



**MINISTÈRE
DES ARMÉES**

*Liberté
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REFERENCE DOCUMENT **GUIDING DEFENCE INNOVATION**



DrOïD 2022



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EDITORIAL



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The increasing number of health, economic, geopolitical and environmental crises that have affected us in recent years confirms the importance of positioning innovation as a compass. For the Ministry of the Armed Forces, this is reflected in the 2019-2025 military programming law, which places defence innovation among our main priorities to ensure our operational superiority and strategic autonomy. This desire has been translated into an ambitious and respected financial projection with one billion euros of resources dedicated to preliminary studies starting in 2022.

This unprecedented effort responds to the diversity and complexity of the challenges facing our defence: preparation of structuring programmes, exploration of emerging technologies, early identification of potential breakthroughs, capture of innovations from the civilian world and new forms of innovation.

Concrete results have been achieved since the creation of the Defence Innovation Agency in many areas such as detecting dual innovations, strengthening the defence innovation network, the development of support resources and services for the benefit of the various players in the innovative ecosystem, as well as scaling up: the deployment of innovations to users. Above all, these innovations are the driving force for the civil world and the entire nation.

The Ukrainian conflict demonstrates the decisive role of innovation in the war effort. Whether it is emerging technologies such as hypervelocity, innovations in the use of drones, or innovations from the civilian world in the field of satellites and communications or in the field of confrontation in immaterial fields, innovation is omnipresent on the battlefield.

Based on this observation, our priority is to continue and even amplify the dynamics of defence innovation for the benefit of all the ministry's players. This requires us to explore the whole spectrum, from high-intensity technological challenges to the capture of low-cost innovations.

Finally, the magnitude of the challenge requires that we fully integrate all efforts to support innovation in France and at the European level, whether they are specific to Defence (European Defence Fund) or global (Horizon Europe and France 2030) to accelerate both the development and the deployment of our innovations to the forces. Innovation has never been an option for the operational superiority of our forces. At a time when the threats to our security are becoming more and more apparent, and when war in Europe is once again a reality, we must give our forces the best that technology and innovation can offer them. The success of France's weapons is at stake.

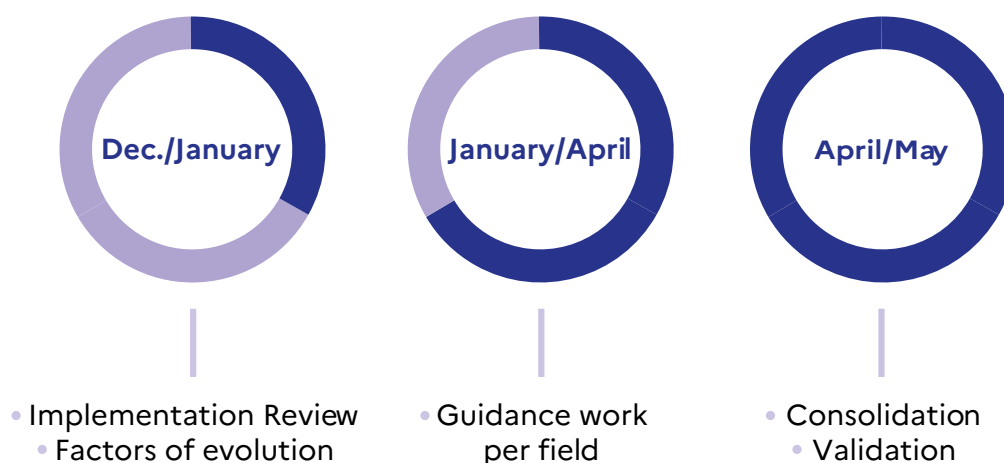
Sébastien Lecornu,
Minister of the Armed Forces

INTRODUCTION

1.1 THE ORGANISATION OF DEFENCE INNOVATION GUIDANCE

The Defence Innovation Guidance Document (DrOID) aims to establish the ambitions of the Ministry of the Armed Forces' innovation policy, in response to three essential goals: the operational superiority of the armed forces, France's strategic autonomy and the Ministry's performance. It takes into account all aspects contributing to this policy without forgetting the challenges of agility and audacity. It focuses in particular on the transformation levers to be implemented in order to achieve these goals.

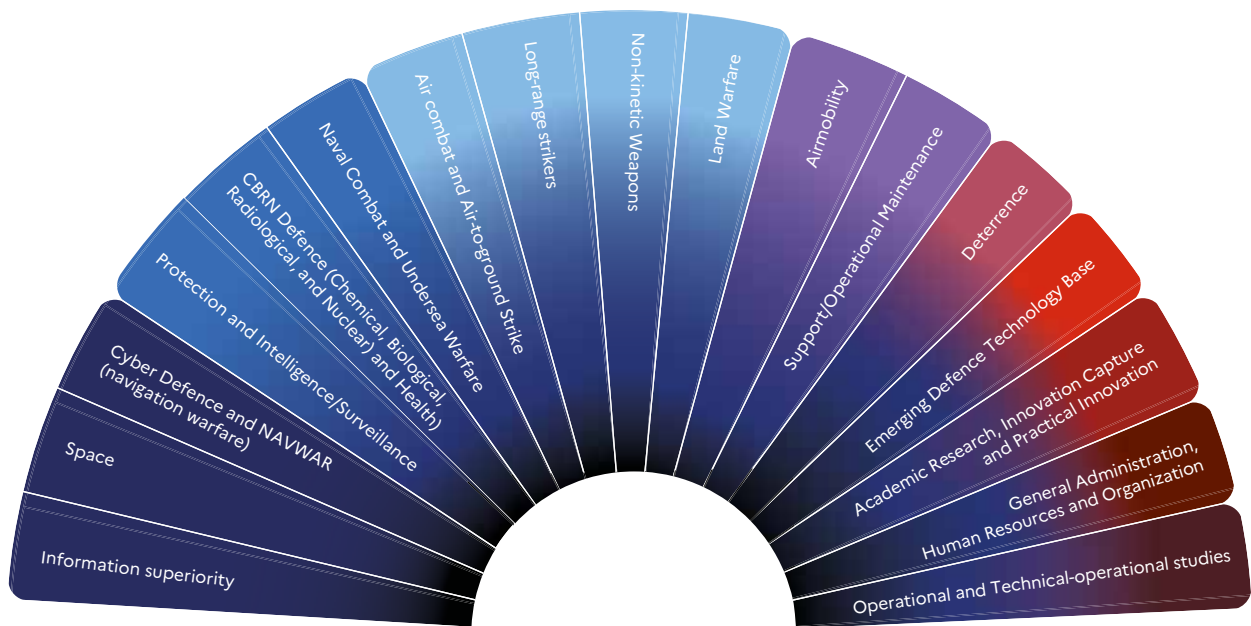
The strategic challenges of the innovation policy are updated annually in an approach that is based on the restitution of the execution of the innovation work carried out and on the identification of factors likely to influence the current orientation, particularly in terms of capabilities, industry, technology and cooperation. These development factors are validated in the ministerial executive committee and are then taken into account in the various fields of innovation, then consolidated with the relevant stakeholders of the EMA, the DGA and the SGA in order to present an overall update of the adopted objectives and coherent financial and calendar ambitions.



New edition of the Ministerial Instruction on Defence Innovation

A new edition of the Ministerial Instruction on Defence Innovation within the Ministry of Defence is being published to strengthen the governance and coherence of the innovation policy. It incorporates the validation of evolution factors in the Ministerial Executive Committee to strengthen the governance and legitimacy of policy work, the implementation of new provisions to promote the scaling up of innovation projects, and affirms the central role of the Defence Innovation Agency in all innovation projects in order to ensure overall coordination and consistency.

1.2 INNOVATION DOMAINS



DEFENCE INNOVATION DOMAINS

The existence of the innovation domains «operational and technical-operational studies» (EOTO) and «general administration, human resources and organisation» testifies to the will and capacity to address all categories of defence innovation and not just technical innovations.

The innovation domains «emerging defence technology base» and «academic research, innovation capture and innovation of use» promote a cross-cutting approach to the orientation of common technologies and the development of

emerging technologies. They allow for an ability to consider emerging and/or disruptive technologies, to facilitate the arrival of new entrants and to avoid specialising technologies by product family ability.

The other domains of technological innovation are linked to the defence systems organisation of the Defence Systems Architecture Department (SASD) and the EMA, which enables defence innovation to be fed by a capability-oriented approach with a high level of technological ambition.

Each innovation domain manager creates the conditions to meet the challenges of their domain by using the most appropriate modes of action (prescribed or open), by taking advantage of all the innovation funding mechanisms and by making the most of the work of the cross-cutting domains and operators under the supervision of the ministry (ISL, ONERA), as well as CNES and CEA.

2 FACTORS OF EVOLUTION



The DrOID sets out the Ministry of the Armed Forces' objectives in terms of innovation, in line with the ambitions set out in the Military Programming Act (LPM).

The 2022 edition maintains the priorities of the previous edition, integrates the adjustments of the LPM in terms of cyber defence (preparing approaches, tools and equipment guaranteeing our capacity to operate under cyber-attack), CBRN defence (for the renewal of CBRN equipment in a context combining unrestrained use, new agents, new technologies and new means of dissemination) and anti-drone warfare. It integrates the adjustments resulting from the analysis of the following evolution factors:

Ambitions defined for the European Defence Fund

Cooperation

Accelerating counter-UAS and hypervelocity roadmaps

New capability topics

Hypothesis of major engagement, hybridity and resilience

New contracts with agreed objectives and performance with supervised operators or schools

Technological sovereignty and sustainable support to DTIB, considering inter-ministerial dynamics

European Defence Fund (EDF)

The EDF encourages cooperation between Member States in the fields of defence R&T and capability development. It follows on from the two pilot programmes, the Preparatory Action for Research and the Defence Industrial Development Programme. It contributes to deepening the European Union's strategic autonomy through two aspects: strengthening the European Defence Technological and Industrial Base (EDTIB), in order to limit the EU's technological dependence; and developing capabilities, which will enable Member States to carry out operations with greater efficiency and autonomy.

A budget of almost €8B has been agreed for the 2021-2027 multiannual financial framework.

On 30 June 2021, the European Commission adopted the first annual work programme of the EDF, which led to the publication of 23 calls for proposals totalling 1.2 billion euros, with the first projects being selected in 2022. France has supported 40 projects. Most of them are part of a response to projects under the permanent structured cooperation or in the framework of innovation research and support for SMEs. The main projects concern air combat (collaborative air combat and its standards, cockpit and the combat pilot environment and new generation helicopter technologies), land combat (future modular vehicle, technologies for land-based drones, architecture for firing beyond visual range) and energy resilience (camp energy, energy storage in military operations, propulsion and energy systems for combat aircraft).

The orientation of defence innovation must take into account the opportunity afforded by the projects selected and ensure coordination with national projects and funding.

FACTORS OF EVOLUTION

Cooperation

The structural interest of cooperation, particularly at a European level, lies in interoperability and interchangeability with partners, but also in the search for economies of scale by pooling needs, thus creating a more efficient, robust and integrated industry and access to projects or studies that France alone could not finance. France promotes such cooperation as soon as practicable, limiting its national sovereignty to what is strictly necessary, both through multilateral structures

(EDA, OCCAr, etc.) and through direct cooperation between countries. Such cooperation can be initiated at the earliest stages of projects, particularly in the scientific and technological fields. At the same time, such cooperation must be balanced for all stakeholders and seek the «best competitor» in order to ultimately propose the best equipment that meets the operational needs of the nations concerned and to submit competitive offers for export.

France is committed to maintaining these strategic objectives throughout the projects. At the end of 2021, work on the preparation of the FMAN/FMC programme (future anti-ship missile, future cruise missile) was launched in cooperation with the United Kingdom, taking advantage of both the «One MBDA» integrated model and the combined funding capabilities of the United Kingdom and France. Work is underway on two missile concepts, a low radar signature subsonic and a highly manoeuvrable supersonic. These future missiles will bring a radical change in the ability to engage ships, equipment, hardened targets and air defence assets at very long ranges and in increasingly challenging environments.



Major commitment assumptions, hybridity and resilience

The assumption of major commitment, hybridity and resilience have long been taken into account in programming work. However, the strategic context has been deteriorating for several years and is highlighted by the heightened competition between great powers that is weakening multilateralism and international law. Disinhibited powers are rearming and do not hesitate to use force, while crisis areas are multiplying, raising the risk of disputes and confrontation. The strategies of our competitors and potential adversaries are being deployed in a growing number of environments and arenas.

This dynamic is conducive to the implementation of hybrid strategies that combine military and non-military, direct and indirect modes of action. It also reinforces the assumption of major commitment and consequently, a growing need for resilience for the army and the nation. Recent engagements have shown an evolution in the modes of action, supported by the development of disruptive and emerging technologies, especially in a multi-domain employment logic, affecting all environments and all domains. The adaptation of technologies developed in the civilian sector for military use, as well as the rise in maturity of emerging technologies, are driving innovation work, requiring both reactivity and flexibility of orientation as well as acceleration in certain areas.

Counter-Unmanned Aircraft Systems (C-UAS)

The need for an anti-drone capability is not new. The use of commercial mini or micro-UAVs diverted for intelligence purposes or attacks with improvised explosive charges has been observed for over 10 years in theatres of operation. The extremely rapid evolution of the threat (clever hijacking of commercial UAVs, homemade UAVs, autonomous piloting) and the deployment of C-UAS systems that are also gaining in performance (jamming of remote controls or GNSS signals, detection of the remote pilot's transmitter) constitute a major evolutionary factor. Moreover, the massive use of armed UAVs is becoming widespread in theatres of operation, as shown by the observations made during the conflict between Armenia and Azerbaijan in Nagorno-Karabakh, or more recently in Ukraine. As a result, air situational awareness must now include a mini and micro-UAV component in addition to aircraft.

In addition to the major projects led by the DGA (MILAD, PARADE), the C-UAS roadmap is being accelerated in order to integrate equipment as it matures, making maximum use of the various types of projects supporting innovation :



Capturing open innovation, with experiments on drones intercepting drones, through the call for projects launched by the Defence Innovation Agency



Practical innovation, building on the VAB ARLAD works, experimented by the Technical Section of the Army



Planned innovation, through defence technology projects on laser directed energy weapon, to prepare a sustainable development (power, eye safety, source sovereignty)



European cooperation, through the C-UAS Project



FACTORS OF EVOLUTION

Hypervelocity

While hypersonic refers to speeds above Mach 5, hypervelocity combines hypersonic and manoeuvrability.

Historically, ballistic missiles fall into the first category, but new hypervelocity weapons are appearing on the battlefield or are the subject of major development efforts: hypersonic manoeuvring gliders and hypersonic propelled missiles. Offering unparalleled defence penetration capabilities, these weapons can be designed to carry a variety of payloads and can be deployed from air, sea or land platforms.

The technical challenges are numerous. They include :

Designing super-ramjets for propelled missiles, to control a limited-speed initial phase, a hypersonic cruising speed, and the final phase.

Controlling hypersonic steering of an object with aerodynamics changes due to the ablation phenomenon of its outer skin

Develop materials and thermal protection for extremely harsh conditions, adapt guidance chains and military loads while seeking out a compact design to meet demanding integration constraints

Developing warning and response systems against adversary threats





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New capability topics

The seabed is a subject of great interest with the development of underwater infrastructures : telecommunications cables, energy transport, oil exploitation. Mining could potentially be developed there. The seabed remains poorly understood because of the opacity of the environment, particularly to electromagnetic waves, and the technical difficulties of accessing the great depths. These characteristics make them ideal areas for clandestine and non-attributable actions.

However, the seabed cannot be dissociated from ocean space as a whole. For the military, control of the seabed is directly linked to the

domain of underwater warfare. In early 2022, the Ministry of the Armed Forces formalised its strategy for controlling the seabed, the aim of which is to guarantee our freedom of action and strengthen our strategic autonomy by taking advantage of technological and industrial opportunities and related cooperation. It is broken down into a roadmap that focuses on automated means such as drones and robots to monitor, detect and intervene at great depths (6000m).

At the same time, the France 2030 recovery plan provides for investment in innovations that will enable exploration of the

seabed, while consolidating the industrial and scientific ecosystem in this domain. The inter-ministerial committee for the sea (CIMex) meeting in early 2022 entrusted the DGA with two of the first missions of this plan to support the development of a drone and a remotely operated deep-sea robot.

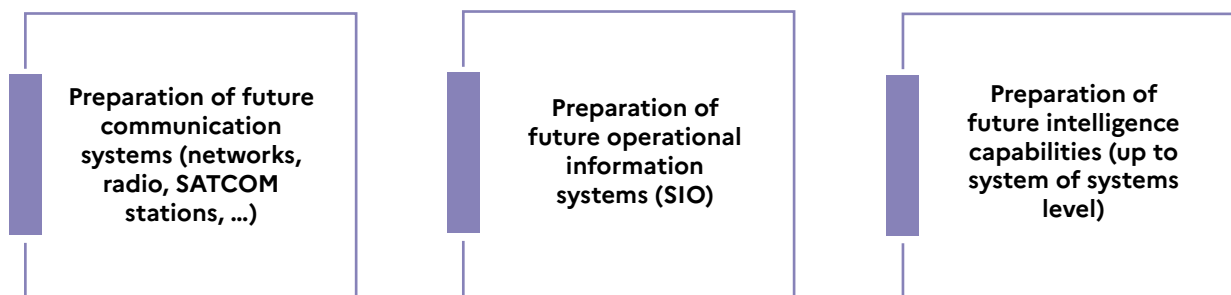
The technologies concerned, which are largely twofold, make it possible to envisage the convergence of this work. Additional studies for the specifically defence-related aspects of seabed control will be carried out by the Ministry of the Armed Forces.

3 AT THE HEART OF INNOVATION DOMAINS



3.1 INFORMATION SUPERIORITY

The «information superiority» area of innovation covers the actions necessary to :



For communication networks, the main challenge is to support the objective of digitising forces by enabling connectivity between the various military platforms, which is essential for collaborative combat and for command and control centres. The studies contribute to the robustness and resilience of networks and to global networking (concept of a network of networks). The defence means of communication are based on :

- a « **controlled core capability** » to guarantee the conduct of operations and the resilience of the State. It contributes to national autonomy and sovereignty of communications, including deterrence;
- an « **augmented capacity** » to complement the services, particularly from opportunities in the civilian market.

The analysis of new technologies mainly driven by the civil sector is also a challenge. The use of these technologies for the «controlled core capability» must be analysed under the criteria of their suitability to the specificities of the employment context, their expected contributions, their impact on our architectures and our sovereignty.

The issue of inter-allied interoperability is important, in particular at the OIS and communication systems level. It also helps to consolidate the national position in the establishment or evolution of standards.

With regard to operational information systems, the main objectives of the technological work are to prepare the development of the SIA programme, to contribute to prospective standardisation work and in particular FMN support and stimulate the emergence of new data processing capacities and

provide technological building blocks for equipment programmes in the GHOM field (Geography, Hydrography, Oceanography, Meteorology).

Given the strong duality of the sector, the challenge is to capture in an agile way the technological developments of the civilian world and the new services of the sector, which often require the use of a cloud as a prerequisite. Capturing these new technologies will require designing future defence capabilities in an open and scalable manner.

In addition to the productions issued by the specialised centres (data processing in France), it will be necessary to be able to exploit locally, from the platforms or in the field, the data produced by the sensors, whether on board or off-board, for tactical use. This local processing is a prerequisite for collaborative multi-environment warfare.

In terms of intelligence, the first challenge is to prepare future sovereign intelligence mission chains that are modular and optimised from start to finish. The second challenge is to improve existing data exploitation capabilities in order to improve efficiency and to absorb the explosion of data volumes, to identify the reliability of information, shorten the intelligence cycle while optimising its animation and finally to cross-reference multi-domain information.

3.2 SPACE

The technological innovation domain « space » covers all studies for the benefit of :

Future space systems in the preparation phase:

- intelligence and imaging satellite (IRIS) and electromagnetic intelligence satellite (CELESTE), which aim respectively to ensure the development of observation and listening capabilities;
- SYRACUSE 4C, preparing the next generation of military communication satellite;
- EGIDE, which prepares the capability for activities in space.

The use of commercial configurations for military purposes and in particular SATCOM configurations in low or medium orbit that complement geostationary satellites, but also configurations for space surveillance or boosting PNT (Position Navigation Time) signals.

Space assets and C4 (Command, Control, Communication & Computing) of space operations developed within the framework of the ADES programme, which aims to implement the French space defence strategy by 2030 through the development of the capabilities necessary to establish the space environment, to protect national strategic satellites and to conduct military space operations.

The emergence of new space related technologies (e.g. space video, optical space communications, in-orbit services, etc.).





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The first challenge of the domain consists of preparing future space capabilities to support operations as well as the evolution of existing capabilities using a risk reduction approach. This concerns the IRIS, CELESTE and SYRACUSE 4C space programmes and potentially the future NAVWAR programme, by analysing the on-board mono/multi-modal data, as well as the resources transversal to these programmes that allow them to be evaluated, such as the technical-operational simulation tools. In particular, the actions of the domain must contribute to the development of technological building blocks essential to future space systems. These capabilities must be modular and scalable, adaptable to new missions and potential technological innovations. They must also be interoperable with other existing or developing systems observation, civil listening, etc.) in a logical manner for connection with the future C2

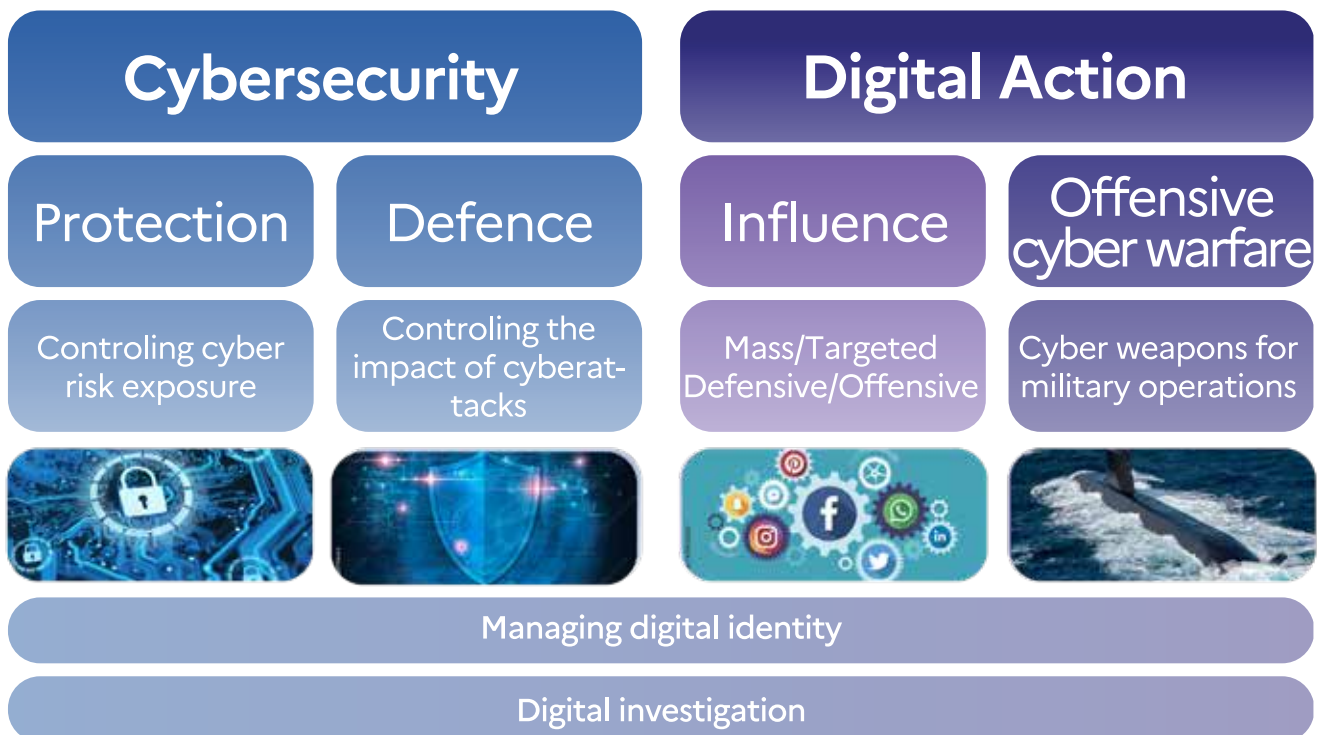
federation, as contributor or beneficiary.

The second challenge is to build an architecture strategy to protect future space capabilities against potential threats and to develop the associated assets. It is also a question of developing the reactive launch component and the in-orbit services that will be able to provide resilience and increase capabilities. This ramp-up mainly involves technological de-risking and understanding the operational concept using feasibility studies and the development of ground and flight demonstrators. EU-backed projects in the field of secure connectivity, observation or space surveillance also provide an opportunity to take advantage of the new impetus given by the EU in the space domain to support the development and implementation of sovereign capabilities. In the context of long-term human

resource constraints and an explosion in the volume of available data, making the most of mass computing by intelligent management and treatment of information is becoming a major challenge. Other issues concern the preservation of the control and availability of critical industrial sectors and the orientation of CNES's work for the preparation of future defence space programmes.

3.3 CYBER DEFENCE AND NAVWAR

The activities related to cyber are described in the figure below :



The acceleration of the digitalisation of the battlefield and the widening of conflicts to the digital sphere lead to new vulnerabilities, thus to an increase in the risks for our armed forces and, on the other hand, to new opportunities for action. With this in mind, the main challenge of cyber defence is the development of a coherent multifaceted tool, allowing all operational assets to carry out their missions despite hostile agents evolving in the digital space (defensive aspect), and to seize the opportunities offered by the development of a more offensive capability, either in order to obtain more effectively effects already achievable by existing capabilities, or to increase the range of achievable effects.

As cyber defence is a capability that cuts across all systems and is highly integrated into their architecture, all programmes are concerned. Specifically cyber armament operations are in charge of providing the elementary building blocks to be incorporated, as well as the integration of the overall capability in the different counter operation domains.

The studies conducted are coordinated with the National Agency for Information Systems Security (ANSSI) at the inter-ministerial level. This activity is realised in particular through the 'key technologies' action of the cyber strategic review, and more recently in the framework of the cyber security acceleration strategy which ensures the continuity and the scaling up of the major cyber challenge.

NAVWAR includes activities related to the following three pillars :



The field of satellite navigation presents strong industrial and sovereignty challenges: it is necessary to have a sovereign and interoperable solution of detectors that can be integrated into weapon systems and respond to emerging threats (denial of access and deception). It is also a matter of preparing the future evolution of OMEGA (operation to modernise the satellite radio navigation equipment of the armed forces), in line with the evolution of the threat (improvement of antennas and processing).

By 2030, OMEGA's defensive approach will be complemented by threat detection, characterisation and localisation capabilities. This will involve adapting operational procedures by developing a system resilience capability, as well as an offensive component to deny an adversary access to satellite navigation services. These activities are also part of a global approach to spectrum management that cuts across several areas of innovation. The NAVWAR component corresponds to the application of this control over the GNSS frequency bands.



3.4 PROTECTION AND SURVEILLANCE

Innovation and research play an important role in surveillance. They contribute to the development of operating systems capable of merging information of different natures and degrees of confidentiality from multiple sources in a short time frame.

These systems, which form the basis of connected collaborative combat, should speed up the decision-making loop for the benefit of operations.

The technical research work will also make it possible to eliminate the risks associated with the upcoming SCCOA programme increments, early warning systems, the C4ISR (Command Control Communications Computer Intelligence Reconnaissance Surveillance) maritime surveillance programme - C4ISR SUR- MAR (maritime surveillance aircraft), SAMP/T (Surface-to-Air Artillery System) increments and future surface-to-air missiles, future AV-SIMAR (Maritime Surveillance and Intervention Aircraft) increments, SDCA (Airborne Command and Detection System) replacement and future HAPS (Stratospheric Balloon) systems, for the associated radar sensors and for all operating systems.

In the field of **space surveillance**, the main objective is to prepare the successors to the GRAVES system (radar dedicated space surveillance) and the SATAM radars (Aircraft and Munitions Acquisition and Trajectory System), and to study the sensors that can contribute to the characterisation and identification of objects in orbit (satellite imaging radars, adaptive optics, etc.) and any other technology that contributes to improving spatial situation awareness.

With regard to **early warning**, the work concerns the validation of existing knowledge, the continuation of work on the characterisation of the threat, as well as the study of early warning system architecture



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and the search for modular solutions for the designation of ballistic targets from the ground to the SAMP/T system.

The work on obtaining a space-based early warning capability, which is being sought on a European scale, is carried out by the 'Space' domain.

The work carried out by the domain also aims to

- to advance knowledge of the environment and its electromagnetic response as well as its modelling, which is essential for the specification and classification of surveillance radars
- to evaluate the performance and value of ground penetrating radars in rural and urban environments.

This work contributes to the sustainability and support of the national industrial sector, particularly in the radar field.

The first challenge of the field is to prepare future surveillance mission chains that must be sovereign, modular and optimised from start to finish.

It is also a matter of preparing the future programmes and the development of existing programmes with a view to risk reduction. This includes:

- programmes dedicated to surveillance capabilities (SCCOA, C4ISR SURMAR, AVSIMAR, the successor to AWACS, the successor to GRAVES, the successor to SATAM, satellite characterisation means);
- airborne radars contributing to various programmes;
- **surface-to-air defence programmes.**

Finally, it is a question of evaluating and supporting technological developments contributing to the improvement of system performance (pseudo-satellites, extension of radar capabilities for ground penetration).

3.5 CBRN* DEFENCE AND HEALTH

This domain covers all studies related to CBRN defence, on improving the monitoring and preservation of the health of military personnel on operations and on improving the efficiency of the military on operations.

In a context of resurgence of the CBRN risk and threat, one of the challenges is to maintain and develop the sovereign capacity to assess the risk. It is also a matter of preparing the implementation of capabilities in the framework of the future incremental programme.

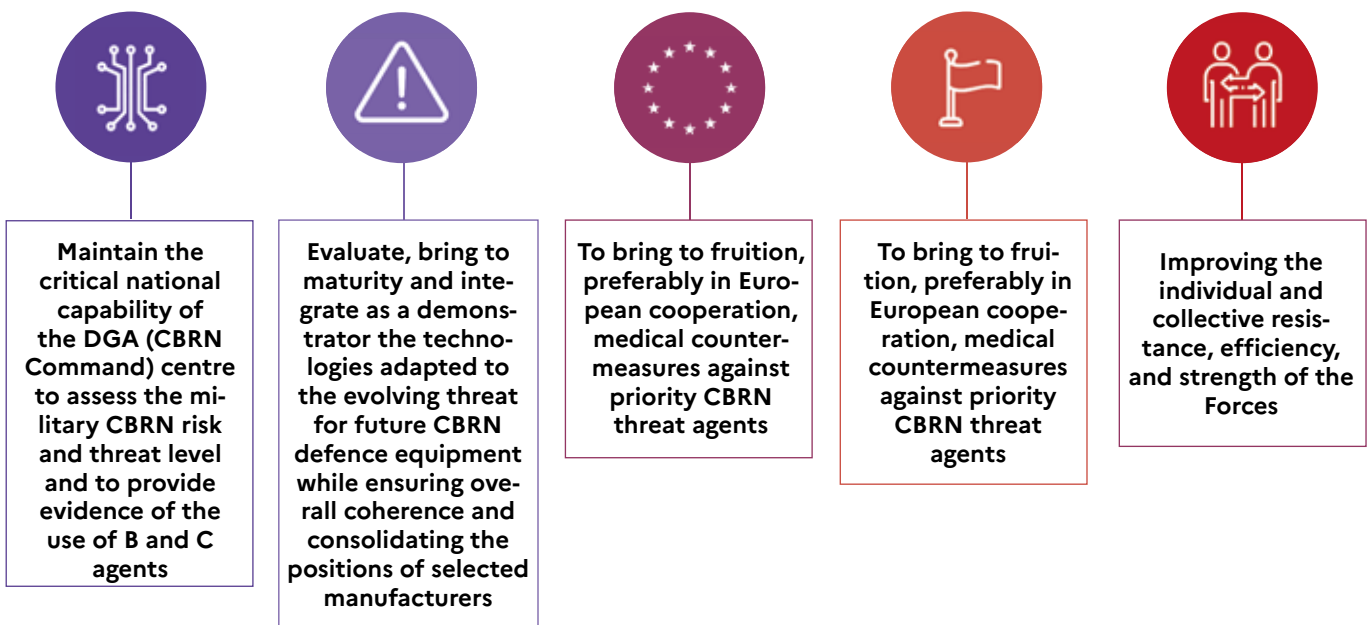
Studies in the field of medical support for operations are intended to complement the provision of care in the civilian domain when it is deemed to be a priority or unsatisfactory, as well as to identify and control the risks to personnel.

They must enable the military health service to carry out its missions by drawing on the expertise of its specialised centres and institutes.



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The main steering elements in this field are :



*Chemical – Biological – Radiological – Nuclear

3.6 NAVAL COMBAT AND UNDERSEA WARFARE

The scope of the domain includes all the technologies required for the design of future surface and submarine vessels (excluding deterrence) as well as for the modernisation of existing ships and submarines. It also covers studies relating to underwater warfare from surface ships and dedicated aircraft. Studies related to above-surface warfare from surface ships, maritime patrol aircraft, helicopters and UAVs are also within this scope.

The main challenge is the ability to develop the existing first rank frigates and SUFFREN class submarines in all their respective areas of combat. At the same time, the aim is to maintain and develop the skills and competitiveness of the naval Defence Industrial and Technological Base (DITB).

Other challenges relate to the improvement of underwater warfare capabilities with work on sonars as well as increasing the performance of electronic warfare, future mine warfare methods and future interdiction capabilities.

Preparations will also be made for a new anti-torpedo system, the renewal of the aircraft carrier component and the airborne maritime patrol capability. The improvement of air-sea engagement through the interoperability of combat management systems, as well as the development of collaborative naval warfare in the first-tier ships, are also challenges.





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The studies selected to address these challenges are as follows :



3.7 AIR COMBAT AND AIR-TO-GROUND STRIKE

Combat aircraft must be able to deal with a wide spectrum of conflicts depending on the type of theatre, from operations against foreign adversaries in urbanised and densely populated areas to high-intensity operations with prolific threats of airspace denial (A2/AD - Anti Access / Area Denial).

The main challenge is to ensure the long-term credibility of combat aviation, both in the context of its commitments in overseas operations and for its contribution to the airborne nuclear component and the protection of the national territory.

In the context of the future air combat system (SCAF), and in order to meet the shorter term operational challenges, notably for deterrence and the achievement of air superiority, it is imperative to modernise combat capabilities and to progress in the various technological fields necessary for the SCAF. This requires the strengthening of connected collaborative combat, the combat cloud, incremental upgrades of the Rafale and other platforms as well as weapons programmes targeting munitions.

A further convergence of transmission means, information systems and the use of data will be pursued. Artificial intelligence and big data analysis will increase

operational efficiency by capitalising on the successive gains linked to a better detection of the adversary. They will also allow the precise analysis of the air picture as well as determining the best tactics to fight the enemy. New munitions to saturate and neutralise the adversary's systems should also be considered.

Finally, control of the electromagnetic spectrum will be sought and new self-protection and counter-armament tools will need to be developed to increase the survivability of combat air systems (fighters, drones, helicopters).

The new capabilities must be just as effective in high-intensity operations as in counter-terrorism and stabilisation operations through their ability to locate and identify even hidden opponents. The use of force must also be adapted to the context and environment, whilst respecting the rules of engagement.



3.8 DEEP STRIKE

This field covers the studies necessary to upgrade existing missile systems or to prepare new systems for conventional deep strike. It also includes « cross-cutting » technological studies for missiles and bombs, in particular energy defence materials, including munitions.

By 2030, militaries will be operating, in a national or coalition framework, in increasingly varied and interlocking theatres, more closely monitored, where the technological advantage and the ability to achieve the element of surprise will be called into question. The greatest threat lies in strategies that aim to challenge France's offensive superiority. The contestation of airspace and access depends in particular on integrated air defence systems, employing powerful radar and surface-to-air systems integrated in mesh networks, possibly used in coordination with combat aviation. These strategies can also be developed around naval capabilities with increasingly effective offensive means, creating highly coherent and robust defence barriers several hundred kilometres wide or deep that can hinder some of our offensive and defensive modes of action.

The ability to deep strike high-value enemy targets, at sea or on land, whilst limiting the exposure of our forces, remains a key capability to have. It requires the ability to operate remotely from the national territory, from projected air bases, from forward ground positions or from the sea.

These power projection capabilities, for strategic missions as well as for first strike, are necessary both to stop a crisis and to contribute to the achievement of land, sea and air superiority in a contested environment.

In particular, the « Deep Strike » domain must prepare :

the FMAN (future anti-ship missile) and FMC (future cruise missile) programmes, by means of a dual-capability weapons family demonstrator (cruise and anti-ship) deployed from air and naval platforms;

the mid-life update of the MdcN naval cruise missile;

the development of future defence energy materials;

the maturing of technological building blocks in the field of non-powered hypervelocity, in order to master long-term hypersonic glider technologies and thus ensure the ability to cope with the development of defences and airspace access denial strategies;

assessment of the use of missile technologies that could meet the need, to be defined, for long-range surface-to-surface strikes;

maintenance of the innovation capability of the industrial defence base in the missile domain;

in the longer term, the development of electric artillery technologies.



3.9 NON-KINETIC WEAPONS

Drones, robots, connected and collaborative equipment are developing rapidly in many countries. They are changing modes of operation by opening the way to evasive strategies (e.g. drone swarm attacks). These strategies are mainly based on low-end means, of which non-kinetic weapons are a promising field of application.

They offer both offensive and defensive opportunities to complement the existing weaponry available to our armies and to respond adequately to these new threats. Non-kinetic weapons can be used in all types of conflicts, from the first confrontation in a crisis to open, high-intensity conflict.

Compared to conventional weapons, directed energy weapons (DEW) have the following advantages: absence of ammunition (logistical and financial benefits, absence of debris), discretion, and scalability of effects. They can also achieve innovative effects compared to kinetic weapons: dazzling the combatant, neutralising protection systems, etc. They therefore appear today as effectors that can advantageously supplement the arsenal of current weapon systems without replacing them and that offer new graduated responses adapted to the context of a crisis, the contesting of space or the unauthorised occupation of space (particularly at sea) while controlling the level of force.

The use of directed energy weapons is promising for surface-to-air or ground-to-air defence and in particular for anti-drone warfare (C-UAS) and zone protection (in the medium term - 5 to 10 years). The ultimate goal of the ADL is to neutralise malicious drone behaviour by providing a threat-proportionate response that minimises fratricide and collateral damage. In terms of protection, DEWs can also be used in the fight against improvised explosive



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devices and self-protection of platforms in all environments. At the other end of the spectrum, DEWs can contribute to the fight against integrated air defence systems, act against optronic sensors and induce effects on the various components of hostile systems.

In the longer term (circa 20 years), a breakthrough is sought with air defence and airborne lasers, applications that are still difficult to envisage given the poor size to power ratio of these systems.

In adopting a systems approach and a technology maturity approach, the main techno-operational challenges of the domain are as follows:

- preparing our future laser weapon systems ;
- preparing our future electro-magnetic directed energy weapon systems ;
- removing risks on particle beam weapon technologies.

3.10 LAND WARFARE

The objective of the land warfare domain is to have the technologies necessary for the development of future land weapon systems (including those of ground-based special forces): mounted and un-mounted soldiers, combat platforms, robots, artillery systems, logistical and engineering resources, guided missiles and rockets for land warfare, weapons and ammunition, active and passive devices contributing to survivability as well as high-level platforms combining these highly digitised systems in a collaborative manner.



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on semi-autonomous control of manned systems and exoskeletons. Improving the protection of land systems is a major challenge, with the development of passive/active protection (soft kill, hard kill), passive/active stealth and the streamlining of protection. The development of multi-sensor systems for the detection or neutralisation of improvised explosive devices must also be studied. It is also necessary to improve the weapon capability in order to increase the range and better control the military effect and accuracy of the weapons.

The technological challenges identified are numerous. The aim is to strengthen and improve the reliability of collaborative combat technologies made possible by the networking of all tactical elements, the storage and processing of data and the development of artificial intelligence technologies. Collaborative combat will have an impact on all major functions at the level of the joint battle groups (protection, observation, fire management, command support, etc.). The resilience of systems in the face of degraded, jammed or 'cyber-vulnerable' communications must also be studied, in particular the architecture and operating principles of the systems.

In the field of ground and near-ground robotics, artificial intelligence technologies will enable progress to be made on the decision-making autonomy of robots (mobility functions and more tactical functions related to mission execution), on multi-robot cooperation and

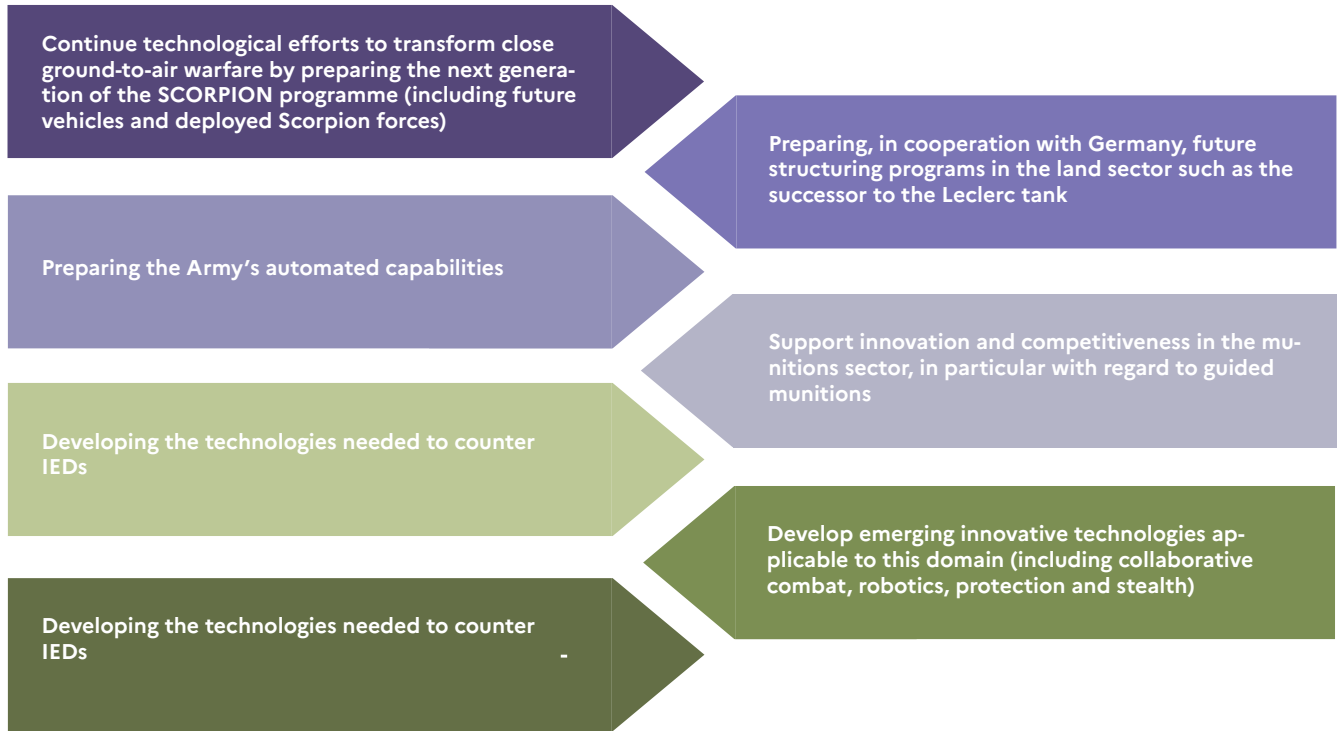
The improvement of optronic technologies for infantrymen (sensors, augmented reality) and vehicles (communicating optronics, next-generation sights/fire control, missile departure detection) will be sought.

In the fields of mobility (hybrid vehicles, engine technology), logistics (instrumentation and big data processing), energy (autonomy of systems, alternative energies), the use of dual or commercially available technologies should address the needs.

A monitoring of current technologies is already in place in order to detect any possible technological gap and to evaluate its application potential for the needs of the land forces.

AT THE HEART OF INNOVATION DOMAINS

Therefore, the field of land warfare is primarily concerned with :



These goals are part of the Titan ambition to ensure the ability to achieve and maintain superiority in the land environment against a top-tier adversary by 2040.



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3.11 AIR MOBILITY

This domain covers helicopters (combat, utility or transport), transport aircraft, airdrops and airlift, aerial drone platforms (excluding combat drones) and mission aircraft, as well as weapons (excluding non-kinetic weapons) for these platforms.

It also includes all the elements necessary for the platforms and their protection, electronic warfare sensors and thus the self-protection of these platforms, optronic sensors, avionics and combat systems.



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The main technological breakthroughs envisaged in this field are :

Drone-aircraft
cooperation,
integrating swarm
drones

Improving man-system
interface to reduce the
crews' workload

New propulsion and
power generation
architectures to
optimize the future
platforms' performance

Improving the
performances of
helicopters, with
better stealth and low
altitude tactical flight
capabilities

AT THE HEART OF INNOVATION DOMAINS

Given the dual nature of the domain, ONERA's expertise should be exploited as well as civilian developments of future helicopter platforms and future autonomous airborne systems. The strategic objectives selected are aligned with military specifications.

Amongst other things, this involves having the critical technologies linked to the autonomy of platforms for future transport aircraft or UAV programmes, including mission and avionics systems. This includes the technologies necessary for manned aircraft-drone cooperation without increasing the size or workload of the crews, via open modular architectures allowing accelerated and simplified development cycles. The technologies needed to improve the flight performance (speed, autonomy, consumption, payload, acoustic and infrared discretion, etc.) of platforms, logistical drones and very long-range drones must also be developed.

The technologies needed to improve the flight performance (speed, autonomy, consumption, payload, acoustic and infrared discretion, etc.) of platforms, logistical drones and very long-range drones must also be developed.

It will also be necessary to have the technology to guarantee the integration of UAVs into air traffic,

a coherent architecture for self-protection in the face of threats in the post-2030 horizon as well as the technological building blocks for pilot assistance systems in degraded visual conditions.

The control and availability of critical industrial components for platforms and systems is also a strategic autonomy issue.



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3.12 MAINTENANCE, REPAIR AND OPERATIONS

The innovation domain « Maintenance, Repair and Operations » aims to develop new technological solutions to improve technical availability and control support costs for all platforms. It does not deal with platform specific solutions but contributes to the development of generic solutions.

The main elements of the approach are as follows :

Consideration of the issue of data (collection, labelling, storage, exploitation, processing), which is the raw material for many new enabling technologies

The development of the most promising maintenance concepts and methods, taking advantage of technological developments

Promotion of priority actions across all platforms, such as obsolescence management or surface protection



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METAL ADDITIVE MANUFACTURING

The FAMSIE (Metal Additive Manufacturing for State Industrial Support) innovation acceleration project, accredited in 2021, aims to establish and de-risk the metal additive manufacturing process for aeronautical parts, including their certification. The aim is to compensate for supply shortages on non-critical parts, which leads to downtime. The parts produced during the experiment will be used in a real operational environment, the Mirage 2000D fleet being a prime target.

This project constitutes a practical innovation that will help the Aeronautical MRO chain (DMAé and SIAé) in the development and use of new technologies and processes.

3.13 EMERGING DEFENCE TECHNOLOGIES BASE

The innovation domain brings together specific defence studies in cross-cutting areas, such as components, energy, eco-design, sensors, quantum technologies, materials and systems of systems. These studies are of interest in many areas of innovation because of their multiple spin-offs for a large number of programmes.

The challenges of the innovation domain are the control of risks related to the security of supply in the materials and components sector. It is also necessary to prepare the future generations of critical components as well as developing the most promising cross-cutting technologies for defence applications in areas not covered by the other innovation domains.

This domain also contributes to the consideration of the energy role in weapon systems in accordance with the objectives of the ministerial strategy for energy performance. It is also the owner of the actions relating to the inter-ministerial roadmap on quantum technologies. Another challenge is the positioning of the innovation field vis-à-vis the European Defence Fund and the opportunity to structure cooperation initiatives around mutual subjects of interest (components, quantum sensors, materials).

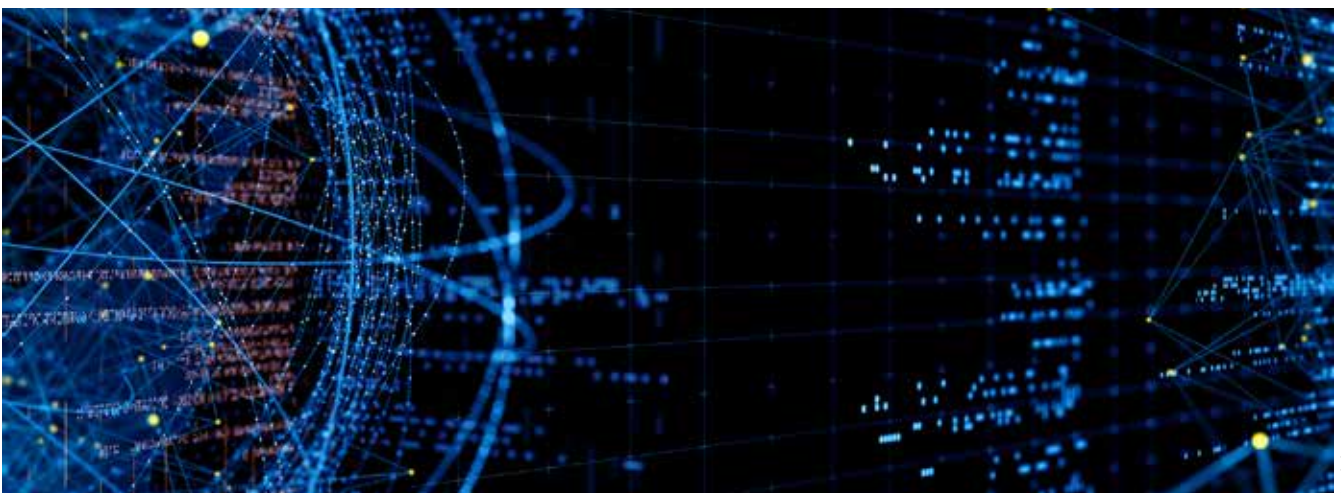
The main elements of the 2023-2028 guidelines in the Platform for Emerging Defence Technologies» domain are as follows :

Ensuring long term access to critical components. This means developing cooled infrared detectors, gallium nitride components, 3rd generation IL tubes (visible and near-infrared) and the related industries, to ensure security of supply.

Develop cross-cutting technologies: quantum sensors (ultra-stable, semi-naturised atomic micro-clock, spectral analyser), stealth materials, ballistic protection, high-temperature materials, functionalised textiles, additive manufacturing, radar processing, new optronic technologies (laser sources, active 3D imaging, energy efficiency, etc.) and promote their integration into future defence systems.

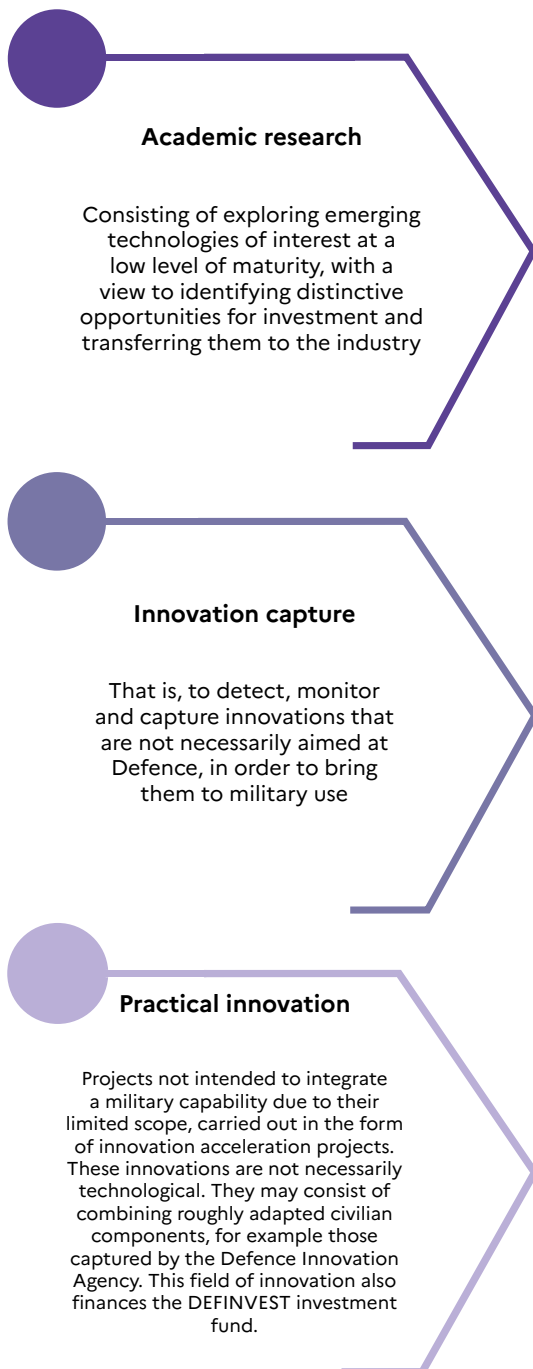
Adapt and strengthen State technical skills, which span other fields of innovation and are necessary for future armament operations (system engineering, component operating safety, material behaviour, new radar and optronic technologies, control of electromagnetic constraints, etc.).

Contribute to the establishment of the interministerial roadmap for the development of quantum technologies



3.14 ACADEMIC RESEARCH, INNOVATION CAPTURE AND PRACTICAL INNOVATION

The innovation domain includes three activities aimed at the wider ecosystem outside the ministry :



Academic Research

The challenge is to exploit the exceptional potential of the French research ecosystem, both to prepare the capabilities needed to satisfy the «foreseeable military need» and to prepare for the distant future. The chosen approach consists in exploring the opportunities offered by the different scientific fields of interest to defence, by investing in a differentiating manner, i.e. by financing work that would not be conducted or not geared towards a defence need without this intervention. It includes projects with a low, or even very low level of technological maturity, in particular on emerging topics that are potentially ground-breaking, with significant risk-taking, highlighted by the creation of IDEES theses in 2022.

IDEES theses

In 2022, the Defence Innovation Agency launched the first call for IDEES thesis projects, for Unclassifiable, Unusual, Surprising, Astonishing and Singular. This new programme aims to encourage an innovative, offbeat or even heterodox approach, promoting strong risk-taking, by selecting independent subjects, based on an original methodological approach. In keeping with the innovative and atypical nature of this scheme, the Defence Innovation Agency has set up a specific thesis selection committee, made up of young doctors from the DGA, trainee officers from the École de Guerre and researchers from the Institut de Recherche Stratégique de l'École Militaire (IRSEM).

AT THE HEART OF INNOVATION DOMAINS

The Agency finances more than one hundred theses per year, which allow numerous scientific avenues to be explored. Larger research projects may allow these avenues to be explored in greater depth and to consider transferring this work to industry. On the one hand, the Agency relies upon an «open» component of calls for projects focusing on themes of defence interest, relying on its long-standing partnership with the National Research Agency (ANR) to access the entire academic community, either through a generic call for projects on a broad spectrum of interest, or with calls for projects

on a more specific theme, such as energy or cognitive warfare in 2022. On the other hand, the establishment of partnerships with reference players on specific themes allows for long-term coordination until the research work is transferred to industry, like the partnership with the Institut Polytechnique de Paris and its interdisciplinary centre for defence and security studies created in 2021.

ASTRID Call for projects on Energy

Consists of two subthemes :

Energy efficiency adapted to severe environments, with a particular interest in maintaining the performance of energy storage systems in a temperature and humidity range compatible with overseas deployments. The adaptation of energy storage systems to impulse operation, and the security of energy storage systems are also topics of interest.

Energetic materials. This sub-theme focuses on increasing performance (detonation rate, specific impulse) and safety. It focuses on the development and evaluation of new energetic molecules, but also on new formulations, particularly with regard to the search for new binders.

It also targets new processes for the synthesis and implementation of energetic materials (mixing by acoustic resonance, flow chemistry, additive manufacturing, etc.).

The link with industry is particularly sought after, either directly within the framework of research work, with the financing of CIFRE-Défense theses, scientific interest groups, industrial chairs or within the framework of projects for the maturation of research work towards industry, which facilitates the exploitation of this work for the benefit of innovation domains with a focus on capacity.



Innovation Capture and Practical Innovation

The challenge is to capture civilian and dual-use innovation in order to seize either the opportunity for rapid integration of new technologies or high value-added solutions, or to support the diversification of civilian innovations into defence use cases to generate a breakthrough. In both cases, the objective is to support the operational superiority of the headquarters, directorates and services (EMDS). The Agency will strengthen its efforts to identify and support high-potential projects. The levers used for this purpose are the continuous dissemination of active monitoring reports, as well as the results of the implementation of innovation acceleration projects. In decreasing order of maturity, these projects may be prototypes, demonstrators or models. The prototypes, defined as first pre-production, will aim to satisfy

the sub-capability needs of the MSDEs not taken into account in the framework of the military programming law. By «sub-capability» we mean those needs which are not intended to be taken into account by a military capability or an armament programme, due to their small volume or limited scope, but which nevertheless correspond to obstacles for the armed forces. Furthermore, if the maturity of the innovation (for example, technical solution) is not yet at the prototype stage, demonstrator projects will aim to develop insights in order to inform armament programmes and capability development. The future increments of the armament operations concerned will thus be able to benefit from this process of acceleration and the associated de-risking.

Finally, some of the projects financed by this domain of innovation pertain to the model, i.e. the illustration of a concept. They will involve the development of exploratory sketches in order to shed light on the capability chain for use cases not taken into consideration by classic forecasting. The projects in this field of innovation are financially supported by contracts (public contracts) or subsidies (in particular the RAPID programme).

In addition, the Agency will conduct activities with the EMDS in order to better understand and capitalise on the sub-capacity needs not taken into account under the military programming law. This database will be continuously updated based on feedback from these agencies to the IDA.



AT THE HEART OF INNOVATION DOMAINS

AI Roadmap

Artificial intelligence performs tasks that have long been reserved for humans based on three factors: the availability of digitised information, accessible computing power and algorithmic advances.

Amongst the most significant recent advances, Generative Adversarial Networks techniques have enabled the creation of pre-annotated synthetic data. In the field of automatic language processing, transformer-type architectures have made rapid progress and are being extended to other applications such as image processing. However, this promising approach requires very large amounts of data and high computational costs. These constraints will require close collaboration with the academic and/or industrial research community in order to adapt this technique to the defence environment. If AI is to play a major role in the future operational superiority of the armed forces, particularly in the event of high-intensity conflicts, the criticality of defence systems integrating AI requires understanding their requirements beforehand and an incremental approach is recommended to rapidly increase the performance of our capabilities.

Thus, a perfect mastery of the issues of ethics, trust, embeddability and robustness in the face of the risks of circumvention is to be sought along three lines of R&D, which may be subject of shared efforts in the European Defence Fund:

- **explainable AI** : acceptability to human interaction, hybrid AI systems mixing symbolic and digital ;
- **frugal AI** : techniques for small data and embedded AI, distributed AI, edge computing ;
- **evaluation, verification and qualification** methods that could be further developed in collaboration with the stakeholders of the Grand Défi confiance.ai.

Defence-related missions require the removal of technical barriers relating in particular to the processing of massive and heterogeneous data (images, video, text, speech): real-time intelligent sensors, detection, recognition and identification techniques, multi-target localisation with particular

dynamics, detection of changes, anomalies and singularities in digital streams Beyond defence systems, AI must contribute to the cybersecurity posture, to the fight against disinformation and digital influence.

One of the prerequisites for the successful integration of AI in defence systems is the creation of a body of data, which is needed in large quantities for machine learning. However, although the tools for massive data processing are now mature and the architectures have been stabilised, they require a high level of skills to deploy and operate them, hence the recommendation to use the ARTEMIS-IA software development kit, available at the end of 2022, which will enable the tools necessary for massive data processing and the development of AI algorithms to be learned in a representative environment, whilst promoting scalability.

Finally, the use of AI for defence systems must rely heavily on the civilian, academic and industrial ecosystem. Stimulating and encouraging the ecosystem allows for early detection of opportunities and support for feasibility and innovation work by pursuing a policy of calls for projects and reviewing spontaneous requests from specialised economic players. The Ministry of the Armed Forces is also preparing a «Defence AI Ecosystem» project, the overall management of which will be entrusted to a trusted public or academic participant via a framework agreement.

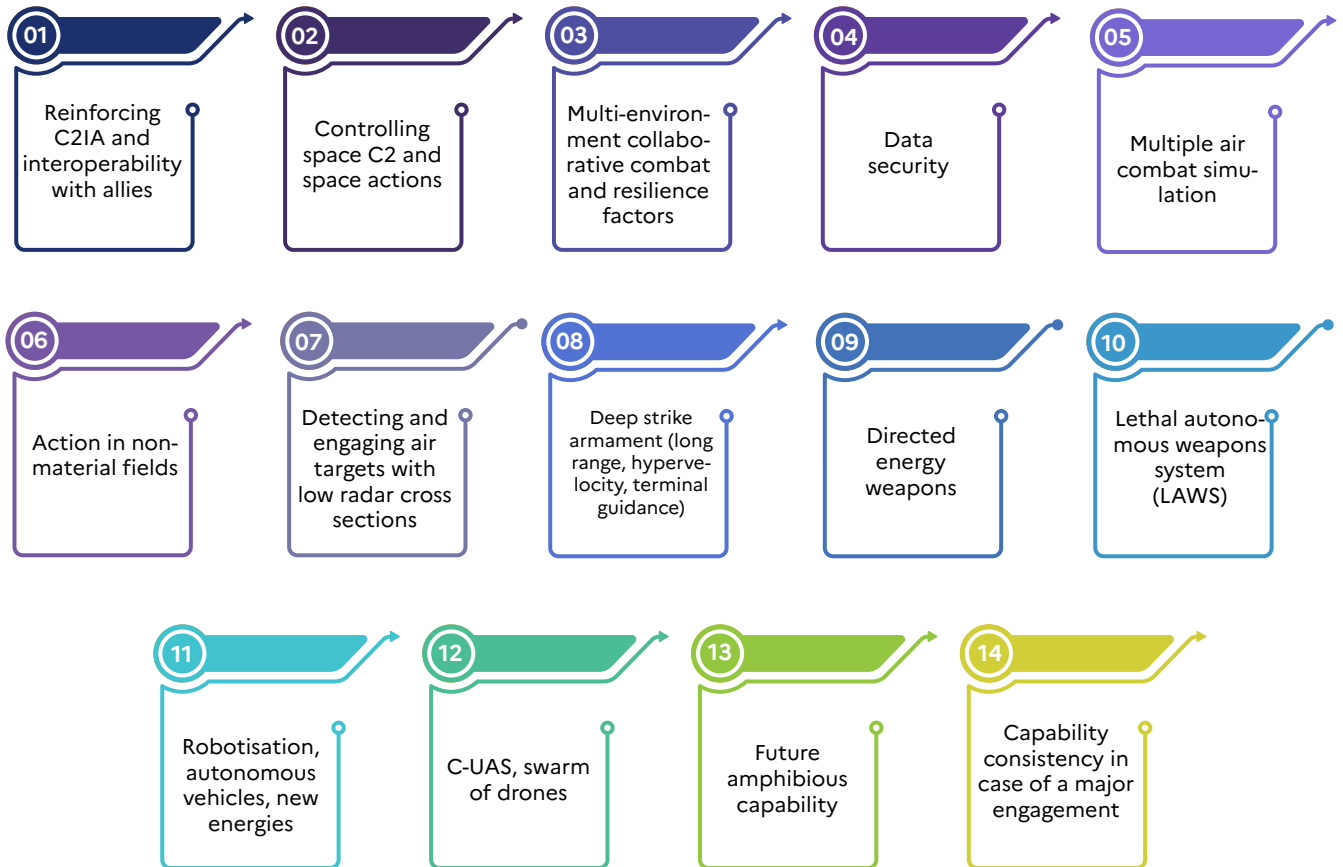
This work will be done in synergy with the roadmaps of the prime contractors with whom it is desired to establish institutional exchanges and share a map of trusted French players specialised in AI.

3.15 OPERATIONAL AND TECHNICAL-OPERATIONAL STUDIES

In the organisation of defence innovation, the Armed Forces General Staff is responsible for the innovation domain «Operational and technical-operational studies» (EOTO), which is designed to structure these studies. These studies are part of the planned innovation chain from the very beginning of the analysis of military needs, even before the launch of defence technology projects in preparation for armament operations. They are one of the tools for preparing future capabilities and may be useful in clarifying choices in support of a long-term strategy structured by master plans. These studies also serve as a means of elaborating threats. They are

also intended to provide elements of understanding for the assessment of future military needs and assist in the search for the best compromise between operational requirements and technical possibilities for the benefit of financially sustainable future capabilities. The EOTOs contribute to the preparation of armaments programmes within the framework of Ministerial Instruction No. 1618 and its implementing legislation in favour of strengthening the capability approach.

In order to anticipate programming and to meet capability milestones, the following themes of interest constitute the orientation of EOTOs over the current LPM period :



3.16 GENERAL ADMINISTRATION, HUMAN RESOURCES AND ORGANISATION

As a lever for transformation and modernisation, innovation in the administrative professions of the Ministry of the Armed Forces aims to offer a better quality of service to the defence community and its users, but also to gain in efficiency by involving new ways of working for the personnel on a daily basis.

The Delegation responsible for the Transformation and Performance of the Ministry (DTPM) aims at supporting the services in their digital transformation projects and innovation capability.

Innovation and R&D are mainly conducted by two laboratories :

- LABO BI and Big Data. This innovation lab focuses on data, and more specifically digital and technological innovation on big data and artificial intelligence;

- Innovation and services Lab. It develops in accelerated mode POCs or MVPs with its team of UX designers and web developers. It fast-tracks ideas to support the EMDS. It frames, structures, and resolves transformation issues and opportunities related to administration positions.

The transformation of professions can only be achieved with a multidisciplinary approach and greater importance given to human resources (managers and employees) and to the cultural and managerial transition, inseparable from any transformation project. This is why the SGA has set up a change management and innovation centre to support projects and to disseminate new and best practices in this field through e-learning modules and webinars open to all. Thus, innovative solutions are being sought in particular for :

- Develop real-time data sharing and collaborative design capabilities;
- Ensure the security, integrity and traceability of data and information and exchanges;
- Develop capabilities for predictive analysis, correlation and processing of structured and unstructured data that is widely available in order to give depth and perspective to the performed analyses;
- Develop facial recognition on historical images and videos;
- Design and build smart buildings to facilitate their maintenance and evolution;
- Automate repetitive and time-consuming tasks; automate the production of documents from existing content;
- Accelerate and automate the search for and identification of the 'right' information on recurring topics;
- Simplify existing administrative processes by integrating users/customers in their revision ;
- Implement new models of continuous learning, by exploiting playful formats (serious games, augmented reality and simulation) to accelerate learning;
- Rethink recruitment and internal transfer models, by developing talent acquisition programmes, using behavioural and cognitive science techniques;
- Rethink the relationship with users, using the contributions of behavioural and cognitive sciences;
- Offer new user experiences to museum visitors through virtual and augmented reality;
- Increase the uptake of new ideas by setting up a new ideas platform and organising ideas challenges open to civilians;
- Devise and test new uses in the field of Business Information Modeling (training, maintenance, security, supervision, simulation);
- Improve decision support through the use of new technologies;
- Test the applicability of Metaverse, greentech, virtual or augmented reality technologies to the administrative professions.



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The Ministry of the Armed Forces is continuing to explore several avenues of research :

New ways to collaborate on projects and initiatives

Improving working environments by customising and streamlining interfaces

Greater cooperation and collaboration between agents

Experimenting with new management systems and capitalising on knowledge

The sharing of internal management practices

Managerial and organisational innovation consists of adopting more agile, more fluid and more collaborative modes of operation, which bring value to staff and their departments.

It is mainly a question of adapting to the restructuring of the organisation, working methods and tools and the managerial posture. Managers and their employees have high expectations of their work environment.

4 EVOLVING SERVICES

Les défis du XXI^{ème} siècle



4.1 TOOLS FOR INNOVATIVE PLAYERS

By calling on the civilian world, the Agency increases its chances of making use of know-how and innovative solutions likely to meet defence needs. Ultimately, this enables us to significantly strengthen the operational superiority of our armies, directorates and services.

With this in mind, the Agency is multiplying its efforts to capture and even divert innovations from the civilian world.

The One-Stop-Shop

The Agency has set up a one-stop shop to collect spontaneous innovative proposals from economic players (start-ups, SMEs, ETIs, industrial groups), as well as from laboratories and research centres.

A simplified and more efficient project submission

Since March 2022, new services have been implemented in connection with the one-stop shop. Thus, the applicant has the opportunity to self-reference in the Agency's database. This enables the Agency to have a good knowledge of its know-how and skills, so that in the future it can address targeted calls for tenders insofar as the applicant is now known to the Agency's services.

Subsequently, if the applicant wishes to submit a project, it fills in a simplified form and is invited to make an appointment on the dedicated telephone platform. They can then describe their project in detail, emphasising its innovative nature and added value for end users.

Once the defence interest has been confirmed, the applicant will be asked to complete the proposal by filling in a more detailed form. The Agency will then evaluate the project as a whole and decide whether or not it should be awarded a label.



Become known by AID

The applicant registers their company on the Agency's digital application



Consolidating a project

The applicant fills in a simplified form and submits a request for a telephone interview to present his or her project



Submitting a project

At the Agency's request, the applicant fills out a detailed form, which provides the Agency with detailed information on the project

EVOLVING SERVICES



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The labelling of a project results in financial support, close dialogue with the Agency during the course of the project, and a wide promotion of the project leader's know-how. With the implementation of this new service, there are multiple benefits for both the Agency and the promoter :

- the project's defence interest is confirmed as much faster;
- the dialogue between the Agency and the applicant during the project study phase is significantly improved;
- above all, the time taken to respond to applicants is significantly reduced.

hAPPI to « capture ideas »

Transformation, which enables any organisation to be reactive and adaptable to the changes in its environment, is of course part of the DNA of the Ministry of the Armed Forces. It feeds on permanent exchanges and is no longer conceivable without a system for listening to and collecting ideas.

hAPPI*, which stands for «AccomPagner les Projets Innovants», went live in March 2022. The tool capitalizes on four years of experimentation within the Air Force and the Space Agency. It is intended to accompany, advise and support all the ministry's personnel in their innovation, digital transformation and improvement projects.

hAPPI

Far from being a simple « ideas box » and beyond a digital tool, hAPPI is part of a wider system. Designed to allow each player to be a free and easy source of proposals, hAPPI gives each department of the ministry the means to study, validate and develop these initiatives to improve the service provided. hAPPI covers all areas (management, organisation, processes, innovations in use or technology) and all areas (operational, administrative, support).

*<https://happi-ng.intradef.gouv.fr/>

RAPID platform internalised in the Agency

The internalisation of the RAPID platform since 1 January 2021 enables the Agency to take full advantage of the entire range of modes of action (public contracts, subsidies, capital-intensive approach) that it employs to accelerate innovation. The Agency promotes the grant approach for projects that indirectly contribute to the objectives developed in capability roadmaps, and in a timeframe consistent

with the possibility of incorporating an innovation into a future armament programme. This represents a further step by the Agency in decompartmentalising open innovation and planned innovation on the one hand, but also between civilian innovations and armament programmes on the other.



The Defence Innovation Fund

The strategy for generating and developing innovation must be accompanied by a global financing strategy. Innovation projects should be supported by a range of mechanisms tailored to the maturity of the project and the profile of the contributors (schools, universities, laboratories, start-ups, SMEs, ETIs, large groups, etc.). However, it is also necessary to be able to respond to the financing needs of innovative companies in the growth phase and developing dual and cross-cutting technologies of interest to the defence world. This is the objective sought by the Ministry with the Defence Innovation Fund, which invests in the capital of innovative dual companies whose primary market is outside defence. The companies targeted are mainly players in the energy, quantum, information technology,

electronics and components, materials, health and human sectors.

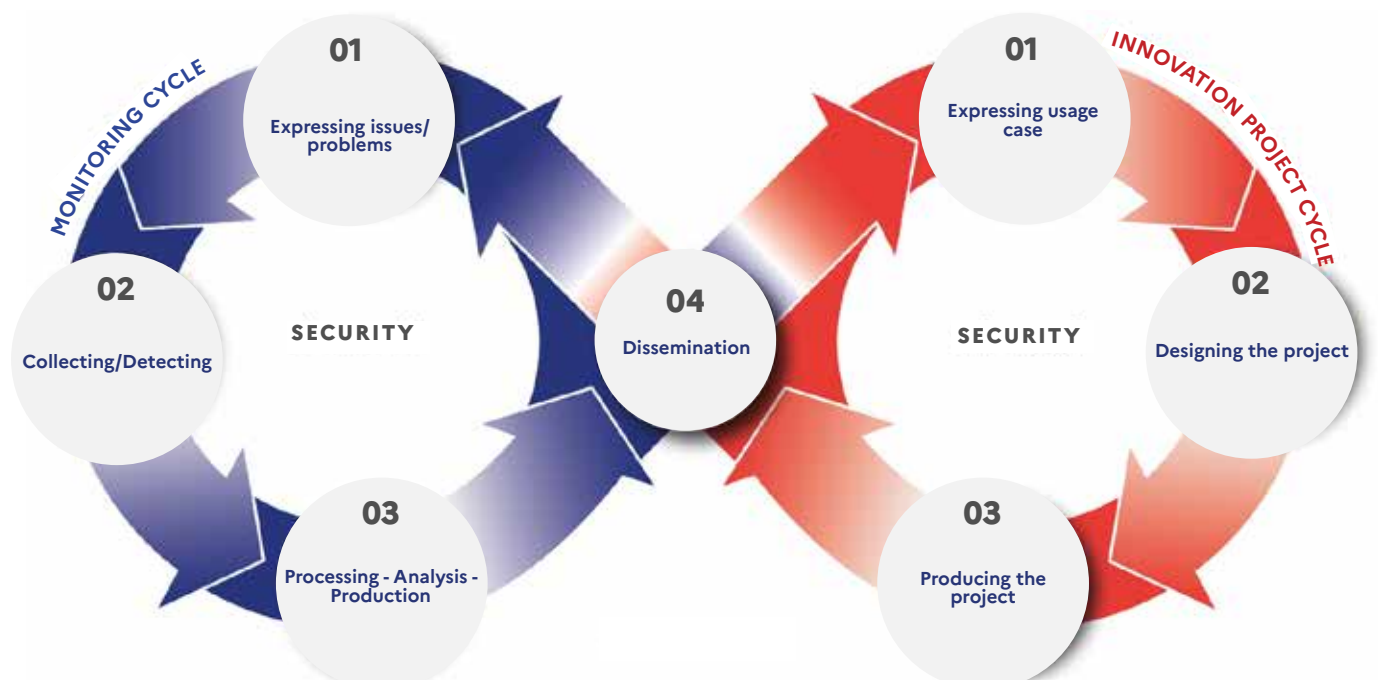
The Ministry of the Armed Forces therefore has two investment funds, the Definvest fund for strategic BITD companies and the Defence Innovation Fund for innovative companies. It thus provides itself with the means to strengthen and support the development of economic players with a defence interest and to exert a leverage effect through its investments and through its exchanges or partnerships with other investors (the «French Tech Souveraineté» component of the General Secretariat for Investments, specialised funds, the «Defence Angels» business angels network in particular).

4.2 HOW TO INTEGRATE OPEN INNOVATION

Detecting and Capturing Open Innovation

The strategy implemented in the open innovation domain consists of detecting and tracking innovations that are not necessarily aimed at the defence sector, including those from start-ups, in order to launch the right co-development projects at the right time.

This approach combines a monitoring activity and an innovation project management activity. These two activities are bound together by the continuous dissemination of knowledge.





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The objective of this dissemination is to steer the internal roadmaps as well as those of the identified companies, in order to allow the convergence of a level of technological maturity, economic development maturity of the innovative company and maturity of uses in a suitable co-development project (models, demonstrators and prototypes). The expression of need mainly comes from the issues expressed by the internal customers, i.e. the EMDS. The continuous monitoring cycle leads to sensor orientation, information gathering, processing and dissemination. Regular iteration is essential to ensure that one is looking in the right direction. This rationale applies both to the mo-

onitoring deliverables (Open Innovation Bulletin produced every 3 weeks) and to the projects mentioned above. The main objective of the mock-ups or demonstrators is to get feedback from internal customers in order to refine the need, identify the key functions and thus steer the planned roadmaps.

Finally, this approach makes it possible to integrate serendipity by periodically exchanging with internal clients to show what has been detected or achieved, not only on their topics, but also beyond the needs initially expressed.

The priority themes identified for this diverted innovation are :

- Autonomous vehicles and autonomous vehicle fleet management;
- Information superiority, covering the detection of abnormal behaviour, big data collection and the control of connected objects;
- Augmented man and man-machine interfaces as well as the disruptive potential of energy, robotics, maintenance (including additive manufacturing), Cyber and New Space.

Autonomous vehicles and their fleet



Information Superiority



Augmented humans



Health



New Space



Robotics



Energy



Cyber



Operational Maintenance



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Accelerating the maturity of projects

The objective of the Innovation Acceleration Projects (IAP) is to accelerate the technological and user maturity of innovations originating from the civilian market or from a diverted or used innovation.

For innovations at a low level of maturity, the aim is to identify opportunities for the ministry presented by products or services, particularly from the start-up community. For operationally mature innovations, opportunities for rapid deployment to the forces (scaling up) should be seized.

Innovation acceleration projects aim to :

Meet the short-term needs of EMDS not adequately addressed

To this end, the AID and the EMDS have organised the collection of needs to meet them according to their level of priority via the construction of high-potential IAPs.

Foster the integration of open innovation in armaments operations

In accordance with the provisions of the instruction on the conduct of armament operations, many operations are conducted using an incremental approach. The identification of themes of interest for the next steps with the programme teams helps guide the potential contributions of open innovation.

Highlighting capability with «atypical» cases

In collaboration with the SASD and the EMA's Capability Coherence Division, exploratory roadmaps are being developed to guide the capability approach. They allow the initiation of relevant IAPs such as mock-ups or demonstrators.

Integrating open innovation into Technology Defence Projects (PTDs)

The ongoing tendency is to oppose «open innovation» and «planned innovation» when these two modes of action are not of the same nature and can be adopted simultaneously. This point is emphasised in the Ministerial Instruction on Defence Innovation (IMID).

Initiatives such as the ITP Missiles or PTDs such as MMT and CENTURION aim to take advantage of the abundance of innovation in large and dynamic environments, in favour of the preparation of a cross-cutting programme or technological roadmap.

The agility and contractual reactivity of this approach allow for increased exploration potential with the entry of new players and a challenge to established positions, as well as an acceleration of the partnership dynamics of integrators within the civil sector.

Feedback on these initial approaches will be provided rapidly to propose recommendations for their implementation.



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CENTURION

Accelerating innovation for the benefit of the deployed soldier

The CENTURION PTD, in the form of a seven-year framework agreement was awarded at the end of 2019 to the temporary consortium of companies (GME) made up of SAFRAN Electronics & Defence and THALES SIX GTS France. This agreement aims to develop technological and usage innovations for the benefit of the combatant, by offering direct access to future FELIN program upgrades. It also contributes to the development of the future SCORPION deployed combatant system. In concrete terms, CENTURION is an innovative contractual tool designed to facilitate the transition from idea to implementation, by ensuring continuity in the maturation of innovations and by taking into account, from the outset, the integration of the combatant's equipment.

Through its innovative approach to animating the environment, selecting and supporting innovative projects and through its governance directly connected to the combatant equipment programmes, CENTURION accelerates innovation for the benefit of the combatant and offers an additional opportunity to innovation players.

As an example, several projects resulting from the first follow-on contract awarded at the end of 2020 under CENTURION should be proposed in less than two years for scaling up in the FELIN programme.

CENTURION is firmly in line with the objective of accelerating the defence innovation policy presented in 2019 by the Ministry of Defence and implemented by the AID.

4.3 ASSETS FOR SCALABILITY

The scaling up of innovation consists of taking it into account in the equipment, preparation and employment, or force support programmes, with a view to deployment to end users. In terms of open innovation, scaling up is a challenge insofar as the characteristics of speed and opportunity appear to clash with a budgetary programming dynamic characterised by forecasting.

To increase the Ministry's flexibility, the Ministerial Executive Committee (COMEX) of May 2021 adopted the principle of identifying a financial workflow within the P146 and P178 programmes for the ordering of initial operational capabilities associated with open innovation projects.

The use of this workflow was decided by the representatives of the DGA and EMA budgetary programme managers, organised in a Scalability Governance Committee (CGPAE) on the basis of a proposal from the Innovation Acceleration Standing Committee (CPAI), chaired by the Agency.



4.4 INNOVATION PROCUREMENT

The ministerial action plan «Innovation Procurement 2021-2024».

The ministerial procurement policy meets the needs of the armed forces, directorates and services for the acquisition of goods, works and services necessary for their activity, by making a decisive contribution to the operational effectiveness, security and resilience of the forces, while ensuring the support of the defence industrial and technological base.

Within the framework of this policy, the purchase of innovation is a powerful lever to increase effectiveness and efficiency in all support functions and to simplify and modernise the working conditions of personnel.

To this end, the Ministry of the Armed Forces has adopted a departmental plan dedicated to innovation procurement for the period 2021-2024. It was drawn up to ensure the dynamic and structured management of a set of actions aimed at staffs, directorates and services, intended to encourage initiatives.

The monitoring of the implementation of this action plan has been entrusted to the Defence Procurement Mission with the support of the Defence Innovation Agency in connection with all the ministry's procurement departments, along with a six-monthly review to assess the results in terms of development and performance of innovation procurement.

The plan is structured around four pillars :

- 1- Promote the purchase of innovation by implementing measures such as the sharing and appropriation of a clear definition of the purchase of innovation from the public order code;
- 2- Consolidate the performance of innovation buyers. To this end, the network of innovation purchasing referents in existing purchasing entities will be given a more operational mandate. The improvement in performance will also be achieved through the training of innovation procurement officers, which has been modernised. The action plan also aims to connect the networks of innovators in the armed forces, the IDA and innovation buyers;
- 3- Boosting the efficiency of procurement departments, particularly by enhancing their practices;
- 4- Facilitate the reception of proposals for innovative works, supplies or services from economic players and promote knowledge of the Ministry's needs through meetings with economic players.

« Innovative Procurement » Decree

A decree from December 2018 allowed an experiment lasting 3 years for the procurement on quotes of innovative products or solutions, for an amount less than €100,000 before tax.

The feedback from the experiment covered the entire scope of the ministry's purchasing, both armament and non-armament, which led to the conclusion that this scheme was of real interest. Now included in the public order code, this provision facilitates and accelerates the acquisition of innovations.

5 EVER MORE PARTNERS



5.1 A DYNAMIC DEFENCE INNOVATION NETWORK

To capture innovations produced by the civilian sector, the Ministry has created a sensor network comprising the academic research network, competitiveness clusters, operators of start-up bootstraps, acceleration programs and capital investment funds. This network is totally internal within the Ministry's Labs and Fabriques Numériques, as well as innovation clusters from the DGA's expertise and testing centres and the Armed Forces Labs.

2021 demonstrated the interest in this sensor network, with a significant increase in the number of projects detected by these sensors and labelled by the AID.

In 2022, the coordination between innovation clusters and the AID will be further developed to make the most of the available resources.

The network will be asked to choose the themes and define the future calls for expression of interest. If they wish, clusters will have the possibility to support the Agency in investigating the innovation acceleration projects that will be assessed by the Labelling Committee. This will significantly improve the upstream framing of

projects and the processing time to decide on their support. Finally, the continuous exchanges between the Agency and the clusters will strengthen the link with innovative French companies.

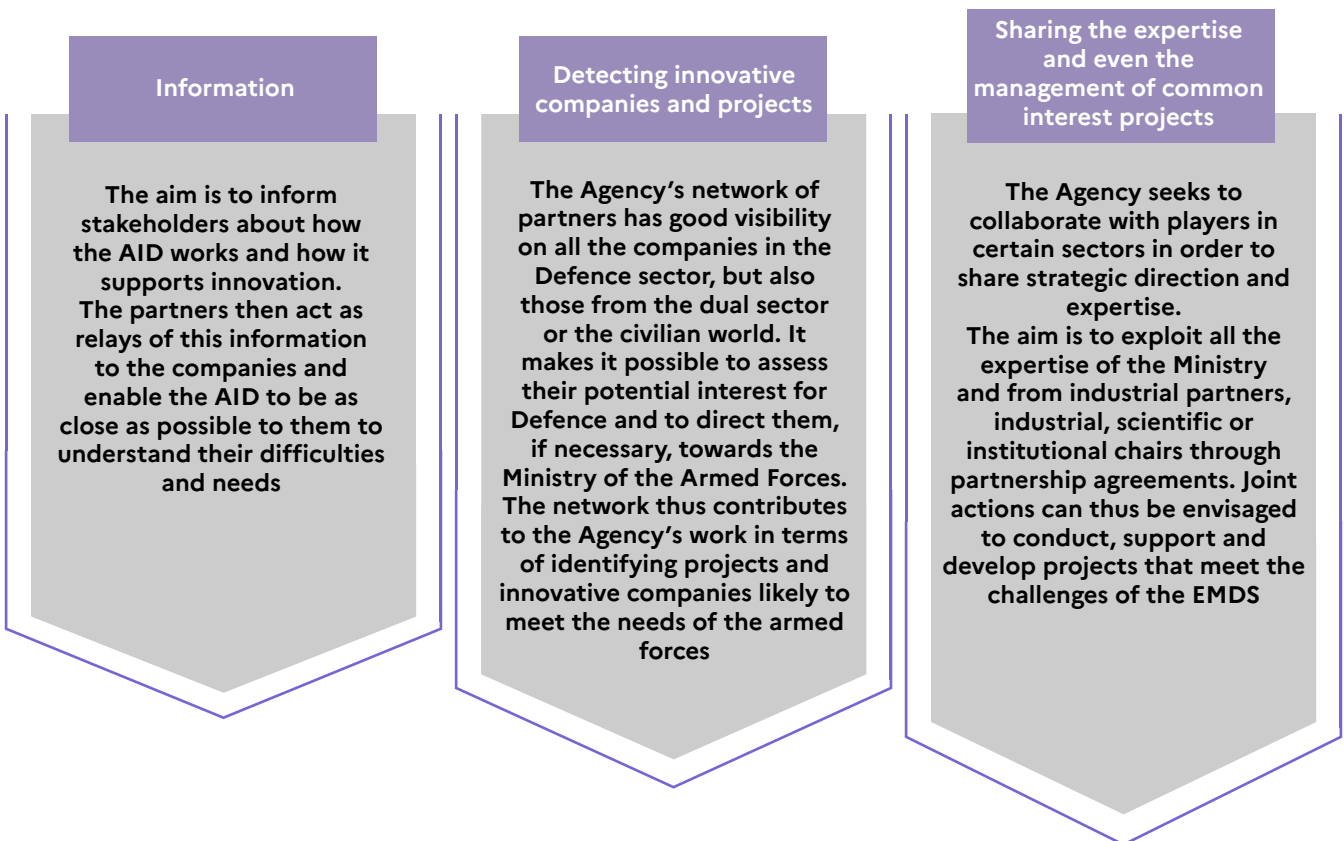
Proof of dynamism, the network keeps on expanding: a new innovation cluster called PILOT was created near Angers (Pays de Loire). It is attached to the DGA TT and will mainly focus on land mobility.



5.2 NEW PARTNERS

To better support defence innovation, the Agency constantly cooperates with all the stakeholders that have been asked to contribute or submit projects – whether they come from the industry, the research sector, or institutions. To do this, AID creates partnerships with stakeholders and networks from the DTIB and the innovation world: professional groups, start-up accelerators, associations, entrepreneur networks, competitiveness clusters, research centres, etc.

These partnerships have several goals:



The selection of these partners also reflects a strategy that aims to achieve maximum territorial coverage, the most comprehensive representation of challenges and players possible (whether or not they come from the DTIB) and the development of expertise.



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5.3 OPEN ACADEMIC RESEARCH, CONNECTED TO INDUSTRY

By investing in exploratory research, the Ministry of the Armed Forces is preparing for the future beyond the foreseeable military need, whose horizon is typically about fifteen years away. It thus supports projects with a low, or even very low, level of technological maturity (TLM), in particular on emerging subjects that are potentially ground breaking

The Ministry also wishes to reinforce the effectiveness and efficiency of its investment in research, by encouraging synergy between systems and players (from academic research and industry in particular) to favour the acceleration of projects and thus optimise the results.

The general principle governing this investment is that it is differentiating, i.e. it allows the financing of work that would not be conducted or not oriented in the directions of interest for Defence, without the intervention of the Ministry of Defence.

The Agency nevertheless ensures that it retains a significant «open» component allowing it to capture proposals from the entire academic community and to detect breakthroughs across a broad spectrum of technological fields.

EVER MORE PARTNERS

Schools supervised by the Ministry of the Armed Forces

The Ministry of the Armed Forces oversees several higher education institutions that contribute to defence innovation through their training and research activities. In order to strengthen the link between the innovation policy of the Ministry and the policy of the schools, a strategic plan and then a roadmap for the involvement of the Grandes Ecoles in defence innovation were implemented. The Ministry is seeking to promote cooperation through the creation of structuring partnerships around centres of competence in the field of defence. After the creation of the CIEDS (Interdisciplinary Centre for Defence and Security Studies) with the Paris Polytechnic Institute in 2021, the IngéBlue institute (for maritime engineering based at ENSTA Bretagne), the Naval School, ENSTA Paris and SHOM) were established in June 2022. In the longer term, the emergence of an aeronautics and space centre involving ISAE-SUPAERO and the Ecole de l'Air et de l'Espace, in cooperation with ONERA, is being explored. This approach is intended to support the rise in competence of the schools on defence subjects, to reinforce the visibility of the schools under the supervision of the Ministry and to encourage the transfer of results by diversifying funding sources.



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The Agency supports the « swarm of drones » challenges implemented by the CIEDS. These challenges involve teams of students from polytechnic institutes in Paris competing in missions such as mapping an unknown territory with a swarm of drones in order to prepare the arrival of an operational team. One of the objectives is to encourage the development of innovative techniques in perception, navigation and localisation. The best teams are rewarded.

More generally, this approach of enhancement through the transfer of research results to economic players capable of exploiting them by marketing them on the civil or defence market must be widespread. It will be the subject of particular attention in the framework of the grants paid to the organisations under supervision, by seeking the continuity of the supported activities and partnerships with the industrial world, while preserving the element of exploratory research, which is necessary for the maintenance of skills and the emergence of new technologies.

Supervised operators



Energetic materials and systems

Flight techniques for projectiles

Electromagnetic technologies

Protection, safety and situational awareness technologies

Laser



CBRNE

Life sciences

Cyber security

Quantum components and technologies

Onboard energy systems



Smart Systems Strategic Aerospace Materials Propulsion Technology Photonics and optronic systems Electromagnetism and radar Multimodal Artificial Perception Sensors and Space Environment



Earth Observation

Electromagnetic data

Action and Resilience

Space

Space Telecommunications

Position Navigation Timing

The supervised organisations play a special role in the defence innovation environment. As leaders in their fields of competence, they manage their own networks of partners and promote the direction of defence innovation. Beyond the lines of effort driven by the needs of Defence, they direct exploratory research to meet future needs.

ONERA's contract of agreed objectives (COP) 2022-2026 was signed at the beginning of 2022. In particular, it intends to strengthen ONERA's position in its environment and to use the roadmaps to renew the dialogue on the directions given to the office. ONERA also has a decisive role to play in future deterrence and combat aircraft programmes, with a horizon that goes beyond the programmes currently under preparation.

As reflected in the COP 2022-2025, the development of CNES under the impetus of the Ministry in charge of Space (MEFR) is another factor in the growth of relations. A new governance of the CNES-Ministry of the Armed Forces relationship has been put in place and CNES should become an increasingly close partner of the Agency for innovation in the space field.

France and Germany will work with the ISL to define its strategic orientations until 2030, in order to give it the visibility necessary to optimise its innovation potential.

Partnerships with research institutions

In the domain of exploratory research, partnerships with research organisations should build a long-term relationship allowing the transfer of innovative technologies to Defence systems. They are therefore designed with a broad scope and play a transverse role to the existing support mechanisms. In this domain, the partnerships are based on a principle of benefit for each of the signatory organisations. With the CNRS, the Agency will support the HEAD scientific interest grouping (in the field of high-energy additive manufacturing) in 2022 via research grants for the purpose of grouping projects of

interest for Defence. In the field of antennas, a partnership is being prepared between the AID and laboratories of the CNRS, CEA-LETI and TELECOM Paris. It will enable the implementation of a roadmap dedicated to integrated compact RF antennas and associated components.

A first phase of design and implementation of the model is to be launched in 2022. It will focus on two areas of effort: shutters and radiation panels.

The Agency has a partnership with the ANR, which is the operator of the ASTRID and ASTRID maturity programmes. In particular, it enables the ANR to manage programmes or to co-finance programmes managed by the ANR.

In 2022, the Agency will fund two thematic ASTRID calls for projects, one on energy efficiency in harsh environments and on energy materials, the other on cognitive warfare to explore influence and counter-influence techniques.

ASTRID Call for projects on cognitive war

Today, attacks in the cognitive domain involve the hybridisation of computational influence, AI, disinformation, psychological actions and social engineering capabilities. They are increasingly frequent and sophisticated. They impact the capability of organisations, decision-makers and de facto all stakeholders involved or targeted. It is therefore necessary to know how to detect these attacks aimed at the cognitive domain, particularly those orchestrated by hostile groups or states, whatever the means of transmission. It is also a question of being able to counter these new threats, having first defined the doctrine and the framework, as was done for the fight against computerised influence.

Cognitive wars position the mind as a battle space. This space is contested and conquered through low-cost, low-risk actions for the attackers, mostly based on existing knowledge. The hybridisation of humanities, social sciences, cognitive sciences, modelling, language sciences, information and communication sciences and digital humanities is essential. This new work will be carried out by academic, institutional and industrial players, those involved in the computerised struggle for influence and those from the digital world whose views converge towards a shared objective.



5.4 DEFENCE INDUSTRY

The Ministry of the Armed Forces must be able to rely on a high-performance, sustainable national industrial base with a strong innovation capacity. This base is made up of major defence industrial groups and several hundred SMEs, VSEs and start-ups that the Ministry supports in their innovation projects and development.

Beyond this mainly contractual relationship, the defence industry is also a partner in updating the direction of defence innovation.

The objective is to optimise the efficiency of investments in defence innovation and to accelerate the integration of innovation in programmes. This requires an exchange, in all areas where possible, around state and industrial roadmaps. In this context, the themes of upstream work carried out by operators under the supervision of the Ministry of Defence, as well as research or acceleration projects, are shared. This makes it possible to identify possible convergences with the industrial technological roadmaps and to develop partnerships.

These exchanges make it possible to identify topics of interest to industry that can be entrusted to the

operators under supervision, as well as research work that can be enhanced by industry, or via defence technology projects.

Similarly, the use of more open modes of action should be developed wherever possible, both to take advantage of the spontaneous proliferation of innovation, in order to accelerate integration into programmes as soon as possible. Thus, the State-industry dialogue makes it possible to reinforce the themes where this mode of action is particularly suitable and can be implemented rapidly.

5.5 INVESTING IN FRANCE 2030

Opening up to civilian innovation to seize opportunities for integrating high value-added technologies means being accessible to the start-up community to divert some of their technologies to Defence, but it also means identifying and optimising the development of dual technologies. The future investment programme (PIA) until recently and now the France 2030 investment plan are major assets to achieve this objective.

Under the fourth part of the Future Investment Programme, launched at the beginning of 2021, the State is financing exceptional investments in a few emerging and priority sectors and technologies with a budget of 20 billion euros over five years. These national acceleration strategies are defined within the framework of interministerial steering to strengthen the alignment of public initiatives and the effective and rapid implementation of the defined measures. The Ministry of the Armed Forces is associated with its governance and is directly involved in the cybersecurity,



quantum technologies, artificial intelligence, 5G, cloud, re-emerging infectious diseases, bio-based products and industrial biotechnologies, sustainable fuels, sustainable cities and innovative buildings, and electronics strategies.

EVER MORE PARTNERS

On 12 October 2021, the President of the Republic presented the France 2030 plan, a massive investment plan to bring out tomorrow's technological champions and support the transformation of our sectors of excellence. France 2030 has a dual objective: to position French industry in strategic markets by supporting emerging players and to transform innovations into industrial projects. With a budget of 34 billion euros, France 2030 identifies ten priority objectives (nuclear, decarbonised hydrogen

and renewable energy, decarbonisation of industry, the first low-carbon aircraft, 2 million electric and hybrid vehicles, healthy food, 20 bio-medicines and innovative medical devices, cultural and creative content, new space adventure, deep seabed) and tighter conditions for project selection (50% of the credits will be in favour of decarbonisation, 50% of the fund for emerging players). France 2030 integrates all the initiatives financed by the «Investing in France 2030» mission, including the PIA4 finan-

cing of the acceleration strategies (management component), as well as the structural tools resulting from the previous PIAs.

In addition to the aforementioned acceleration strategies inherited from the PIA4, the Ministry is participating in several strategies, including those relating to space adventure, the deep sea, robotics, electronics and the creation of the first low-carbon aircraft.

AIT and AID: a common strategy and objectives

The Transport Innovation Agency (AIT) was launched in August 2021 by the Ministry of Ecological Transition, responsible for transport. The AIT's mission is to coordinate innovation support measures between the departments of the Ministry of Transport, to identify and reference innovations and to support their expansion.

The AIT and the AID therefore have common objectives. The two agencies have a vocation to carry out joint actions on subjects of shared interest such as the identification of encouraging innovations from companies and start-ups, with a proven potential for diversification for common defence and transport needs.

This collaboration quickly led to the joint publication in September 2021 by the Ministry of Transport and the Ministry of Defence of the call for projects «U-space Together», regarding the development of air traffic management for drones.

AID's support for the AIT's PROPULSE programme, aimed at accompanying and accelerating innovation initiatives arising from four themed calls for projects, has also enabled AID to make a rapid contribution to the AIT's innovation policy.

More recently, the IDA has undertaken with the AIT to structure a collaboration around the AID-ANR-CNES «MOBILEX» challenge, on the theme of autonomous vehicles.

In the longer term, the natural cooperation between the two Agencies is set to continue, especially on topics of common interest: integration of innovative airborne vehicles in air traffic, autonomous vehicles, energy, cyber, etc.

5.6 INTERNATIONAL COOPERATION IN DEFENCE INNOVATION

Consolidating Europe's sovereignty means building a cooperative innovation strategy.

Taking into account the experience of the implementation of a defence innovation policy at national level, such a project can be taken incrementally to the European level by setting up an innovation network. The first step is to share a common idea of defence innovation, a joint definition and a common philosophy of innovation incentives.

As part of the Presidency of the Council of the European Union, France has given a strong impetus to the establishment by the European Defence Agency of the HEDI (Hub for European Defence Innovation) mechanism, which will facilitate innovation work and projects originating outside the defence sector, with a view to creating projects that are more oriented towards military uses. As a support tool for the European defence innovation network created informally by the Member States, HEDI will enable nations to share their approach to innovation and to identify the work and initiatives that are important for users, without seeking to duplicate the American DARPA model, whose direct implementation in Europe would appear to be complex. Particular attention will be paid to the attributions of HEDI and those of DIANA (Defence Innovation Accelerator for the North Atlantic), in order to maximise the synergy and efficiency of these two emerging entities.

At the same time, a strong participation is foreseen by the implementation of the ambitious principles published by the European Commission in its Defence package and more particularly of the innovation scheme which will allow the European Union to benefit from the respective added values of the Commission, the EDA and the Member States.



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EVER MORE PARTNERS



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The European Defence Fund

The European Defence Fund represents a major challenge. The topics of the 2021 Work Program were selected in mid-2022. The next step will consist in defining the 2022WP innovation themes and innovating of tools. The first challenge is that the approach should contribute to the development of the Member States European innovation network overseeing HEDI as well as the EUDIS (EUropean Defence Innovation Scheme) developed and implemented within the EDF.



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Strengthening bilateral agreements

The reduction of health constraints has allowed the consolidation of links with our allies and partners who wish to explore innovation not originally dedicated to Defence. The USA, Canada, the Netherlands, Singapore (with the forthcoming setting up of a joint artificial intelligence laboratory) and the United Kingdom will offer possibilities for exchanges, or even more concrete collaboration, in the exploration of methods of capturing innovation opportunities.

6 ADDING VALUE



6.1 PROMOTING PROJECTS

The most advanced form of promoting projects, and a priority for the Agency's efforts, is clearly the deployment and scaling up of innovations relevant to the EMDS, in all operational, technological, organisational and administrative processes or within the Ministry's investment operations.

In addition, promotion is also based on other factors :



In addition to the actions already launched to promote the most promising projects, new mechanisms have been activated :

The introduction of theme days has been adopted with a view to disseminating information and promoting the innovation projects supported by the Agency.

These occasions for exchange and demonstration, devoted to a specific field of innovation or combat environment, are intended to share the results of research projects and open innovation amongst all players in the Ministry of the Armed Forces. The aim is to valorise the results through a planned follow-up, such as in the framework of a defence technology project (DTP) or through direct integration in an armament programme. These theme days, organised by the Agency, also contribute to the development of companies, which come from the civilian sector and their defence-related know-how.

The first theme days will take place in 2022 and will start with the CAFAS innovation domain, air combat and air-to-ground strike.

The compilation and dissemination of a catalogue of value-added projects.

The accumulation of information concerning projects supported by defence innovation support mechanisms is sometimes based on varied and dispersed elements. However, certain data is essential for the development of projects: levels of maturity, challenges for Defence, internal, industrial or academic partners involved, possible follow-ups, etc.

They make it possible to identify successful projects and the development actions to be carried out: new technological maturation required, search for the end user in the Ministry of the

Armed Forces, communication needs for the partners, cross-cutting and generalisation potential, search for integrators or systems for innovation, etc.

To encourage the continuation of the project, for example through new innovation support mechanisms, integration into an armament programme, an SGA programme, or directly via the armed forces, a project catalogue is gradually put in place. It summarises all the elements of the project and highlights its defence interest, the added value of the Agency’s support and the planned follow-up.

MINISTÈRE DES ARMÉES
Armée de l'Air
Armée de la Mer
Armée de Terre

ESPACE

#Antenne #TélécommunicationsSatellites #bandeKa

Projet
3SFA, pour « Smart Steerable Satcom Flat Antennas » propose une antenne plate à reconfiguration électronique pour des applications de télécommunications satellites dans la bande Ka.
La technologie est issue de la recherche académique et consiste à contrôler le rayonnement d'une cavité à perte par le biais d'une surface dont les propriétés électromagnétiques sont reconfigurées en temps réel à l'aide d'une électronique ultra-rapide.

Enjeux

- Développer des antennes intelligentes, peu onéreuses et très sobres en énergie afin de répondre aux enjeux de la connectivité de demain.
- Le design unique consiste à contrôler les réflexions des ondes électromagnétiques et non leur émission.
- La flexibilité permettra à terme d'adresser plusieurs bandes de fréquences.

Accompagnement AID
Financement et suivi scientifique
Exposition au Forum Innovation Défense en 2021

Débouchés MINARM
Démonstrateur issu du RAPID 3SFA testé en août 2021 par la DGA, pour la validation du fonctionnement et des performances.
Nouveau RAPID accepté fin 2021 avec l'objectif d'aboutir à un prototype fonctionnel en bande Ka, passant d'un TRL 4 à 6.

Timeline:
2019: Plusieurs thèses DGA
2021: RAPID 3SFA (D), RAPID m3SFA (P)

Diagram: Matériaux technologiques, Méthodes opérationnelles, Processus civil, Société-citoyen, Outils de performance, Droits de R, Rayonnement, Externalités positives.

Verger pour illustration

Date de mise à jour : 28/04/2022

6.2 PROMOTING THE INNOVATORS OF THE MINISTRY OF THE ARMED FORCES

Building on the work of the « Valuing Innovators » working group launched in 2020, the year 2022 will see the publication of two new texts designed to improve innovators' access to financial rewards.

For innovators behind non-patentable innovations :

An order of 22 April 2022 allows programme managers of the defence mission to grant financial rewards to teams behind projects or initiatives that promote the emergence and development of innovative services, tools or uses that meet the needs of the headquarters, directorates and services of the organisations that are attached to them.

For innovators creating patentable «mission» innovations :

A decree to expand the list of those eligible for the incentive bonus and the patent bonus to almost all personnel present in the Ministry of the Armed Forces is awaiting publication.



Extension of the Innovators's Trophy to other themes in 2023

Launched on a single theme in 2021, the « Defence Innovators' Trophy » will be awarded again in 2023 and presented by the Minister of the Armed Forces during the Defence Innovation Forum 2023, on a wider range of themes:



Land Warfare



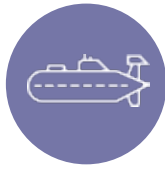
Air and Space Operations



Supporting the Combatant support



Management and Organization



Maritime



Operational Maintenance



Operations in intangible fields (Cyber, intelligence, information, cognitive...)

2022 prospects for collaboration with the National Institute of Industrial Property (INPI)

Signed in 2021, the partnership agreement with INPI will continue to focus on :

- collaboration to answer the questions of the Defence Innovation Agency's industrial partners.

In this way, industrial players, particularly start-ups, very small businesses and SMEs, can be put in touch with the INPI for support in developing an ad hoc intellectual property strategy for their projects.

- support for inventions made by civilian or military personnel of the Ministry of Defence.

The INPI will provide a link with the Ministry's innovators, for one-off meetings or via the possible establishment of a permanent office. The INPI will also be integrated into the « Valuing Innovators » working group's deliberations on the implementation of a strategy for employee inventions classified as « outside the mission scope ».

Other activities mentioned include the development of joint awareness-raising activities.

7 FINANCIAL INSIGHTS



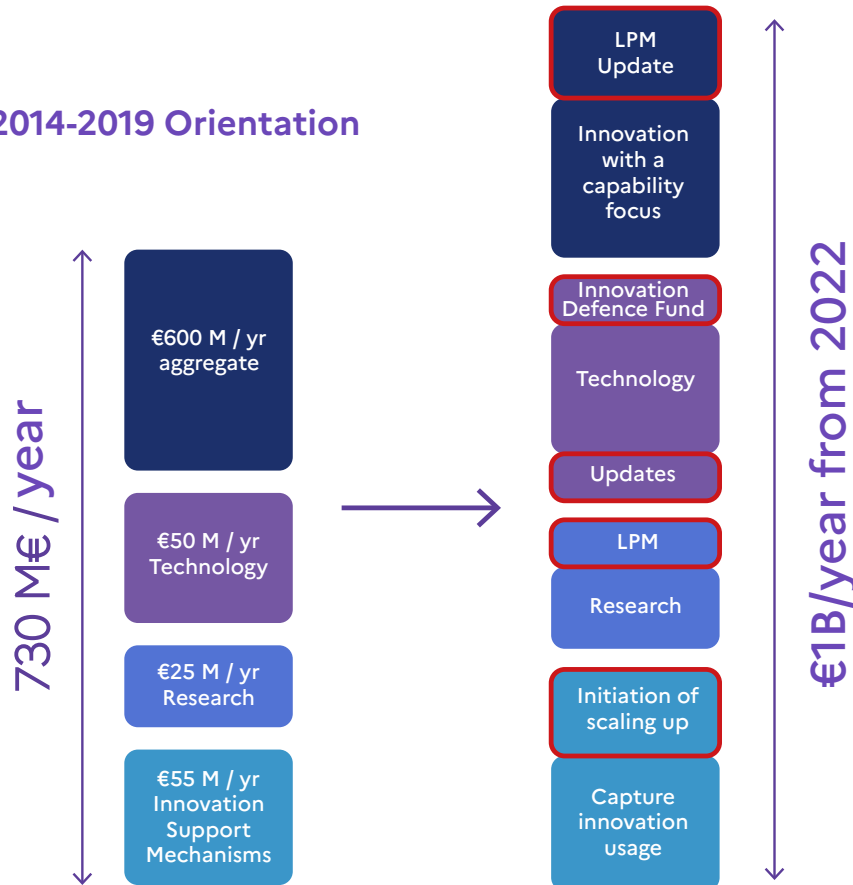
The military programming law has been respected since 2019: the credits allocated to preliminary studies have increased from an average of €730 million per year over the period 2014-2019 to €1 billion from 2022.

This has led to increased funding across all innovation strands :

- technological innovation has taken into account the new dimension desired in the quantum and energy fields, new technologies in the field of sensors and critical components and integrated the implementation of the venture capital investment fund Fonds Innovation Défense, for breakthrough innovations of a dual nature;
- innovation capture and use innovation initiatives continue to grow in importance:
 - a specific action on the start of scale-up was implemented
 - the amount of the DEFINVEST investment fund has been doubled

- innovation with a capability vocation has integrated the ambitions of the LPM update: thus, actions related to anti-drone warfare have been accelerated, the space strategy has been declined into innovation actions and the fight against NRBC threats is consolidated;
- finally, fundamental research activities considered to be of interest to Defence have been reinforced, allowing the transition from a pure capture strategy to a strategy more oriented towards theme-based partnerships and targeted calls for projects while maintaining a strong capture ability.

2014-2019 Orientation



+ €120 M compared to 2014 - 2019

ACRONYMS AND ABBREVIATIONS

A2/AD	Anti access / Area denial
AED	European Defence agency
AIT	Transport innovation agency
ANR	French National Research Agency
ANSSI	French National agency for information systems security
ARES	Spatial action et resilience
ARTEMIS	Architecture for the processing and massive exploitation of multi-source information
ASTRID	Specific support for Defence research projects and innovation
AVSIMAR	Maritime surveillance and intervention aircraft

BITD	Defence industrial and technological base
BITDE	European Defence industrial and technological base

CAFAS	Air combat and air-to-ground strikes
CEA	Alternative Energies and Atomic Energy Commission
CEA-LETI	Laboratory of Electronic and Information Technologies of CEA
CENTURION	Study framework of new technologies and usage innovation for the benefit of the combatant
CGPAE	Scability governance comitee
CIEDS	Interdisciplinary Center for Defence and Security
CNES	National Center for Space Studies
CNRS	National Center for Scientific Research
COP	Agreed objectives and performance
CPAI	Innovation acceleration standing comitee
C-UAS	Counter Unmanned Aerial System
C2	Control command
C4	Command, control, communication & computing
C4 ISR	Command, Control, Communication, Computers, Intelligence, Surveillance, Reconnaissance

DARPA	Defense Advanced Projects Agency (USA)
DGA	Defence Procurement Agency

DIANA	Defence innovation accelerator for the North Atlantic
DMAé	Directorate for aeronautical maintenance
DrOID	Defence Innovation Orientation Directive
DTPM	Delegation for the transformation and performance of the Minsitry

EDRIN	European Defence Research and Innovation Network
EMA	Defence staff
EMDS	General staff, directorates and services
EMM	General staff of French navy
EnR	Renewable energies
ENSTA	Superior National School of Advanced Techniques
EOTO	Operational and technical-operational studies
ETI	Medium-sized companies

FAMSIE	Metal additive manufacturing for state industrial support
FED	European Defence Fund
FMAN	Future anti-ship missile
FMN	Federated Mission Networking
FMC	Future cruise missile

GIS	Scientific Interest Group
GHOM	Geography, hydrography, oceanography, meteorology
GME	Temporary consortium of companies
GNSS	Global Navigation Satellite Systems
GRAVES	Radar dedicated space surveillance

HAPPI	Supporting innovative projects
HEAD	High-Energy Additive Manufacturing
HEDI	Hub on European Defence innovation

IA	Artificial intelligence
IHM	Human-machine interface

ACRONYMS AND ABBREVIATIONS

IP Paris	Paris polytechnic institute
ITP	Innovation and Technology Partnership
IRISA	Research Institute in Computer Science and Random Systems
ISL	French-German research institute of Saint-Louis

LAD	Anti-drone warfare
LPM	Military planning act
LSM	Undersea warfare

MDCN	Naval cruise missile
MILAD	Joint-army resources of anti-drone warfare
MRO	Maintenance, Repair and Operations
MMT	Man Machine Teaming
MVP	Minimum Viable Product

NAVWAR	Navigation warfare
NRBC	Nuclear, radiological, biological, chemical
NRBC-E	Nuclear, radiological, biological, chemical and explosives

OCCAr	Organization for Joint Armament Co-operation
OMEGA	Operation to modernize the GNSS equipment of the armed forces
ONERA	Aerospace research center
OTAN	North Atlantic Treaty Organization

PAI	Innovation acceleration project
PARADE	Deployable modular anti-drone protection
PIA	Investments for the Future programme
PILOTE	Innovation cluster for land mobility in the Loire Valley
PME	Small and medium-sized companies
PNT	Position navigation times
POC	Proof of Concept

PTD	Technology Defence projects
RACI2U	Academic research innovation capture and use innovation
RAPID	Dual-use innovation support regime
R&D	Research and Development
R&T	Research and Technology
SAMP/T	Medium-range/terrestrial ground-to-air
SATAM	Aircraft and munitions acquisition and trajectory system
SATCOM	Satellite communication
SASD	Defence system architecture department
SCAF	Future Combat Air System
SCCOA	Aerospace command and control system
SCORPION	Synergy of contact reinforced by information system
SER	Equivalent radar surface
SIA	Armed forces information system
SIAé	Aeronautical industry service
SGA	General Secretariat for Administration
SIO	Operational information systems
TPE	Very small companies
TRL	Technology Readiness Level
UE	European Union
UX	User experience
VAB ARLAD	Armoured front vehicle – Reactive adaptation for anti-drone warfare
WP22	Work Program 2022

« Innovation was never an option for the operational superiority of our forces. At a time when the threats to our security are becoming more and more apparent and when war in Europe is once again a reality, we must give our armed forces the best that technology and innovation can offer them.

The success of France's military depends on it. »

Sébastien Lecornu, Minister of the Armed Forces.



www.defense.gouv.fr/aid