

NATO, *Glossary of Terms and Definitions (English and French)*, AAP-06 Edition 2014, http://nso.nato.int/nso/zPublic/ap/aap6/AAP-6.pdf

NATO, *Use of Helicopters in Land Operations* (ATP-49(C) Vol. 1), March 2000, http://www.Navy.mi.th/navedu/stg/databasestory/data/laukniyom/ship-active/big-country-ship/United-States/ATP/atp49c1.pdf

NATO, *Use of Helicopters in Land Operations* (ATP-49(C) Vol. 2), March 2000, http://www.Navy.mi.th/navedu/stg/databasestory/data/laukniyom/ship-active/big-country-ship/United-States/ATP/atp49c2.pdf

NATO Joint Air Power Competence Centre, *Enhancing NATO's Operational Helicopter Capabilities. The Need for International Standardisation*, August 2012, https://www.japcc.org/?p=112

Riccardo Niccoli, "Aeronautica Militare", in *Coccarde Tricolori 2013*, pp. 126-138

Riccardo Niccoli, "AW.139 per la Guardia Costiera", in *Coccarde Tricolori 2011*, pp. 118-121

Riccardo Niccoli, "La Brigata Aeromobile 'Friuli'", in *Coccarde Tricolori 2005*, pp. 77-85

Riccardo Niccoli, "Carabinieri", in *Coccarde Tricolori 2013*, pp. 147-148

Riccardo Niccoli, "Esercito: verso i 90.000 uomini", in *Forze di Terra 2013*, pp. 20-29

Riccardo Niccoli, "Guardia di Finanza", in *Coccarde Tricolori 2013*, pp. 149-151

Riccardo Niccoli, "Marina Militare", in *Coccarde Tricolori 2013*, pp. 144-146

Riccardo Niccoli, "Nexus anche per la Forestale", in *Coccarde Tricolori 2010*, pp. 114-117

Riccardo Niccoli, "Gli NH-90 in Afghanistan", in *Coccarde Tricolori 2013*, pp. 80-85

Riccardo Niccoli, "I nuovi elicotteri della Guardia di Finanza", in *Coccarde Tricolori 2010*, pp. 96-101

Riccardo Niccoli, "I nuovi SH-90 della Marina", in *Coccarde Tricolori 2012*, pp. 88-95

Riccardo Niccoli, "Polizia di Stato", in *Coccarde Tricolori 2013*, pp. 152-154

Riccardo Niccoli, "La riorganizzazione della Protezione Civile", in *Coccarde Tricolori 2013*, pp. 110-113

Riccardo Niccoli, "Vigili del Fuoco", in *Coccarde Tricolori 2013*, pp. 155-156

Michele Nones and Alessandro Marrone (eds.), *The Transformation of the Armed Forces: The Forza NEC Program*, Roma, Nuova Cultura, October 2012, (IAI Research Paper No. 5), http://www.iai.it/en/node/1387

Michele Nones and Stefano Silvestri (eds.), "The Role of the Helicopter in the New Defence Model", in *IAI Quaderni English series*, No. 1 (November 2000)

David Olivier, "The UK Rotary-Wing Unmanned Air System Takes-Off", in *Indian Defence Review*, 25 November 2013, http://www.indiandefencereview.com/?p=13451

Pagine di Difesa-Redazione, "Dottrina, le operazioni delle unità aeromobili", in *Pagine di Difesa*, November 2005, http://www.paginedidifesa.it/2005/pdd_051155.html

Franco Persenda, "Il punto sulla Guardia Costiera", in *Coccarde Tricolori 2013*, pp. 118-121

Eugenio Po, "L'EI cambia volto", in *Rivista italiana Difesa (RID)*, n. 2/12 (February 2012), pp. 22-31

Eugenio Po, "Il punto sul 'nuovo' Esercito", in *Rivista italiana Difesa (RID)*, n. 3/14 (March 2014), pp. 38-43

RID-Redazione, "Notizie: AgustaWestland consegna il primo NH-90 FOC all'Esercito", in *Rivista italiana Difesa (RID)*, n. 6/13 (June 2013), pp. 8

RID Redazione, "Notizie: Gli AW-129 sulle navi: finalmente!", in *Rivista italiana Difesa (RID)*, n. 1/13 (January 2013), pp. 12

RID-Redazione, "Notizie: Consegnato alla Marina il primo NH-90 FOC", in *Rivista italiana Difesa (RID)*, n. 12/13 (December 2013), pp. 13

RID-Redazione, "Notizie: In Afghanistan gli elicotteri NH-90 dell'AVES", in *Rivista italiana Difesa (RID)*, n. 10/12 (October 2012), pp. 7

RID-Redazione, "Notizie: Primi AW-139 alla Polizia di Stato", in *Rivista italiana Difesa (RID)*, n. 8/13 (August 2013), pp. 12

RID-Redazione, "Notizie: Primo volo per l'elicottero ICH-47F dell'Esercito", in *Rivista italiana Difesa (RID)*, n. 8/13 (August 2013), pp. 8

Malcolm Rifkind, "Medium Support Helicopter", in *House of Commons Debates*, Vol. 256, 9 March 1995, http://www.publications.parliament.uk/pa/cm199495/cmhansrd/1995-03-09/Debate-1.html

AnnaLee Saxenian, "The Age of the Agile", in Samuel Passow and Magnus Runnbeck (eds.), *What's Next? Strategic Views on Foreign Direct Investment*, Stockholm, ISA with UNCTAD and WAIPA, 2005, pp. 46-53, http://www.ischool.berkeley.edu/~anno/Papers/The_Age_of_the_Agile.pdf

Richard Scott, "UK receives first upgraded Merlin helos", in *Jane's Defence Weekly*, 24 July 2013

Richard Scott, "UK seeds Crowsnest assessment work", in *Jane's Defence Weekly*, 18 April 2013

Michele Sirimarco, "Il punto sul Raggruppamento Aeromobili", in *Coccarde Tricolori 2014*, pp. 164-169

Javier Solana, *Opening address at the EDA Conference "Helicopters - Key to Mobility"*, Brussels, 10 March 2009, http://www.consilium.europa.eu/uedocs/cms_data/docs/pressdata/en/esdp/106566.pdf

STACCATO, *Executive Summary of the Final Report Study*, http://www.iai.it/pdf/Economia_difesa/STACCATO_Final-Report-Executive-Summary.pdf

Rikard Stankiewicz, "The Concept of 'Design Space'", in John Ziman (ed.), *Technological Innovation as an Evolutionary Process*, Cambridge, Cambridge University Press, 2003, pp. 234-247

Guillaume Steuer, "Liaison 16 sur Rafale: retours d'expérience", *Air & Cosmos*, n. 2114 (29 février 2008), pp. 20-23

Paolo Treu, "Le Forze Aeree della Marina", in *Coccarde Tricolori 2010*, pp. 82-91

UK Home Department, *Policing in the 21st Century: Reconnecting police and the people*, July 2010, https://www.gov.uk/government/collections/policing-in-the-21st-century

UK House of Commons, "The Strategic Defence Review White Paper", in *House of Commons Research Papers*, No. RP98/91, 15 October 1998, http://www.parliament.uk/briefing-papers/RP98-91.pdf

UK House of Commons Defence Committee, *Helicopter Capability. 11th Report of Session 2008-09*, 16 July 2009, http://www.publications.parliament.uk/pa/cm200809/cmselect/cmdfence/434/434.pdf

UK House of Commons Defence Committee, "Written evidence from the Ministry of Defence", in *Operations in Afghanistan, 4th Report of Session 2010-12*, Vol. I, 17 July 2011, http://www.publications.parliament.uk/pa/cm201012/cmselect/cmdfence/554/554.pdf

UK Ministry of Defence, *Army Doctrine Publication (ADP): Operations*, November 2010, https://www.gov.uk/government/publications/Army-doctrine-publication-operations

UK Ministry of Defence, *Battlefield Helicopters, House of Commons 486 Session 2003-2004*, 7 April 2004,

http://www.nao.org.uk/report/ministry-of-defence-battlefield-helicopters

UK Ministry of Defence, *British Air and Space Power Doctrine*, AP3000 Fourth edition, 2009, http://www.raf.mod.uk/rafcms/mediafiles/9E435312_5056_A318_A88F14CF6F4FC6CE.pdf

UK Ministry of Defence, *British Maritime Doctrine* (JDP 0-10 Fourth Edition), August 2011, https://www.gov.uk/government/publications/jdp-0-10-british-maritime-doctrine

UK Ministry of Defence, *Chinook Mk3 Helicopters*, House of Commons 512 Session 2007-2008, 4 June 2008, http://www.nao.org.uk/report/ministry-of-defence-chinook-mk3-helicopters

UK Ministry of Defence, *Defence Industrial Strategy. Defence White paper*, December 2005, https://www.gov.uk/government/publications/defence-industrial-strategy-defence-white-paper

UK Ministry of Defence, *Future 'Black Swan' Class Sloop-of War: A Group System*, Joint Concept Note 1/12, May 2012, https://www.gov.uk/government/publications/joint-concept-note-1-12-future-black-swan-class-sloop-of-war-a-group-system

UK Ministry of Defence, *Future Capabilities: Government Response to the House of Commons Defence Committee's Fourth Report of Session 2004-05*, July 2005, https://www.gov.uk/government/publications/future-capabilities-government-response

UK Ministry of Defence, *Future Character of Conflict*, Report in DCDC Strategy Trends Programme, February 2010, https://www.gov.uk/government/publications/future-character-of-conflict

UK Ministry of Defence, *Future Land Operating Concept*, DCDC Joint Concept Note 2/12, May 2012, https://www.gov.uk/government/publications/joint-concept-note-2-12-future-land-operating-concept

UK Ministry of Defence, *The Major Projects Report 2011*, House of Commons 1520-I, Session 2010-2012, 16 November 2011, http://www.nao.org.uk/report/ministry-of-defence-the-major-projects-report-2011

UK Ministry of Defence, *The Major Projects Report 2012*, House of Commons 684-I, Session 2012-2013, 10 January 2013, http://www.nao.org.uk/report/ministry-of-defence-the-major-projects-report-2012

UK Ministry of Defence, *National Security Through Technology: Technology, Equipment and Support for UK Defence and Security*, February 2012, https://www.gov.uk/government/publications/national-security-through-technology-technology-equipment-and-support-for-uk-defence-and-security-cm-8278--2

UK Prime Minister, *Securing Britain in an Age of Uncertainty: The Strategic Defence and Security Review*, October 2010, https://www.gov.uk/government/publications/the-strategic-defence-and-security-review-securing-britain-in-an-age-of-uncertainty

UK Ministry of Defence, *UK Air and Space Doctrine* (JDP 0-30), July 2013, https://www.gov.uk/government/publications/uk-air-and-space-doctrine-jdp-0-30

US Dept of the Army, *Operational Terms and Graphics*, Manual FM 1-02 (FM 101-5-1), September 2004

US Dept of Defense, *Dictionary of Military and Associated Terms*, 8 November 2010 (amended 15 August 2014),
http://www.dtic.mil/doctrine/new_pubs/jp1_02.pdf

Serge Vinçon, *Les hélicoptères de l'armée de terre: situation et perspectives*, Rapport d'information n° 350 (2001-2002), 10 juillet 2002,
http://www.senat.fr/rap/r01-350/r01-350.html

Marcus Weisgerber, "AgustaWestland Pitches AW119 for US Navy Helicopter Trainer", in *Defense News*, 7 April 2014,
http://www.defensenews.com/article/20140407/DEFREG02/304070033

WEBSITES

http://www.aeronautica.difesa.it
http://www.airbushelicopters.com
http://www.analisidifesa.it
http://www.assemblee-nationale.fr
http://www.aviation-report.com
http://www.cdef.terre.defense.gouv.fr
http://www.cesa.air.defense.gouv.fr
http://cesm.marine.defense.gouv.fr
http://www.corpoforestale.it
http://www.defence.gouv.fr
http://www.defence.gouv.fr/terre
http://www.defence.gouv.fr/marine
http://www.defence.gouv.fr/air
http://www.difesa.it
https://www.eda.europa.eu
http://www.enav.it
http://www.esercito.difesa.it
http://www.eurocopter.com
http://www.gdf.gov.it
http://www.gendarmeria.interieur.gouv.fr
http://www.globalsecurity.org

https://www.gov.uk
http://www.guardiacostiera.it
https://www.iai.it
http://www.interieur.gouv.fr/Le-ministere/Securite-civile
http://www.legifrance.gouv.fr
http://www.marina.difesa.it
http://www.nao.org.uk
http://www.navy.mi.th
http://www.official-documents.gov.uk
http://www.paginedidifesa.it
http://www.parliament.uk
http://www.poliziadistato.it
http://www.protezionecivile.gov.it
http://www.publications.parliament.uk
http://www.senat.fr
http://www.vigilfuoco.it

Annex 1
List of interviews

The Italian case study

MASSIMO BONESI, Lieutenant Colonel, Amy Aviation
VITTORIO CARMINATO, Lieutenant Colonel, Air Force
ALESSANDRO CARROZZO, Colonel, Head of the Air Unit, General Command of the Financial Police
ENRICO CREDENDINO, Counter Admiral, Navy
LORENZANO DI RENZO, Captain, Navy
LUIGI FRANCAVILLA, Brigadier General, Army Aviation
GIUSEPPE MASSIMETTI, Colonel, Navy
MASSIMO MEOLA, Colonel, Army Aviation
ROBERTO PREO, Colonel, Air Force
ARMANDO SIMI, Navy
DIEGO SISMONDINI, Lieutenant Colonel, Air Force
ENZO STEFANINI, Lieutenant General, Secretary General of Defence and National Armaments Director

The French case study

Joint Staff, HIL Program Senior Officer
Army Aviation Command, General in Command
Army Aviation Command, Head of Doctrine Division
Navy Staff, Helicopter Program Officer
Air Force Staff, Helicopter Program Officer
Air Force, Air Transport Brigade Commander
Forces Aériennes de la Gendarmerie, General in Command
Forces Aériennes de la Gendarmerie, Staff Officer
Customs agency, Aviation Senior Officer
Sécurité Civile, Aviation Senior Officer
State Aviation Safety Authority, Senior Officer

Annex 2
The French case study: the evolution of the helicopter fleet

The following diagram gives a global overview of the evolution of government owned helicopter fleet from 2013 to 2019. In addition, we have categorized the fleet according a dual-use criteria and we give the average percentage of each category among the total fleet as of 2019. That shows that in the French future vision, two third of the Defence fleet could be composed of dual-use helicopters (future HIL or any medium helicopter) either "militarized," that is to say fitted with heavy assets – for example Air to Ground Missiles (AGM) or Air to Air Missiles (AAM) – or "customized" that is to say fitted with optional equipment (for example door machine gun, avionics, self-defence suites, etc.). We give also the average age of the different fleets. From 2020 on, two third of the French helicopter fleet should be decommissioned and replaced. But as French MoD has no clear view of what will be its budget after 2020 the renewal of the fleet will occur long after this date.

Table 1 – The French helicopter fleet: current situation and future plans

Armed Forces[1]										
	Military helicopters				Dual-use "militarized"		Dual-use "customized"			
% versus total fleet in 2019	31%				21%		48%			
average age (years) in 2019	12		8		+30		++30		+30	
	Attack Helicopters Tiger		Attack Helicopters NH/NFH 90		Light attack and reconnaissance Helicopters SA 342		General purpose Light Helicopters[2]		Medium Helicopters[3]	
	2013	2019	2013	2019	2013	2019	2013	2019	2013	2019
Army	39	60	7	38[4]	147	81	0	0	121	77[5]
Navy	0	0	9	24[6]	0	0	52	40	22	0[7]
Air Force	0	0	0	0	0	0	42	40	42	32[8]
Armed Forces	**39**	**60**	**16**	**62**	**147**	**81**	**94**	**80**	**185**	**109**
Armed Forces total fleet in 2013	**481**									
Armed Forces total fleet in 2019	**392**									
Security Forces and Customs Agency fleets[9]										
Gendarmerie	0	0	0	0	0	0	56	56	0	0
SC	0	0	0	0	0	0	35	35	0	0
Customs	0	0	0	0	0	0	9	9	0	0
Total	**0**	**0**	**0**	**0**	**0**	**0**	**100**	**100**	**0**	**0**

[1] French National Assembly, *Loi relative à la programmation militaire pour les années 2014 à 2019 et portant diverses dispositions concernant la défense et la sécurité nationale*, No. 1168, 18 December 2013, http://www.assemblee-nationale.fr/14/dossiers/loi_programmation_militaire_2014-2019.asp.

[2] General purpose are supposed to be dual-use helicopter. They comprise Alouette III, Fennec, Lynx, EC 355, EC 135, EC 145. Some of them could be "militarized" for light attack and reconnaissance needs in support of SA 342.

[3] Panther, Puma, Super Puma, EC 225, and EC 725 Caracal.

[4] Additional NH-90 will be procured after 2019 in order to maintain a total capacity of 115 TTH (NH-90 + medium helicopters).

[5] 43 Puma, 26 Cougar, 8 Caracal.

[6] 3 NFH 90 to be procure after 2019 to reach the final target of 27 NFH 90.

[7] Future Navy medium helicopter is NFH Caiman.

[8] Puma, Super Puma, EC 225 and EC 725 Caracal.

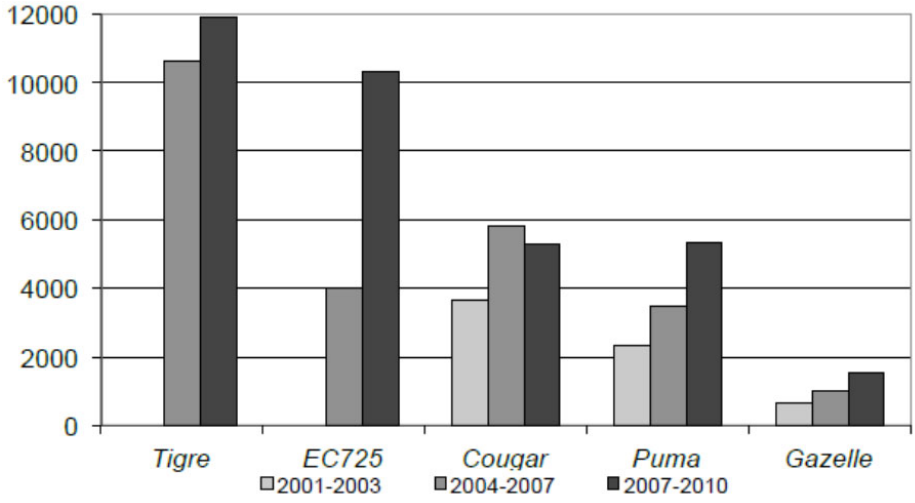
[9] Data from various Agencies officials documents.

Annex 3
The French case study: costs analysis

French MoD as well as Ministry of interior and Customs Agency are facing crucial budget issues. French presidential decision announced in January 2014 to cut off public spending by 50 billion euros during the next three years (17 billion a year) will increase pressure on government procurement projects. For sure MoD will be on the front line for it counts for two third of government investment expenditure. For that reason, the planned budget allocated to Defense by the Loi de programmation militaire 2014-2019 (€31 billion a year for the period among which €16 billion for procurement) will certainly decrease once again (around 4% according President's words that is to say €1,24 billions).

The costs of helicopter procurement, operating and ownership are dramatically increasing. MoD's fleet is impacted by two phenomena. On one hand, its ageing fleet has higher maintenance costs without giving improved operational capability, on the other hand, new generation aircraft are much more expensive to operate. So the bottle-neck is now the Maintenance, Repair and Overhaul (MPO) budget. The following diagram shows the increasing ownership cost-per-flight-hour of Puma and Gazelle during a 10 years period and the ratio between old (Puma and Gazelle) and news (Tiger and EC725) AH or TTH generations. In case of Tiger/Gazelle, the ratio is 1/7, and 1/2 between EC725 and Puma. EC 725 fleet figures are not relevant, fleet being too small.

Figure 1 – Costs for flight hours in million €



Source: Josselin Droff, *Le facteur spatial en économie de la défense: application à l'organization du Maintien en Condition Opérationnel (MCO) des matériels de la défense*, Thése à l'Université de Bretagne Occidentale, Brest, 28 novembre 2013, p. 260, http://tel.archives-ouvertes.fr/tel-00942906.

Another problem is that the maintenance costs of deployed helicopters in operation are three times as much as the average maintenance costs. That means that as 60 helicopters out of 481are currently deployed, real size of the fleet in terms of maintenance costs is: 421(minus 60 deployed aircraft) + [60 (deployed aircraft) x3] = 601 aircraft with a MOP budget fitted for only 421. Two consequences should be underlined: discrepancy on aircraft readiness rate, for example Puma readiness is 70% when deployed (operational priority) and only 38% at home,[1] and crucial results on pilot's training (156 flight hour/pilot instead of 180).

In addition to ownership costs, procurement of last generation military helicopters put heavy constraint on budget. As for Tiger AH the ini-

[1] French National Assembly, *Défense: Préparation et emploi des forces: forces terrestres*, Avis de la commission de la défense sur le projet de loi de finances pour 2014, No. 1433, Vol. IV, 10 October 2013, p. 22, http://www.assemblee-nationale.fr/14/budget/plf2014/a1433-tIV.asp.

tial global costs[2] of the project is €9 billion with 1,5 billion for research and development (R&D) for 215 aircraft (215 for France and 212 for Germany). The average costs was around €41 million/aircraft. As of 2014, France will procure no more than a total of 80 and Germany 57 in order to cut off ownership costs. But the result will be a huge procurement costs increase.

According the French Cour des Comptes[3] when going down from 215 to 80 (with an intermediate step at 120 planned by the LPM 2009-2014, and quickly forgotten in the LPM 2014-2019) the global Tiger program costs will have a 33% fall down. But the costs per unit will have a 78% rise. As for the NH-90, the rise will be 21%. It is worth to note that according the MoD, the cost per unit of the Tiger is around €20million and NH-90 €28 million. But these figures are exclusive of any ownership costs (training equipment, infrastructure, spare parts, etc.). The Cour des Comptes figures (see below) are an all-inclusive approach.

	Initial target	Current target	Initial program costs (millions €)	Current program cost (millions €)	Initial cost/unit	Current cost/unit	
Tigre AH	215	80	8,899	5,898	41,4	73,7	78,1%
NH-90	220	160	8,787	7,759	39,9	48,5	21,4%

Main lessons learned are that, due to the high level of military helicopter procurement costs and the difficulties to export these kind of weapons (the only prospect for Tiger is Malaysia that could buy some of the exceeding Tiger after the last cut down of the French procurement from 120 to 80), the French vision is clearly, as shown with the HIL program, to look for on-the-shelves dual-use helicopters with the

[2] Serge Vinçon, *Les hélicoptères de l'armée de terre: situation et perspectives*, Rapport d'information No. 350 (2001-2002), 10 July 2002, http://www.senat.fr/rap/r01-350/r01-350.html.

[3] Cour des Comptes, "La conduite des programmes d'armement", in *Rapport public annuel 2010*, February 2010, pp. 48-51, https://www.ccomptes.fr/Publications/Publications/Rapport-public-annuel-2010.

idea that, the less they will cost to be "customized" or "militarized", the better.

The idea is also to pull down ownership costs thanks to synergies to be created with civilian operator in terms of Maintenance, Repair and Overhaul (MPO) and, Airworthiness.

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