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Unmanned combat aerial vehicles: European programmes

REPORT

submitted on behalf of the Technological and Aerospace Committee
by Nigel Evans, Vice-Chairman and Rapporteur
(United Kingdom, Federated Group)

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[1] Adopted unanimously by the Committee.

DRAFT RECOMMENDATION

on unmanned combat aerial vehicles: European programmes

The Assembly,

(i) Recalling its Recommendation 754 on unmanned combat air vehicles (UCAVs) and military aeronautics of the future, emphasising that the aerospace sector with its specific technical constraints and requirements is a driving force for progress and innovation;

(ii) Stressing the growing role being played by UCAVs in military operations and in internal security;

(iii) Considering that European UCAV technology demonstrator programmes are making a major contribution to strengthening and developing defence research and technology (R&T) in Europe;

(iv) Expressing support for the ongoing and future projects in this area which are helping strengthen the European defence technological and industrial base (EDTIB);

(v) Underscoring that UCAV technology demonstrator projects contribute to the development of autonomous European infocentric defence architectures;

(vi) Considering that with these projects soon due to reach maturity, it is highly desirable for the interested defence staffs and the NATO and EU military authorities to initiate a process of reflection on the integration of these UCAV systems into their air forces and on their operational use;

(vii) Considering that those aspects which the UCAV technology demonstrator projects have in common could lead to the development of new synergy and cooperation in the field of defence aeronautics in Europe;

(viii) Stressing in this regard that NATO and the European Union already have working arrangements and experience in the field of standardisation, interoperability, flight technologies, communications and networks, certification and airspace integration of unmanned air vehicles;

(ix) Considering that this work is also beneficial to UCAV projects;

(x) Expressing the wish for the states and companies engaged in that research to cooperate more closely in order to set up a common European programme for future combat aircraft, both manned and unmanned;

(xi) Taking the view that such a programme should fully involve NATO, the European Defence Agency and OCCAR in its different development phases so as to reduce the risks of duplication and institutional rivalry;

(xii) Considering the potential applications of UCAV technology demonstrators in the field of internal security,

RECOMMENDS THAT THE COUNCIL INVITE THE WEU NATIONS THAT ARE MEMBERS OF THE EUROPEAN UNION AND NATO TO

1. Launch a coordinated process of reflection within NATO and the EU on the requirements and doctrines for the use of UCAV systems;

2. Involve the relevant industries from the outset in that process of reflection;

3. Pursue the work being done within NATO and the European Defence Agency on interoperability, standards, and the certification and integration of unmanned air vehicles, both armed and unarmed;

4. Promote and encourage coordination, cooperation and exchanges of information among the states that are active in this area, NATO and the European Defence Agency;

5. Envisage within NATO and the EU the common procurement of UCAV systems, as NATO has already done for AWACS radar aircraft and C-17 transport planes;

6. Promote exchanges of information between Europe and the United States on UCAV systems with a view to their future interoperability;

7. Ensure that all transatlantic technology transfers in this field are two-way, taking into account the national security interests of states and industrial interests in Europe;

8. Keep the Assembly informed about the progress of work within NATO and the EU in the field of unmanned air vehicles.

EXPLANATORY MEMORANDUM

submitted by Nigel Evans, Vice-Chairman and Rapporteur (United Kingdom, Federated Group)

I. Introduction

1. On 30 November 2004, the WEU Assembly adopted a report on unmanned combat air vehicles and military aeronautics of the future (Rapporteur: Antonio Braga – Portugal, Socialist Group) constituting an introduction to the whole issue of the increasing use being made of unmanned aerial vehicles[2] in military operations. The use and effectiveness of such systems for intelligence, surveillance, target acquisition and reconnaissance (ISTAR) or for ground attack has been amply demonstrated in the ongoing conflicts in Afghanistan and Iraq.

2. These aircraft are present in different configurations and with varying characteristics in all the armies of Europe, the exception being the attack variant. This is still the monopoly of the United States with its Predator series (MQ version).[3] However, this is one area in which Europe runs the United States a close second and studies are under way that will lead to Europe's skies being increasingly "peopled" with unmanned craft for ground and sea surveillance and internal security tasks.

3. In the European Union framework, the European Defence Agency (EDA) has a pilot project for introducing unmanned aircraft into European civilian and military air control systems. Clearing this hurdle, something that the United States has not yet managed to do either, is necessary in order to deploy UAVs so as to meet the needs of the various public and private operators.

4. UAVs are only one highly publicised part of a process of modernising the armed and security forces based on concepts of network-centric operations and structures and involving an increase in the fleet of robotised, semi-autonomous or remote-controlled air, land and sea-going vehicles. These developments in technology also affect human resources. The Assembly's Technological and Aerospace and Defence Committees have raised these topics in a number of the reports they regularly produce on defence technologies and their implications.

5. However, one area in which Europe is still striving to achieve excellence is autonomous systems of which practically no better example can be found than the technology demonstrators for unmanned combat aerial vehicles (UCAV). This technology challenge is embodied in three major projects:

- Neuron: a multilateral European project led by French aeronautics major Dassault Aviation;
- Taranis: the UK newcomer being developed by BAE Systems; and
- Barracuda: a German-Spanish bilateral project developed by EADS Germany, suspended in late 2007 following the loss of a prototype.

6. The pioneer country, the United States, has rationalised its UCAV projects. Of the two systems under study, Boeing's X-45 (for the air force) and Northrop Grumman's X-47 (for the navy) managed through an organisation called Joint Unmanned Combat Air Systems (J-UCAS), only the latter has been kept as part of a programme renamed Unmanned Combat Air System Carrier Demonstration (UCAS-D). If funds continue to flow, the first deployment tests on board an aircraft carrier will take place from 2011 onwards with a view to a production launch in 2020.[4]

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[2] For the sake of brevity the acronyms UAV (unmanned aerial vehicle) and UCAV (unmanned combat aerial vehicle) will be used in reference to all unpiloted aircraft (aeroplanes, helicopters and other air platforms without distinction) with the exception of guided missiles.

[3] The Predator RQ-1, MQ-1 and MQ-9 Reaper are built by US manufacturer General Atomics Aeronautical Systems. Italy also has six (unarmed) Predator MQ-1, five of them assembled in Italy by Meteor. www.airforce-technology.com and www.ga.com

[4] X-47B UCAS, Northrop Grumman (United States). www.is.northropgrumman.com

7. The US Air Force, which would like control of all unmanned aerial systems (including those belonging to the Army, Navy and the Marine Corps) has now turned its attention to a future strategic bomber project intended to replace the B-52, the B-1 and possibly the B-2 as from 2018-2020.

8. Future projects also include UCAVs carrying directed energy weapons, lasers or high-power electromagnetic or microwave impulse charges but no demonstrators of such technologies are envisaged in the near term. Priority will in actual fact go to the development, production and commissioning of more traditional fighter aircraft such as the F-22 Raptor and the F-35 Lightning II Joint Strike Fighter and to renewal of the in-flight refueller fleet.

9. In reality, in Europe and in the US alike it is not operational requirements that are driving UCAV technology. Essentially, these projects which are highly productive of leading-edge technology are knowhow and research, technology and development (RT&D) capability demonstrators. The end product is less the object of the exercise than the knowledge and superiority acquired in technologies and processes and the spin-offs for other defence or non-military industrial sectors.

10. The states of Europe involved in such projects are thus, unsurprisingly, the most technologically advanced and those furthest ahead in terms of defence and security RT&D. Fragmentation and duplication of effort are once again to be regretted, but national considerations tend to prevail: protection and development of national technological capacity, return on investment and procurement schedules (not synchronised with those of other countries) and differing operational requirements.

II. Current European projects

11. A flagship cooperation project with financial support from France, intended as a research and advanced technology "umbrella" for autonomous network-centric aeronautic systems started to come together in 2004. This was Neuron, awarded to the French manufacturer Dassault Aviation by France's national procurement office (Direction générale de l'armement – DGA).

12. The first European partner in this venture was the Swedish company SAAB, followed by HAI (Hellenic Aerospace Industry),[5] RUAG (Switzerland), Alenia Aeronautica (Italy) and EADS. Belgium also aspired to join this initiative but intercommunal wrangling meant that the intention never became a reality.

13. Of the partners, SAAB and Alenia Aeronautica contributed substantial technical and technological expertise on drones (as well as funding) in the form of the Swedish and Italian prototypes: SHARC (Swedish Highly Advanced Research Configuration) and FILUR (Flying Innovative Low-Observable Unmanned Research) in the case of the former and Sky-X in the case of the latter. The others brought specialist niche technologies into the various project segments.

14. At the same time mention of names such as Raven, Replica and Corax – UAV and UCAV technology demonstrators designed and developed by the UK aeronautics firm BAE Systems – appeared with increasing frequency in the specialist press.

15. While Neuron was born of a government initiative whose aim was to strengthen and develop France's and then Europe's industrial and technological capabilities, the UK projects have been spun off from what was originally the US F-35 Lightning II Joint Strike Fighter programme. They are also part of a strategy for positioning the industry in the area of autonomous network-centric aeronautics systems in anticipation of a possible statement of needs from the UK Ministry of Defence.

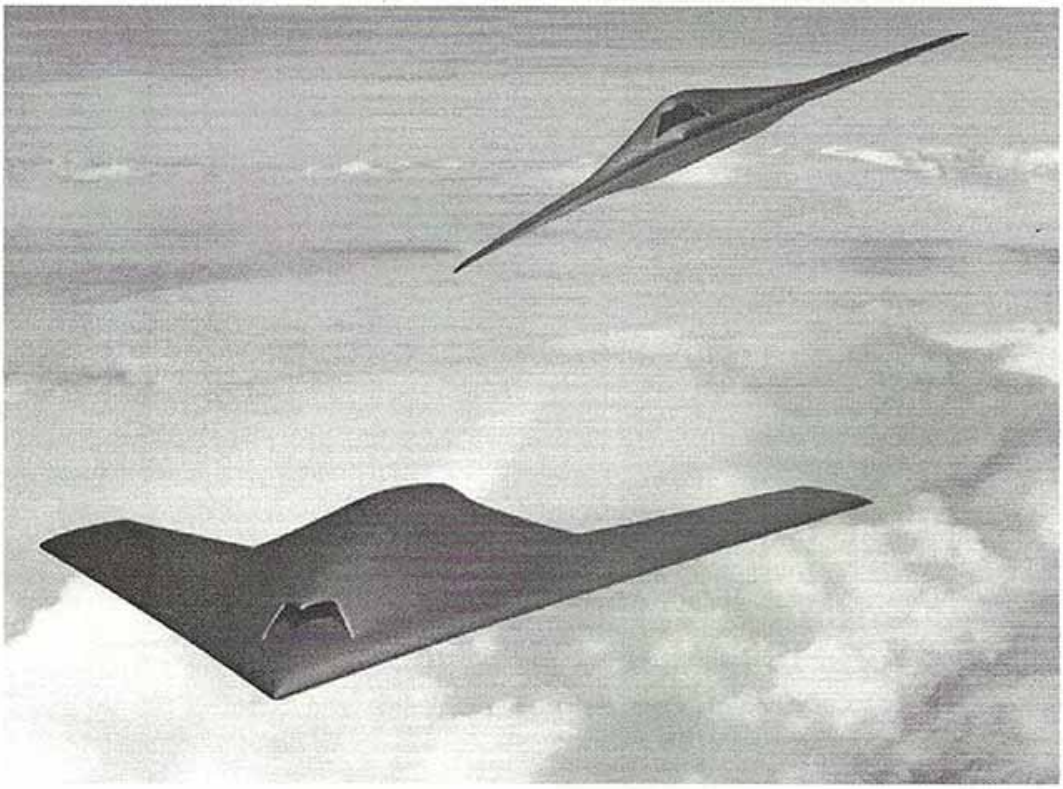
16. Apart from these two French-European and United Kingdom initiatives, Finland, Germany and Spain have joined forces in a common UCAV technology demonstrator project called Barracuda which reached its culmination in September 2006. Barracuda is part of a wider project, "Agile UAV in a network-centric environment" the driving force behind which is EADS Germany as the prime contractor. This project could emerge as a competitor to Neuron. Unfortunately the only existing prototype was lost in the Mediterranean during a test flight in September 2006. The project restarted in early February 2008 with Switzerland replacing Spain.

[5] A Greek state-owned company.

17. These various projects tend rather to complement than compete with one another. In interoperability terms, the differences between them whether in regard to technology or end use are not insurmountable. And yet, because they involve commitment on the part of the larger European nations and the major leading-edge firms in the aeronautics sector, it will be difficult for them to converge, or merge, in a future joint flagship programme.

18. Each of these UCAV projects, born of national investment, interest and the desire to protect the national defence technological and industrial base (DTIB), are too "strategic" to allow anyone to give way to the competition. Moreover, uncertainty over investment returns, in the form of orders placed by air forces and export opportunities, point to the need ultimately for a European UCAV technology pool based on interoperability and complementarity.

1. Neuron – Europe's flagship



19. Neuron is not a UCAV but, like its other European counterparts, a technology demonstrator. First announced in 2003 and supported by a generous subsidy in excess of 300 million euros from the French Defence Ministry, the project acquired a European dimension from the outset under the sponsorship of its "framework" nation, France. The governments and companies involved negotiated throughout 2004 and into 2005 over the common design, financial contributions and work sharing.

20. 2006 saw the formal launch of the project with the award, by France's national procurement agency the Direction générale de l'armement (DGA) on 8 February 2006, of the contract for the development of the demonstrator to Dassault Aviation as the prime contractor. The participants' goal is production of an operational technology demonstrator by 2011.

21. European countries involved in Neuron alongside France are Greece, Italy, Sweden and Switzerland. Participation is open to other states subject to their making a financial[6] and technology contribution. The limited number of state participants is both an advantage and a handicap, the advantage being that three of them, France, Italy and Sweden, already have acknowledged expertise in aeronautics technologies and unmanned aerial vehicles. Greece and Switzerland bring technical capacities and specialist knowhow in certain fields (such as materials, engineering, test infrastructure and evaluation).

22. The project also represents a European commitment that does not exclude consideration of national economic, industrial and technology interests. If the demonstrator project succeeds and becomes an armaments programme, the participant nations will have a 21st century network-centric combat aircraft and – perhaps an even more difficult feat to achieve – one with the kind of artificial intelligence to guarantee the system's autonomy. These defence spinoffs are mirrored by advanced technology gains in the civilian sphere (in terms of materials, information technology and networks).

23. Neuron is thus, technologically speaking, a great leap forward for the countries behind the project and, overall, for science and technology in Europe. In this respect, the project represents a combined effort of considerable potential by a small, tightly-knit group of countries, with coherent objectives, which are evenly balanced in terms of their technological capacity. Even with Dassault Aviation and the French Government at its core, a project such as this can only be viable in European and international market terms by operating as a multilateral industrial and technological cooperation between governments.[7]

24. As a vehicle for industrial and technological cooperation, Neuron is strengthening and developing synergy between European firms in the aeronautics sector which until now have remained outside the EADS constellation (with the exception of the Spanish EADS-CASA). Dassault Aviation, SAAB and Alenia Aeronautica are major national and international industrial players in the military and civilian spheres. They work with EADS-Airbus but until now have remained independent.

25. Through close cooperation in an innovative high-tech project, firms such as these could be the forerunners of an emergent European industrial grouping in the field of UCAVs and artificial intelligence as applied to military and civilian aeronautics. This is another major challenge for Neuron.

26. From an operational viewpoint Neuron is not as yet an unmanned fighter aircraft, but a technology demonstrator. Its purpose is to "demonstrate the capability to perform the most stringent missions, under the harshest conditions, fully integrated within a network-centric environment". Its maiden flight is scheduled for 2011. The objectives are:

- "to show that it is capable of fully automatic take-off and landing;
- to demonstrate the feasibility of an air-to-ground mission (...) and launch one or several offensive payloads; [and for it]
- to reach its target under optimal stealth conditions, with minimal radar and infrared signatures".[8]

27. The current prototype has a single engine and a swept W-shaped wing, similar to the American B-2 Sprint strategic bomber. The plane, to a scale three quarters the size of the future operational UCAV, measures 9.3 metres in length with a 12.5 metre wingspan. Take-off weight is estimated at 5-6.5 tonnes. It is a subsonic craft (Mach 08.5) with endurance of some 12 hours.

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[6] In the project's present configuration, France provides 50% of the funding. Total investment by the five partners is of the order of 400 million euros.

[7] A parallel can be drawn, bearing in mind the different contexts, with the pattern of procurement and export of the European fighter aircraft Rafale (France, 294 envisaged, 120 ordered to date, none exported) and Eurofighter-Typhoon (Germany, United Kingdom, Italy, Spain; 620 aircraft envisaged with an additional 72 for export). The JAS-39 Gripen (Sweden) has also had a measure of success but its price is lower than that of its two competitors (204 envisaged with an additional 66 for export).

[8] "Neuron – Europe's UCAV Demonstrator", Dassault Aviation. www.dassault-aviation.fr

28. The engine is a Rolls-Royce/Turbomeca, the infrared sensors are of Italian origin (Galileo Avionica) and the data links are supplied by the European industrial group Thales. For the purposes of the forthcoming demonstration Neuron has two bomb bays each able to take an Mk.82-type bomb – originally an American-made all-purpose gravity bomb, commonly found in the arsenals of European nations.

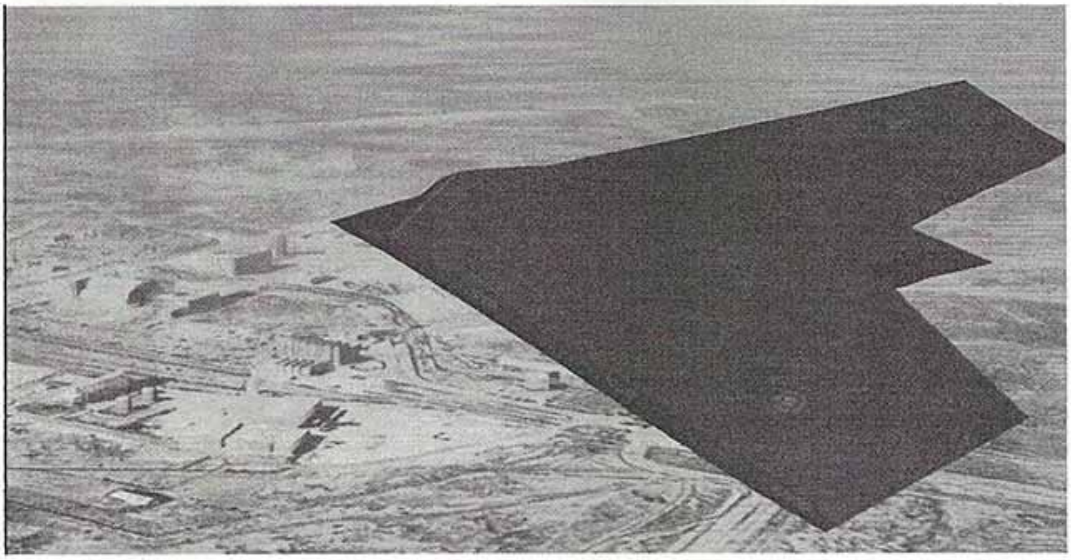
29. To save money, the prototype includes easily available components such as, for example, the engine used in the Hawk training aircraft (United Kingdom, BAE Systems) and the landing gear is taken from the Mirage 2000 fighter plane and the Falcon 900 business aircraft, both produced by Dassault.

30. Another very important and ongoing aspect in this climate of savings is the process known as Product Lifecycle Management (PLM) which involves, when undertaking a project, taking into account its entire industrial lifespan, from start to finish, through the design and manufacturing stages until final product withdrawal and including also information technology instruments and support. This process, developed in the case in point by Dassault Systems and IBM, is being used for the first time in the context of a European defence aeronautics programme.

31. Another very important aspect in relation to European high technology cooperation programmes is the protection of each partner's intellectual property rights. This sensitive issue is currently an obstacle to developing deeper cooperation in this area and to the integration of the European defence technological and industrial base (EDTIB). Within the Neuron framework the advances and discoveries made by a participant firm remain its own exclusive property. Joint ownership extends only to those made in common.

32. This concern for even-handedness in cooperation is the key to the success of the industrial framework supporting the Neuron project. Each individual firm brings in its own special expertise, avoiding overlap and competition as much as possible. All of the partners are responsible for sub-projects and specific components and final integration falls to the group leader, Dassault Aviation. Thus Neuron is more than a technology demonstrator. It is also a demonstrator of political and industrial cooperation in a defence high-tech added-value field.

2. Taranis, the thunder god



33. The Taranis project (named after the Celtic thunder god) represents the knowhow and capacities of British industry in the area of UCAVs. The Taranis technology demonstrator programme (TDP) is being developed by BAE Systems' Autonomous Systems and Future Capability Division and is

supported by the MoD, which has granted it a budget of 124 million pounds (165 million euros) over a period of four years.

34. The aim of this programme is to produce a UCAV technology demonstrator by 2010-2011. In more strategic terms, its objective is "the development of sovereign UCAV ability for the UK armed forces [and] the development of fully autonomous utility UAV systems".[9] Taranis is the result of a series of experimental and development projects launched in Britain between 2002 and 2003.

35. The Replica, Kestrel, Corax, Raven, Nightjar and Herti projects together represent a coherent effort to master and develop advanced military aeronautical technologies (for both manned and unmanned systems) in areas such as aerodynamics, stealth, materials, systems automation and autonomy, infocentric C4I capabilities and artificial intelligence. Those efforts have given BAE Systems a major edge over its European competitors.

36. Taranis is about the practical implementation of the concepts developed in the framework of those various projects:

- Replica: stealth combat aircraft project conducted in the framework of the "Future Offensive Air Systems" (FOAS) programme in order to develop British stealth technologies. Following a five-year research effort a full-scale prototype was built in 1999 for a total cost of 20 million pounds. In 2005, FOAS was replaced by a new programme called "Future Combat Air Capability" (FCAC). The UK also has access, through its participation in the F-35 Lightning II-Joint Strike Fighter (JSF) programme, to the more advanced American research in the area of stealth.

- Kestrel, Corax and Raven: Kestrel was the first British UAV to be powered by a jet engine. The programme ran for six months and the first test flights took place in 2003. Raven and Corax were similar prototypes, one being presented as a UCAV combat capability demonstrator and the other as a demonstrator of ISTAR (intelligence, surveillance, target acquisition and reconnaissance) capabilities on a conventional UAV platform. The first flights were conducted in 2003 (Raven) and 2005 (Corax) in Australia,[10] following a 10-month design phase. The two systems are above all a demonstration of the use of automated and autonomous flight command systems, in particular during takeoff and landing.

- Nightjar: the aim of this six-year programme (2000-2006) was "to test new features, which could be crucial for the future of air vehicle design. The testbody was designed to have a very low radar signature so that technologies fitted on it could be tested without the body itself figuring in the test results. The Nightjar programme provided valuable data on issues surrounding design, aerodynamics, manufacturing and in-service performance".[11]

- Herti (High Endurance Rapid Technology Insertion) is a UAV and UCAV autonomy demonstrator consisting of a flying prototype and a number of ground stations. It forms the cornerstone of the United Kingdom's UAV and UCAV design and development programme, known as SUAV(E) (Strategic Unmanned Aerial Vehicle (Experimental)).[12] The Herti 1A propeller-powered prototype underwent its first autonomous test flight (meaning without remote guidance from an external operator) in August 2005, over Scotland. In November and December 2006, the aircraft's sensors and systems for exchanging data with the ground stations underwent a series of tests in Australia. Herti is also part of the United Kingdom's Morrigan (UAV and UCAV Battlelab) project, which was subjected to its first tests at the Woomera test centre in Australia towards the end of 2006.

[9] "UAV Demonstrators", BAE Systems. www.baesystems.com

[10] Australia, also a participant in the American F-35 Lightning II-JSF programme, cooperates closely with the UK in the field of UAVs and UCAVs, in particular through BAE Systems' Australian subsidiary.

[11] "BAE Systems and UK MoD technology study will shape new generation of aircraft", BAE Systems, 5 January 2007. www.baesystems.com.

[12] SUAV(E) was launched in July 2005, following the suspension of the FOAS programme.

37. In addition to those projects at national level, implemented in short timeframes and, generally speaking, with small budgets of the order of tens of millions of pounds, the United Kingdom is cooperating with the United States in the area of UAVs and UCAVs. The "Churchill" programme, for example, was launched in 2005 for a five-year period with the aim of "exploring UCAS [Unmanned Combat Air Systems], Concepts of Operation, coalition interoperability, Whole Life Costs and technological feasibility (but not technology development or transfer) employing a number of technologies including distributed simulation between UK and US".[13]

38. Taranis has a firmly established technological base founded on 10 years of experimentation and both theoretical and practical research. It is also the result of the Defence Industrial Strategy (DIS) adopted by the United Kingdom in December 2005, with the aim, among other things, of maintaining and developing a national base of critical technologies. The DIS notes with regard to the aeronautical sector, that:

> "As we are introducing two new highly sophisticated manned combat fast jet aircraft types [Eurofighter-Typhoon and F-35 Lightning II-JSF] which are intended to last for more than 30 years, current plans do not envisage the UK needing to design and build a future generation of manned fast jet aircraft beyond these types. However, precisely because the current fleet and the new types we are introducing are likely to have such long operational lives, the retention of an aerospace engineering and design capability is critical for through-life capability management, in order to provide for maintenance, major upgrade and integration of new weapon systems, avionics and defensive aids".

39. One of the ways, precisely, of maintaining a design and engineering capability in the absence of new aeronautical programmes of the classic type, is to invest in UAV and UCAV programmes given that their characteristics and level of sophistication are increasingly close to those of manned aircraft. The DIS states in that respect that:

> "(...) targeted investment in UCAV technology demonstrator programmes would help to sustain the very aerospace engineering and design capabilities that we need to provide assurance of our ability to operate and support our future fixed wing aircraft. Such investment would also ensure that we can make better informed decisions on the future mix of manned and uninhabited aircraft which will need to be taken in the 2010-2015 timeframe. Additionally, the benefit for UK industry is the opportunity to develop a competitive edge in a potentially lucrative military and civil market".

40. The announcement in December 2006 of the Taranis programme was the logical consequence of that strategic choice. It is not a future aircraft programme, but rather a project designed to maintain and develop critical aeronautical technologies in the area of defence security (UAVs and UCAVs offer interesting opportunities in the field of internal security).

41. Taranis is a technology demonstrator for which the first ground tests (control) are scheduled in 2009 and the first flights in 2010. It is depicted with the same swept wing design as the prototypes already developed in the United States (Boeing's X-45 and Northrop Grumman's X-47) or being developed in Europe (Neuron), and with its length of at least 12 metres, it is one of the largest UCAV demonstrators currently being designed. It has similar dimensions to the Hawk training aircraft (11.96 metres long), will weigh about 8 tonnes and fly at subsonic speeds.

42. Taranis is a national programme, managed mainly by the Autonomous Systems and Future Capability Division of BAE Systems. Other participating companies are Rolls-Royce, with its Adour engine (probably the Mk951 model that equips the Hawk aircraft), General Electrics Aviation (former Smiths Aerospace)[14] for the electrical systems and QinetiQ, which supplies "the high level reasoning

[13] The United Kingdom is also acquiring American Predator B observation and surveillance systems for its forces deployed in Afghanistan. "Defence Projects-Strategic Unmanned Air Vehicle (Experiment) SUAV(E)", The Defence Suppliers Directory (United Kingdom MoD), 2008. www.armedforces.co.uk

[14] The British company Smiths Aerospace, one of the partners in the Taranis programme, was sold in January 2007 for 4.8 billion dollars to the American Group General Electric and incorporated into GE Aviation.

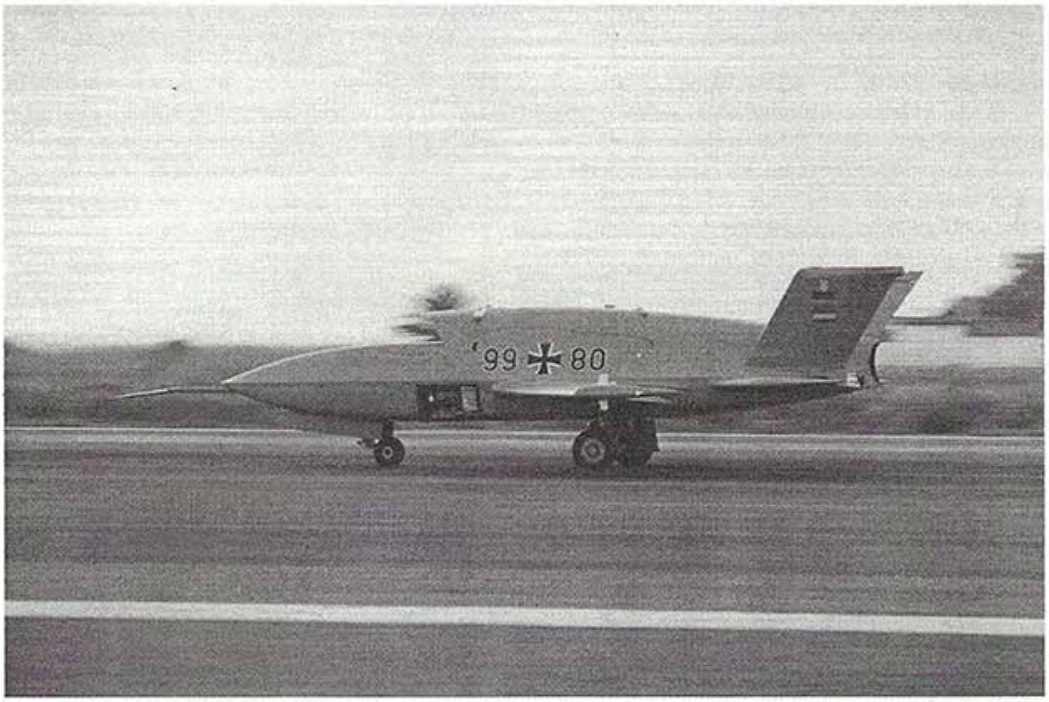
software which will contribute to the vehicle's autonomous capability, the provision of the communications sub-system and associated antennas and the flight safety sub-system".[15]

43. The aim of the first phase, lasting until 2010, will be to demonstrate "the successful integration of off-the-shelf technologies, including Signature Integration, Air Vehicle Performance, Vehicle Management, Command Control, Sensor Integration, Communications Integration and Payload Integration. (...) [An] emulated weapon release will be incorporated into the trial programme as part of a mission representative scenario".[16]

44. A major feature that sets Taranis apart from Neuron or Barracuda is that it is already being developed with a view to future operations. The demonstrator is in fact a first step on the way to developing a genuine "Taranis 2" UCAV designed for deep strikes or air defence operations.

45. As of the second half of the next decade, this new aircraft could replace, at a lower cost, part of the fleet of Tornado GR-4 combat aircraft which are to be gradually withdrawn by 2020-2022. The United Kingdom, with its Eurofighter-Typhoon, F-35 Lightning II and an operational UCAV, would then be the first European country to equip its air force with a mixed fleet of manned and unmanned aircraft.

3. Barracuda – the agile concept



46. In 2003 when the launch of the Neuron project was announced and the United Kingdom's Kestrel and Raven projects had already reached the practical demonstration phase, one company that was conspicuously absent from those initiatives was Europe's major civil and defence industry group, EADS.

47. EADS, the producer of Airbus, the Eurofighter-Typhoon combat aircraft, missiles, launchers and satellites, is a leader in network-centric architectures and their integration in security and defence systems.

[15] "QinetiQ to play strategic role in MoD's £124 million 'Taranis' UAV technology demonstrator programme", QinetiQ, 8 December 2006. www.qinetiq.com

[16] "MoD to invest in unmanned air vehicle technology", UK Ministry of Defence, 7 December 2006. www.mod.uk

48. With its expertise in the aeronautics sector, EADS is a leading candidate for the development of UCAV technology demonstrators, not least of all thanks to the experience acquired through Eurofighter-Typhoon in such fields as simulation, materials, aerodynamics and the integration in combat aircraft of onboard electronics, sensors, avionics and information systems. And yet, the two major EADS shareholder states, France and Germany, have only entrusted it with one major observation UAV programme, EuroMALE.

49. This medium altitude long endurance (MALE) UAV was emerging as the European Global Hawk programme[17] and potential component of NATO's Allied Ground Surveillance system, an ongoing programme comprising a manned Airbus platform and a "Euro Hawk" UAV. The addition of a medium altitude UAV would beef up the capabilities of this system.

50. Moreover, EuroMALE offers observation capabilities not available from tactical UAVs, one of the most sophisticated of which is the Sperwer, developed and produced by the French company Sagem, part of the Safran group. EuroMALE, initially French-funded, appeared also to be a consolation prize for EADS, to compensate for the large investment in the Neuron project.

51. This division of tasks, with the UAV going to EADS and the UCAV to Dassault, was even described as a "founding act" by the French Defence Minister during the announcement of the EADS-Dassault agreement at the Le Bourget Air Show in 2004. Over the following two years, however, EuroMALE was to disappear from the list of European cooperative programmes. This had much to do with the division of tasks between the two major EADS national branches (French and German).

52. Indeed, EADS Germany was in charge of managing the EuroMALE programme, which was also in keeping with Germany's requirements for MALE UAVs. Other European states[18] had also expressed an interest in this major programme with its potential for providing an umbrella structure for various projects. The problem, however, was that the specifications were not defined in common and France was the only country to have clearly stated its requirements, which were for a EuroMALE Eagle-1, with a demonstrator to be operational in 2008.

53. A decision on launching the development and production phases would then be taken by the participating states, first and foremost France, which was to receive the first aircraft, with a view to achieving full operational capability around 2011. EuroMALE could in this way become the European standard in the MALE category, with a total market (European and international) estimated at billions of euros. Indeed, EuroMALE was not a simple UAV but a genuine multirole system which, according to the EADS press releases, would offer the following capabilities:

> "surveillance, acquisition and targeting, in ELINT (Electronic Intelligence) and COMINT (Communication Intelligence) missions, or as a communication relay. For homeland security missions, EuroMALE will be active in the fields of border surveillance, anti-terrorist activities, and pollution control. By equipping it with suitable sensors, it could be of interest to meteorological or cartographic authorities. Scientific research institutions could use it within the framework of atmospheric studies or for terrestrial and oceanographic analysis".

54. However, as of 2006, and following a Senate report recommending that the funds for the project be provided directly from the defence budget (unlike Neuron, which had "supplementary" funding), the French Government reduced its level of support, which led de facto to the end of the EuroMALE project. Nevertheless, the two years of work that had gone into it gave rise to a more ambitious project based on the Barracuda prototype demonstrator that had been designed for EuroMALE.

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[17] The RQ-4 Global Hawk produced by the American company Northrop Grumman is a high altitude long endurance (HALE) UAV. It has a unit cost of 35 million dollars and can fly for 36 hours at 20 000 metres altitude. 14.5 metres long and with a wingspan of 39 metres, it has a maximum weight of 14.6 tonnes ("Euro Hawk"). It is the first UAV to have crossed the Pacific from the United States to Australia (in 22 hours, in 2001). Known in Europe as "Euro Hawk", this model was the fruit of cooperation between Northrop Grumman and EADS. www.luftwaffe.de

[18] Finland, Greece, Italy, the Netherlands, Spain, Sweden, Switzerland and Turkey had also expressed an interest.

55. Barracuda appears to be a spin-off of Eagle-1. It was developed by EADS Germany's Military Air Systems Division and funded by the company in cooperation with EADS-CASA (Spain). It was a UCAV demonstrator which underwent its first flight tests in April and May 2006, the date on which it was unveiled to the public at large, in particular at the Berlin air show (ILA) in June 2006. What set Barracuda apart from its European and British competitors were its shape and dimensions.

56. It was an 8-metre long winged rocket with a 7-metre long wingspan and a maximum weight of 3 tonnes at lift-off. It was composed entirely of carbon composite and powered by a Pratt & Whitney engine (made in Canada). The aircraft body was assembled in Germany and the wings brought in from Spain. There were no hydraulic systems, apart from the landing gear. Barracuda was described in an EADS presentation in 2006, as an "electric airborne system (...) with electro-mechanical actuators".

57. From the outset it was planned as a multirole system in which the UCAV aspect – deriving from its autonomy – was but one among a number of functions. Barracuda was described as follows:

> "a user-friendly technology platform for the testing of a wide spectrum of payloads. The avionic system (...) was developed as an open and modular structure that allows a large number of sensors to be integrated into the demonstrator. (...) these will include electro-optical and infrared sensors, laser target designators, an Emitter Locator System (ELS) consisting of detectors for picking up radio-magnetic signals and also advanced Synthetic Aperture Radar (SAR) systems, which can be integrated on the multisensor principle, being accommodated in the payload bay. In addition to this, it is also possible to equip the testbed for stores tests.
>
> Even if this UAV demonstrator is not a product that is destined for series production, either alone or in cooperation with European partners, EADS will be able to gather fundamental knowhow for operationally mature next-generation UAV products. With this demonstrator, EADS Military Air Systems will gain practical experience in the interoperability of unmanned systems within 'Network Centric Operations' (...) and in autonomous operation interacting with other assets and systems deployed in aerial warfare. The demonstrator will also perform pioneering work towards the certification of UAVs for flight in controlled airspace and the development of 'intelligent UAVs' that can autonomously switch from the surveillance of a predetermined area to a reconnaissance role".[19]

58. EADS Germany sees this project as more than just a demonstration of technological knowhow. Its aim is in fact to create a UAV/UCAV centre of excellence, linking up with the German tradition of aeronautical expertise that was interrupted at the end of the second world war and whose culminating point was the Messerschmitt Me 262 Schwalbe ("Swallow" in English), the first fighter jet to be tested in combat (1944). According to the head of the Military Air Systems Division, "We [EADS] envisage putting the test system, which has within roughly three years been designed and developed up to test maturity by Military Air Systems in Germany and Spain, at the disposal of all those partners in Europe who are interested in the development and production of UAVs for military and other national tasks".

59. EADS Germany then launched the idea of an umbrella programme organised around the concept of "future agile, autonomous and network-capable unmanned mission systems", for which "Barracuda" would be the first demonstrator. It contacted other European countries with a view to involving them in this concept, in particular Italy and Sweden, which had already embarked on the "Neuron" project. The German proposal, which had the financial support of Germany's federal military technology and procurement office (BWB, Bundesamt für Wehrtechnik und Beschaffung), foresaw three development phases:

- 2007: mission development, simulations and hardware-in-the-loop testing of air vehicles;
- 2008: reconnaissance missions demonstrated within Europe including a maritime scenario with a 100 x 100km area of operations at a distance of 500km from the UAV's home base;
- 2010: demonstration of reconnaissance and attack missions.

[19] "UAV demonstrator opens up new technology perspectives for EADS"; EADS Military Air Systems, 11 May 2006. www.eads.net

60. The resulting UCAV technology demonstrator would thus be one year ahead of Neuron, making EADS Germany well placed for a future competitive tender for the production and deployment of such systems on the European and international market. However, those plans suffered a serious setback on 23 September 2006, when the only existing Barracuda prototype crashed into the Mediterrancan Sea off the coast of Spain.

61. Thus deprived of its main asset and technological platform, EADS Germany was obliged to scale down its ambitions whilst keeping alive the concept of an "Agile UAV in Network-Centric Environment" (Agile-NCE). In October 2007, the BWB agreed to support the development of this programme in which Finland (Patria and Insta) and Switzerland (RUAG, which is also a participant in Neuron) are also involved. The new technology demonstrator should in principle be ready for tests in 2008-2009.

62. The programme is due to run five years (2008 -2013) and has the following objectives:

- "risk-reduction processes, the evaluation of key technologies, and the generation of operational concepts for future UAV systems;
- the definition and simulation of missions, of communication links and of platform control under NCE [Network-Centric Environment] conditions ;
- [the] verification and validation of the Agile UAV-NCE concept by performing reconnaissance and sensor-to-shooter missions".[20]

63. Meanwhile the concept of a European MALE UAV was taken up again in 2007, thanks to the joint industrial efforts of Dassault Aviation (France), Saab (Sweden) and Alenia Aeronautica. These three companies, which are also the major partners in Neuron, are proposing a MALE UAV drawing on the technological knowhow acquired from the Neuron project. It will work with the same industrial partnership set-up, with Alenia Aeronautica as the prime contractor.

64. This industrial initiative is also an attempt to preempt the results of a study being carried out by the German, Spanish and French Governments on a joint solution for a new Advanced UAV. Their cooperation, which began in 2006, began to take tangible form when the three states concerned awarded EADS (through each of its three national components)[21] a 60-million-euro risk reduction contract for a duration of 15 months. INDRA (Spain) and Thales are also involved in this programme (for on-board radars). The Advanced UAV system is designed for surveillance and reconnaissance missions. The first results are due to be published in 2009 or 2010.

65. In the meantime, the armed forces of Germany, France, the United Kingdom and other European countries are being equipped with American "Euro-Global Hawk" HALE (high altitude long endurance) UAVs (Germany's fitted with European electronic equipment and sensors, produced in particular by EADS), Israeli-derived MALE UAVs (France and Turkey for Heron and Eagle 1) and American MALE or tactical Predator-B type UAVs (United Kingdom and Italy).

III. European UCAVs: operational, technological and industrial prospects

66. It is anticipated that over the next decade the UAV systems market will be worth billions of euros. New applications include not only homeland security but also environment monitoring and situation assessment in the wake of natural or manmade (industrial or technological) disasters.

67. The existing models, from the small, literally hand-launchable UAVs to the major tactical and strategic systems such as Sperwer, Heron-Eagle, Predator and Euro-Hawk can be adapted at little cost to perform a wide range of missions on behalf of both public and private operators. The major challenge here is to safely incorporate UAVs in civil aviation control systems, for which the constraints are more severe than for military operations.

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[20] "EADS – Agile UAV in Network-Centric Environments' project"; EADS, Military Air Systems Division, 19 December 2007. www.eads.net

[21] EADS Germany is supplying the platform and EADS France the flight system. The flags of the three countries involved in EADS are displayed one above the other on the fuselage of the prototype, with the German flag on top, reflecting the central role of EADS Germany in this project.

68. As far as UCAV systems are concerned, the programmes and projects under way in Europe and the United States are not sufficiently advanced to allow an evaluation of the medium- or long-term requirements. The countries concerned are in the process of renovating their aerial combat fleets and gradually incorporating new aircraft. Moreover, thanks to technological strides in the fields of metallurgy, carbon composite materials, information technology and processing power, and in terms of enhancing engine performance and reducing fuel consumption, the lifespans of existing aircraft and platforms are being prolonged.

69. All this, combined with the increasingly high costs of modern, fifth- or fourth-generation aircraft and the need to maintain a pool of military pilots and attract new recruits (whose main motivation, precisely, is the desire to fly), leaves a marginal role for UCAVs, possibly even as a way of filling minor gaps as and when these arise in the ongoing modernisation/transition of the European and American air forces.

(a) Operational aspects

70. The UCAV concept is a promising one in relation to the likely nature of the conflicts we will face during the 21st century. However, UCAVs are of limited use at their current stage of development which is essentially that of a platform-technology demonstrator. Currently the military capabilities in this area are confined to small subsonic aircraft with a limited payload capacity[22] and armed with 250-kilobombs (90 kg of explosives in the case of the American Mk.82 or GBU-12 Paveway bombs, of which there are two on the Predator) and rockets (four Hellfire on the Predator).

71. By way of comparison, a typical Rafale-type fighter plane has a maximum armed mass of 25 tonnes, flies at Mach 1.8 (2 200 km/hour) and carries 10 tonnes of missiles, bombs and miscellaneous munitions. These features are found on all the existing modern aircraft, including the new American F-22 and future F-35. Moreover, more than one thousand orders for new combat aircraft or upgraded versions of existing aircraft (such as the F-16 and Tornado) have been announced or are planned by the European EU and NATO states alone.[23]

72. Today's first-generation UCAVs take the form of upgraded Predator aircraft useful in theatres like Afghanistan and Iraq and for counter-terrorism and counter-insurgency operations. They are more economical than the more costly traditional platforms, which also take longer to activate (due, for example, to problems of pilot availability, mechanical and technical constraints and ground and naval infrastructure requirements). The current UCAV systems are complementary to piloted aircraft but cannot really replace them.

73. This goes some way to explaining the emphasis given to technology demonstrators. It is not possible on the basis of the current projects and programmes, including American ones, to determine the quantity or characteristics of the final versions that will be chosen by the national defence ministries. The UCAV systems currently in gestation have not yet matured sufficiently to evolve into genuine multirole pilotless combat aircraft.

74. They can be used to design, test and develop aeronautical technologies for incorporation into current manned aircraft or the new combat aircraft being developed for the 2025-2030 timeframe. The best system will probably be mixed, with the option of having a pilot on board or not, according, for example, to the level of danger or whether the aircraft is to serve as a decoy in order to draw enemy fire or locate enemy aircraft.

75. This would presuppose aircraft with similar dimensions and payloads to the combat aircraft currently being flown. This represents a major technological challenge for unmanned vehicles,

[22] Northrop Grumman's X-47, currently in the demonstration phase for the US Navy, could carry up to two tonnes of armaments, equivalent to 20% of the capacity of a modern combat aircraft.

[23] For a more detailed analysis of the modernisation of the aircraft fleets of the United States and Europe (NATO and EU states) see Assembly Document 1948 and Recommendation 792 adopted on 19 December 2006: "Transatlantic cooperation in the aeronautical field: the F-35 Lightning II fighter aircraft (Joint Strike Fighter)", submitted on behalf of the Technological and Aerospace Committee by Nigel Evans, Rapporteur (UK, Federated Group). http://www.assembly-weu.eu

because the parameters to be taken into account are more numerous and more complex to manage (weight, manoeuvrability, management of engines, fuel and other energy sources, choice and activation of weapons systems adapted to the mission, etc).

76. UCAV systems must also be able to defend themselves or evade danger, because although armed UAVs are currently not greatly at risk in Afghanistan and Iraq, apart from light weapons fire, they may well have to operate under much less favourable conditions in the future. UCAV systems, which will be more expensive and sophisticated, with or without stealth capabilities, will be confronted not only with conventional air defence systems but also emerging technologies like directed-energy, electromagnetic pulse or microwave weapons, as well as increasingly sophisticated lasers.[24] These weapons have the specific feature of neutralising onboard electronic systems and causing major disruptions or failure of communications and data transmission networks.

77. UCAV systems present operational advantages related to the types of mission they are designed for, which have been summed up as "dull, dirty and dangerous":[25]

- "Dull: extended periods of operation ('persistence') requiring very long flight times;
- Dangerous: eliminates risk of human exposure to air defence and counter air defences;
- Dirty: eliminates risk of human exposure to nuclear, biological and chemical agent concentrations".

Notwithstanding these qualities, however, UCAV systems are not at the top of the list of priorities when it comes to modernising and replacing European air fleets, a fact which is reflected in the sums invested in the three programmes – Neuron, Taranis and Barracuda – amounting to 500 to 600 million euros over five or six years.

78. In the United States, Northrop Grumman's X-47B demonstrator is being funded by the US Navy which has awarded a system demonstration contract worth 636 million dollars (in 2007) for the period until 2013.[26]

79. These sums concern only the demonstration and initial development phases. Once they have come into service these first-generation UCAVs will need to be updated and adapted to evolving missions and kept permanently maintained. They will require infrastructure and qualified personnel – pilots and operators on the ground, programmers, technicians, mechanics and also users – all of which will call for investments. This is also true of manned aircraft, of course, but UCAVs are supposed to be less costly, which can mean having a larger number of easily replaceable aircraft available as well as making more intensive use of them.

80. Since air force budgets are unlikely to be increased in order to cater for this new category of airborne systems, more complex choices will have to be made when it comes to allocating resources. This is all the more true with the spread of the UAV concept, currently to the field of helicopters, but one day even to that of tanker aircraft. As the inventory of UAVs and UCAVs is increased and they become more widely used (and effective), they will win more support from defence ministries and the case for reducing flight personnel – whose numbers (but not costs) are adjustable – will be all the stronger.

81. This may not have happened yet, but the matter deserves to be given thought, particularly in the context of Europe's regularly declining population rates and tight defence budgets, which are no longer sufficient to pay for all the major land, air, naval but also space equipment programmes that are

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[24] High-energy chemical laser weapons are being studied in the United States and Israel in connection with anti-missile or anti-projectile (shells, mortars and rockets) defence. Examples are the Airborne Laser (ABL) being developed by Boeing as part of the United States' missile defence programme, and the Israeli-American Mobile Tactical High Energy Laser (MTHEL).

[25] BAE Systems – "Autonomous Systems and Future Capability", Mark Kane, Analysts/Fund Managers Visit, 19 April 2007. www.baesystems.com

[26] The US Navy has estimated the cost of the programme at more than 1.5 billion dollars up until 2013, in addition to the initial system demonstration phase: Department of Defense Appropriations Act 2009, Research, Development, Test and Evaluation, Navy (R-1 Line Item 158), February 2008. www.finance.hq.navy.mil

under way or planned for the coming years. The aeronautical sector is particularly at risk, because production series are smaller and states can no longer really afford to buy hundreds of aircraft at a unit cost of 40 to 50 million euros.

82. This is also reflected in the absence of new medium-term combat aircraft programmes for the replacement of the fleets that are currently undergoing modernisation (for the period 2025-2035 and beyond). Under these circumstances, investing in UCAV programmes is a way of maintaining and developing European defence aeronautical technological and industrial capabilities. In the absence of clear declarations on future programmes from state customers slow or unwilling to live up to commitments, the companies in this sector are not motivated to invest their own funds in new programmes that entail anything more than conceptual studies or preliminary research in the area of current and future technologies.

(b) UCAV technology: autonomy, integration in the common airspace and C4ISTAR networks[27]

83. UCAV system demonstrators also offer an affordable means of technological innovation with great potential in terms of practical applications, including in the civil and security sectors. One of the most important features of these systems is their autonomy; more than the simple automation of current UAVs, this entails research into embryonic artificial intelligence systems. Indeed, a UCAV is an "intelligent" weapons system that uses human assistance but is also capable of acting and interacting autonomously in its environment.

84. This is a common challenge for all three European UCAV programmes, but for the Taranis programme in particular. In presentations of its UAV and UCAV programmes, BAE underlines the importance it attaches to this aspect in its ongoing research. Current and future systems are divided into four categories:[28]

- Remotely piloted vehicles: the vehicle is entirely controlled by an operator on the ground;
- Semi-automatic: the vehicle flies on automatic pilot using waypoint navigation;
- Automatic: the vehicle flies a preprogrammed route through waypoint navigation and the payload switches on and off at predetermined points in the flight plan and is capable of tracking a target;
- Autonomous: the vehicle flies a mission based on task and has the ability to autonomously react to threats and its situation awareness; the payload detects and manages target information and the interface between ground and vehicle is task – and information-based, not control-based.

85. The issue of autonomy also raises the question of integrating unmanned air systems in civil air space or in a restricted space that is shared with manned aircraft. This is an essential condition for the future use of UAV and UCAV systems in the fields of security, border surveillance, the fight against trafficking in drugs, weapons and persons and for counter-terrorist action in urban environments. All three European UCAV programmes take that parameter on board.

86. The European Defence Agency and NATO are involved in studies and research in this area, as is the European Organisation for the Safety of Air Navigation (EUROCONTROL), which has a specific UAV-OAT (Operational Air Traffic) Task Force dealing with the subject.

87. Its task is to harmonise operations involving UAV systems in a separate or "segregated" airspace. In July 2007, it also produced a (voluntary) set of specifications for the use of military UAV systems outside such a segregated airspace.

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[27] Command, control, communications, computers, intelligence, surveillance, target acquisition and reconnaissance.

[28] BAE Systems – "Autonomous Capability Overview", Richard Williams, Director Civil Autonomous Systems, BAE Systems (UK & Rest of the World). www.baesystems.com

(c) The European Defence Agency (EDA)

88. From 2005 to 2007 the R&T Directorate of the European Defence Agency (EDA) was involved in a study on "Sense and avoid technologies for long endurance unmanned aerial vehicles".

89. This study was outsourced to a consortium of companies and their research centres: Sagem (France), ONERA (France), ESPELSA (Spain) and TNO (Netherlands). Its objective was "to define a technical solution in 'Sense and Avoid Technologies' for LE-UAVs, in short and medium term as well, in order to integrate LE-UAVs into civilian air traffic and to enable more frequent use of UAVs in crisis management operations. The study was focused on the feasibility of S&A solutions allowing LE-UAVs to avoid mid-air collisions with other airspace users, taking into account technological, regulatory and certification aspects". The results were presented to the Agency's Executive Board in November 2007.[29]

90. The conclusions were as follows:

"The study has demonstrated the feasibility of a mid-air collision avoidance system for LE-UAVs within a 6-8 years timeframe, and following its certification the system may be available in 2013-2015:

- development of new technologies are not needed, but complementary developments and engineering are required to provide a UAV-specific S&A system and its full integration into the UAV airframe;
- in order to achieve the equivalent level of safety with manned aviation, the system should contain non -cooperative sensors and cooperative equipment as well;
- the non-cooperative part of the system should be based on a combined architecture consisting of radar and IR [InfraRed]sensors".

This study also benefited from various initiatives under way in several states participating in the EDA, including the Franco-Swedish MIDCAS project (Midair Collision Avoidance System for UAVs).

91. In December 2005, the Agency's R&T Directorate was tasked with organising another study on "Technology Demonstration (...) on Digital Line of Sight and Beyond Line of Sight Data Links for Long-Endurance Unmanned Aerial Vehicles (LE-UAVs)". This subject is crucial for the future use of UCAV systems, whose autonomy and effectiveness are guaranteed by integrating them in a nodal communication system, a network with over-the-horizon capabilities. This entails the use of C4ISTAR architectures that are complex and robust, in other words capable of continuing to operate even in degraded conditions. The final report was presented in February 2007.

92. The objective was to "define a framework architecture for digital LOS and BLOS data links to integrate the LE-UAV and its on-board subsystems with the existing and future ISTAR networks". The Agency's R&T Directorate called on a Finnish consortium composed of the companies Patria and INSTA, the University of Oulu and the VTT Research Centre to analyse the problem and propose solutions. In its general conclusions the study underlines the following:

> "The success of missions conducted using LE-UAVs are extremely dependent on the availability of robust, high performance communication data links. The Consortium identified flexibility, security and networking as the most important capabilities for the LE-UAV communications still requiring further research and development. These issues were emphasised during all the phases of the study. It was also essential to assure the aspect of multi-source procurement and European self-sustainability of the long-term solutions".

93. The final report, which presents the short-, medium- and long-term prospects, is in fact a veritable technological roadmap for strengthening European security and defence capabilities. These

[29] "Project Overview (18 December 2007) – Technology Demonstration Study on Sense & Avoid (S&A) Technologies for Long-endurance Unmanned Aerial Vehicles (LE-UAVs)", European defence Agency, www.eda.eu. This was the EDA R&T Directorate's third project and the biggest one to have been launched at the start-up of the Agency's activities at the end of 2004-beginning of 2005.

elements, highly useful for ongoing and future UAV and UCAV projects and programmes, are part of a broader framework and their implementation could lead to genuine European autonomy in the field of C4ISTAR capabilities and networks. For the moment Europe is still very dependent on the United States in this area, particularly for NATO external operations or missions in coalition with American forces:[30]

> "The near-term solution for the LE-UAV data link system planned to enter operational use in five years' time must be based mainly on existing standards and solutions. Baseline capabilities are achieved by integrating available state of the art systems and technologies. However, such a near-term solution still has some performance gaps.
>
> Within a period of 10 years, the solution will most likely consist of a mixture of current and emerging technologies, standards and systems. The mid-term solution will provide increased functionality and performance filling the gaps in interoperability, European self-sustainability, throughput and Electronic Warfare-protection. The utilisation of Software Defined Radio technology will provide additional flexibility and interoperability.
>
> The long-term solution, addressing the timeframe of 20 years and further, is based on emerging technologies, standards and systems, as well as technologies still under research. The result will be a cooperative networking solution with sufficient flexibility to adapt to changing regulations and capability requirements. Further improvements in flexibility and performance, will be provided e.g. via cognitive radio and freespace optical communication technology.
>
> (...) Proposed way forward :
>
> - Definition of common rules and standard interfaces for the LE-UAV multilink communication architecture,
> - Selection of LOS and BLOS data link technologies that will form the basis for open standardisation of LE-UAV data link systems. There are strong competencies, as well as many existing elements and work already ongoing in communications technology in Europe. However, attaining the European LE-UAV communications long-term vision will be a multilevel issue and strong initiatives, guidance and coordination of the efforts are needed".

94. In September 2007, the Agency awarded a four million euro contract to a European industrial consortium[31] led by the French government body ONERA (Office national d'études et recherches spatiales) for the construction of three Mini Aerial Vehicle Demonstrators (MAVDEM). This project is worth mentioning since it originally sprang from an initiative of the Western European Armaments Group (WEAG) and was transferred to the EDA following WEAG's dissolution in 2006. MAVDEM is a small four-rotor vehicle that runs on a lithium polymer battery. The first test flights are scheduled for the second half of 2008.[32]

95. At a meeting on 8 and 9 April 2008, the EDA Steering Board confirmed the leading role of the Agency in drawing up a European "roadmap" for the integration of UAV systems in manned vehicle airspace. In January 2008, the Agency awarded a 500 000 euro study to the Air4All industrial consortium (composed of the major European aeronautical and defence technology companies)[33] with a view to developing an integration architecture by 2015.

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[30] "Project Overview (27 February 2007) – Technology Demonstration Study on Digital Line of Sight and Beyond Line of Sight Data Links for Long-Endurance Unmanned Aerial Vehicles (LE-UAVs)", European Defence Agency. www.eda.eu

[31] Onera, Alcore Technologies (France), Oto Melara and Celin Avio (Italy), TellMie (Norway) and Sener Ingenieria y Sistemas (Spain).

[32] "EU Defence Industry". www.european-defence.co.uk

[33] BAE Systems (United Kingdom), EADS, Alenia Aeronautica (Italy), Dassault Aviation (France), Diehl BGT Defence (Germany), Galileo Avionica (Italy), QinetiQ (United Kingdom), Rheinmetall Defence Electronics (Germany), Saab (Sweden), Sagem Défense Sécurité (France) and Thales.

96. The EDA Steering Board also identified four work areas and a new UAV systems project falling under the responsibility of the Agency, and of its Research and Technology Directorate in particular:[34]

- "Integration and coordination;
- Standardisation and harmonisation;
- R&T projects into high-priority technology areas where immediate investment is needed,
- Initial areas for demonstration and validation".

Following a UK proposal concerning the certification of UAV systems, which is currently the responsibility of individual states, the Agency was asked to look into the possibility of setting up an "EU-wide forum on military airworthiness". The aim of this initiative was to limit duplication and save on costs and time in the process of certifying and deploying European UAV systems.

(d) NATO

97. Although the EDA seems likely in the long run to become the European forum for UAV programmes for military and security purposes, NATO is also playing a major role in this area, particularly with a view to the standardisation and interoperability of those systems. By way of illustration we can mention a number of recent NATO standardisation agreements (STANAG) on UAVs, whose specifications can be adapted to UCAVs:

- STANAG 4586 (March 2007) on UAV systems interoperability;
- STANAG 4670 (March 2007) on UAV operator training;
- STANAG 4671 (March 2007) on UAV systems airworthiness requirements (USAR);
- Draft STANAG (2008) on sense and avoid technologies;
- Future draft STANAG (drawn up in cooperation with EUROCONTROL) containing 31 specifications for the use of military UAVs in normal airspace.

98. On 15 March 2007, the Joint Airpower Competence Centre (JAPCC), based at Kalkar in Germany, published a Flight Plan for Unmanned Air Systems in NATO (version 5.4)[35] dealing with the various aspects of UAV use in the NATO framework, including a list of the systems available in the member states, their specific characteristics, utility and operation, issues of interoperability and airspace integration.

99. This report, an update of which is due to be published in 2008, identified a number of problems and proposed various solutions. Identical issues need to be resolved for UCAV systems, which are even more complex than UAVs due to their "intelligent" autonomy:

"a. Ability to plan real-world missions;

b. Fixing problems identified in real-world operations;

c. Effective coordination amongst Nations, the NATO Command Structure, industry, etc.;

d. Prevention of duplication of effort;

e. Prevention of divergent guidance;

f. Identification of future trends/needs and planning for the future;

g. Development of proper documentation;

h. Proper integration between Nations, the NATO Command Structure;

i. Optimization of available capabilities".

[34] "EU governments ask EDA for armaments strategy, agree steps for more defence collaboration", European Defence Agency (EDA), Brussels, 9 April 2008. www.eda.eu

[35] The Joint Air Power Competence Centre (JAPCC) Flight Plan for Unmanned Aircraft Systems (UAS) in NATO (version 5.4), 15 March 2007. www.japcc.de

If these recommendations, which are too numerous and detailed to sum up in the framework of this report, are approved and implemented by the member states, NATO will only arrive at a coherent operational doctrine for the use of UAV systems in 2010, or even, for certain aspects, 2011 and beyond.

100. The Agency initiatives and NATO's efforts to standardise the various European projects and programmes for UCAV systems show the technological potential of those systems which will have major spin-offs for the development of autonomous European advanced RD&T capacities.

101. This in turn will contribute to strengthening the European Defence Technological and Industrial Base (EDTIB) and confirm the role of the defence aeronautical sector as a driving force for innovation in the security and defence sector as a whole, including for land systems (the soldier and vehicles of the future will function in a network), naval systems (the cooperation in engagement concept, CEC) and the development of space capabilities (warning, communications, navigation and observation satellites).

(e) European UCAV systems: industrial prospects

102. Neuron, Taranis and Barracuda represent three programmes, eight companies and some 600 million euros of investments. Like the European combat aircraft programmes of recent years (Rafale, Eurofighter-Typhoon and JAS 39 Gripen), the three UCAV systems are being developed separately, each with its priorities and characteristics, which in some cases are complementary, in others duplicated, in terms of stealth, aerodynamics, engines and materials, autonomy and C4I networks.

103. The interest shown by the big European aeronautical companies in UAVs and UCAVs is also due to the fact that the governments of the major producing countries have not as yet made any commitments as regards future programmes for replacing the aircraft currently being deployed. This process will not be completed before 2015-2020. Afterwards the only remaining markets will be for support, refurbishment and modernisation.

104. Pending possible decisions on the launch of new manned aircraft programmes – which are improbable, but not impossible – it is important for military aeronautical companies to maintain and update their knowhow. This means betting on the future, which entails taking certain financial and technological risks, and it is here that UCAV programmes can play a flagship role.

105. UAV technologies and systems have become widespread and in their small- to medium-sized versions are accessible to a large number of countries with a minimum of industrial capacity in the aeronautics sector. The larger systems however – which include the MALE, HALE and UCAVs – are reserved for the major aeronautical companies. The European products are comparable with the American ones (apart from Predator and the Global and Euro-Hawk), in the fields of observation and tactical surveillance, for example.

106. Furthermore, with American capabilities being tied up in Afghanistan and Iraq, where there is a growing need for these systems – more than 1 000 vehicles of various kinds are being deployed in these two theatres of operations – there is no real pressure to export.

107. The major difference between the US and Europe in this area resides more in the United States' technological edge and in the C4ISTAR resources available to it for the management of deployed planes and UAVs.

108. Neither do the European UCAV technology demonstrators have to fear American competition in the short to medium term, for the United States' only similar project, the X-47B, is destined first and foremost solely for the US Navy for deployment on aircraft carriers. This type of platform is rather rare in Europe.

109. However, in the absence of a real operational demand and a concerted process of reflection on European requirements for UAV and UCAV systems, there is a danger that the EDTIB will once again be characterised by a plethora of different national, intergovernmental and industrial initiatives. Governments are faced with the spiralling costs of external operations like the one in Afghanistan, which has been under way for five years, with no credible exit strategy in sight in the medium-term future.

110. The defence budgets of the European states in the eurozone continue to be taken into account for the calculation of budget deficits, hence a change of trend is unlikely in the medium term. In spite of all the reassuring talk about forces transformation, modernisation and adaptation, there is no consistent follow-up in budgetary terms.

111. In an international environment conducive to a multiplication of international operations – including the fight against terrorism, also known in the United States as the "long war" – the European states are in the front line for having to do more with fewer resources, and this also means an across-the-board reduction in human resources. The pace of equipment programmes has slowed, demonstration, development and production lead-times are growing and there is a real risk of companies gradually turning their backs on the defence sector in favour of the security sector, more profitable in the short term.

112. Neuron, Taranis and Barracuda are three similar and complementary technology demonstrators embodying European knowhow in the high-tech added value defence aeronautics sector. But unless there is a declared operational interest together with a credible timetable, there is a risk that they will remain no more than that, given industrial rivalry and insufficient and irregular government funding.

113. This being the case they will be unable to provide the impetus that would provide the same lift to the European defence aeronautics industry as that which came in the past from the major manned combat aircraft programmes. For all their difficulties, these gave – and will in the medium term continue to give – industry better prospects than that of being a mere service provider (maintenance, modernisation, refurbishment and upgrading).

114. Unless there is a commitment to the later phases of development and production, European UCAV systems may come to look like the swan song of an independent European defence aeronautics industry, with adverse consequences for Europe's autonomy in the field of security and defence.

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