



MINISTÈRE
DES ARMÉES

Liberté
Égalité
Fraternité

DROID 2021

DEFENCE INNOVATION
ORIENTATION DIRECTIVE

EDITORIAL



The year 2020 will no doubt be remembered as one of the most difficult years in our recent history. Hit by a crisis representative of a real strategic surprise, our country and our Defence were able to cope. To transform this difficulty into opportunity, to adapt, gain in agility, in resilience, these were the challenges facing Defence Innovation, challenges that were successfully met by the armed forces, directorates, services and the Defence Innovation Agency. I would like here to applaud the determination, the creativity and the dynamism of the Agency's stakeholders that made this possible. The crisis demands that we reinvent ourselves, and set up reactive and readily adaptable processes. Consequently, and side-by-side with the armed forces, together with the Armament General Directorate, (DGA), we published a call for innovative project solutions destined to combat the pandemic. More than 2580 propositions were submitted and analysed within three weeks, 36 of which were selected and financed. These projects have led, on the one hand, to remarkable successes, and, on the other hand, have shown the operational efficiency of innovation instruction and certification. This led the signature by the Minister for the Armed Forces of the IMID, (Instruction Ministérielle de l'Innovation de Défense) the Ministerial Directive for Defence Innovation, that describes and formalises the process and management of innovation projects. Over and above all this, the Ministry for the Armed Forces has reached its objective in 2020, with, notably, a total of 805 m € in payments, more than 233 start-up

and small or medium-sized companies (SME) identified, 180 research projects launched, 576 projects registered through the Agency's online access portal, 127 of which have been certified, 35 projects sponsored by the Innovation Defence Lab and 21 international agreements signed. The Defence Innovation Forum, in its digital and virtual version was a resounding success with more than 4200 participants. Bridging on from these strengths, new challenges are appearing, as well as remarkable opportunities. I can mention for example the operational deployment of the Defence Innovation Fund and the increasing success of our 'online access portal' open to all innovators promoting projects that come within the scope of the Ministry's themes of interest. We will also be working towards consolidating our links with our industrial partners and our European partners, notably as regards the European Defence Fund, and with our allies. Lastly, we will enhance our efforts in terms of research and innovation capabilities around the themes presented in this document.

The Defence Innovation Agency was founded in 2018 with the intent to: boost, amplify and accelerate defence innovation.

This year the '2021 DrOID' publication presents the concrete reality of actions undertaken by the Agency, the armed forces, directorates and services so that defence innovation will continue to ensure the operational superiority of our armed forces, and the guarantee of our strategic autonomy.

Enjoy the read!

Emmanuel Chiva,
Director of the Defence Innovation Agency

1ST PART

**2020 :
A YEAR COMMITTED
TO DEFENCE
INNOVATION**

REVIEW OF ACTIVITIES

AGENDA HIGHLIGHTS 2020

- JAN.**
 - Call for Artificial Intelligence proposals to develop an operational multi-sensor user interface.
 - Call for proposals to develop GNSS (geolocalisation and navigation by satellite systems) aerial anti-jamming coatings
 - Participation in the first edition of "The Defence Factory"
 - Participation in the International Cyber-Security Forum

- MARCH**
 - Call for proposals to provide innovation solutions in the fight against Covid-19

MAY

→ Publication of the Ministerial Directive for Defence Innovation (IMID)

JUNE

→ Signature of a partnership contract between AID and the GICAN (Industrial Group for Construction and Naval Activities) and GICAT (Industrial group for Land and Air Defence and Security) industrial groups

JULY

→ Call for proposals on quantum technologies

AUG.

→ Participation in the Entrepreneurs Convention

SEPT.

→ Signature of a new cooperation agreement with the CNRS, with an initial application via the "GREAT" project, to accelerate and enhance frequency increase and intensity of Gallium Nitrid components. (GaN)

→ Presentation of the new Defence orientation Innovation Initiatives, by the Minister for the Armed Forces, with the publication of the Defence Innovation Orientation Directive (DrOID) 2020

OCT.

→ Participation in the presentation of French Army capabilities

→ Signature of a partnership convention with the Young IHEDN association

NOV.

→ Call for proposals for an electronic support payload module for drones

DEC.

→ Digital Defence Innovation Forum

→ Official launching of the Red Team and initial scenarios

→ Signature of a new cooperation agreement with the CEA on Defence Innovation

→ Signature of a partnership agreement between AID and the GIFAS industrial group

KEY FIGURES 2020

MORE THAN 100

projects and new phases of projects launched with the DGA covering all capability domains for future integration into weapon systems delivered to the Armed Forces



576

projects submitted through the Agency's universal access portal



35

Projects sponsored by the Defence Innovation Lab

21
International agreements signed



233

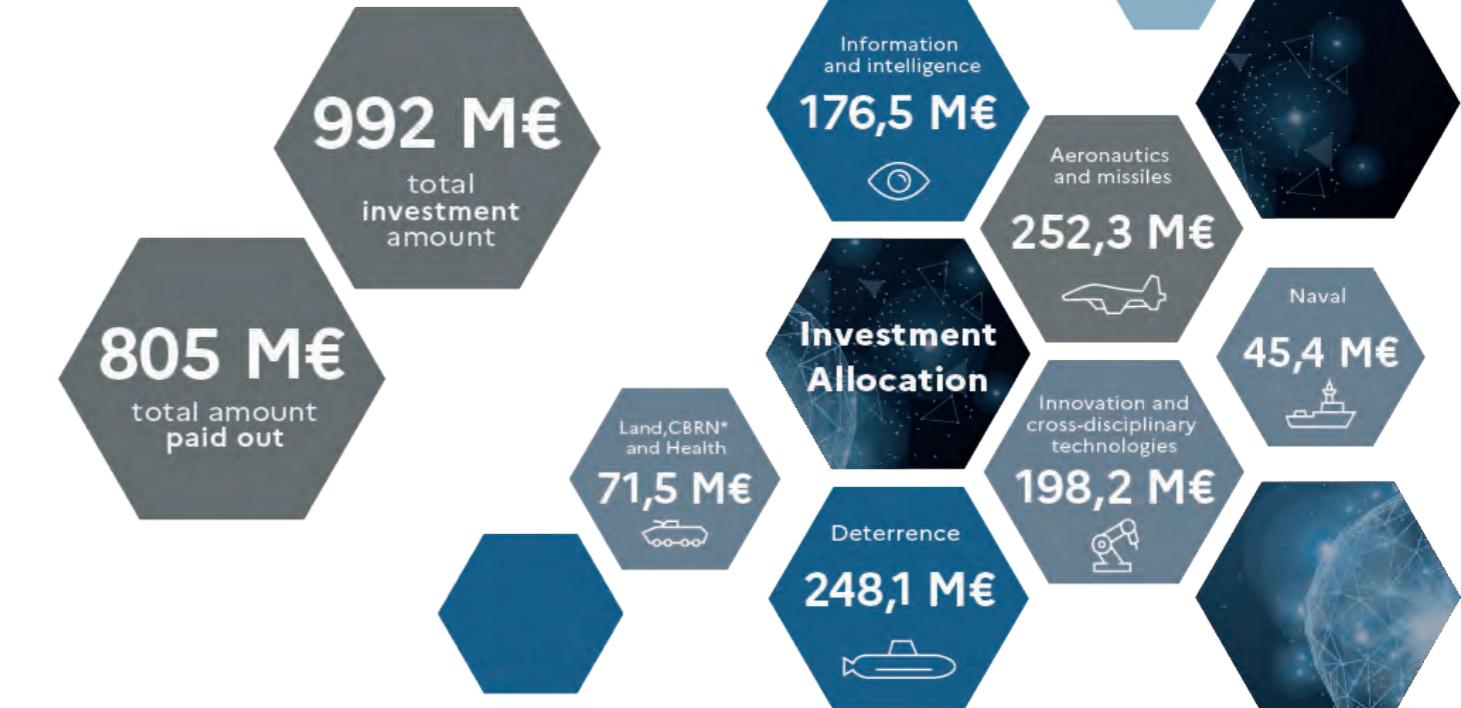
start-up companies registered as Defence Interest assets



2584

Proposals received from the call for proposals for innovative solutions in the fight against Covid-19, of which 36 have been sponsored

FINANCIAL REVIEW



*Chemical, Biological, Radiological, Nuclear

ONLINE UNIVERSAL ACCESS PORTAL

576

Projects submitted in 2020 via the online universal access portal distributed in the following way :

75 Participative innovation projects registered

501 Innovation acceleration projects of which :



471 from industry



23 from directorate labs or from ministry services



7 from the academic domain



« PROJECT-MODE » ORGANISATION



Defence technologies projects

Prepare the defence technologies of tomorrow with Defence Technologies Projects (PTD) which refine the technologies necessary to military requirements. These innovation projects are the main vector for so-called 'planned' innovation.



Innovation acceleration projects

Accelerate innovation with the civilian eco-system with innovation acceleration projects (PAI). They aim to detect innovation stemming from the civilian market in order to deploy them as early as possible.



Participative innovation projects

Encourage innovation emanating from the ministry by way of participative innovation projects (PIP) enabling all personnel, civilian or military from the Ministry for the Armed Forces and the National Gendarmerie to propose an innovative project.



Research projects

Enable the detection and promotion of future strategic technologies with universities, research organisations, schools or certain companies.

In 2020 :

+ 100
Launched with the
DGA

127
certified
projects

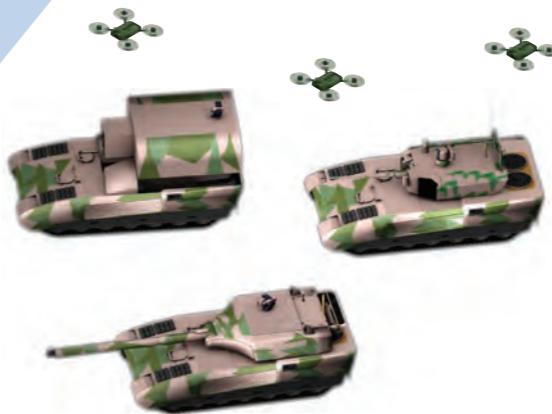
44
projects
launched

180
projects
launched

PLAN

Defence technologies are the backbone of defence innovation policy, made up of projects intended to bring to full maturity the technologies necessary for future military capabilities stemming from foreseeable military requirements, while making sure the industrial and technological defence industry base has attained the level of skill required, (strategic autonomy); in 2020, nearly 800 M€ were allocated to the launch of such projects. The organisation of innovation

domains adopted by the 2020 DrOID clarifies the whole spectrum of capability domains that constitute the defence system. This is illustrated by several projects below, having passed key stages in 2020. Budget allocation however represents only one of the elements used to measure efforts. Other parameters, like, for example, in the case of cyberdefence, the ministry's Human Resources investment, have to be taken into account.



armée de Terre



CNES-2016 / Illustration Mira Productions

MGCS

In 2020, an initial architecture study contract launched the preparation of the French-German MGCS* programme that will replace the Leclerc Main Battle Tank.

It will not be a 'tank' but rather a fleet of combat vehicles, which will benefit from collaborative combat initiated by Scorpion.

They will integrate numerous technological advances in their weapon systems: sensors, protection and even robotisation. This project will stimulate research and industry for many years to come in the domain of land warfare.

*Manufacturers Nexter and KMW. Project under development.

IMAGE INTELLIGENCE (IMINT)

Launch of the application agreement for Image Intelligence (IMINT) in the framework of a CNES-DGA protocol to develop the components of a new generation of space imagery satellites, including, detectors, filters, gyroscopes and actuators.... These innovations will benefit the IRIS programme, intended to improve observation performance and increase efficiency and reactivity.

Manufacturers: CNES with Thalès Alenia Space, Airbus Defence and Space, iXblue, Sodern, Pyxalis, Reosc, Lynred, Cilas and Air Liquide Advanced Technologies. Project under development.

PROGRAMMER**KOVE**

A virtual voice assistant for pilots.

Kove is aiming to create an onboard voice assistant in aircraft cockpits, where various man-machine interactions will be vectored by use of voice, in order to assist the pilot in his missions, notably radiomanagement, fuel-remaining or the tactical situation.

Manufactured by Airudit/EA4T. Project under development.

DOMINNO

Maintenance in Operational Condition in the Big Data age.

The DOMINNO contributes to maintenance cost-reduction and improves operational availability of helicopter engines, by reading the equipment maintenance registered in flight. It demonstrates the relevance of "Big Data" concerning the maintenance in operational equipment and identifies the advantages of this technology.

Manufacturers: Safran Helicopter Engines. Project under development.

**CENTURION**

Accelerate innovation to support the disembarked soldier.

**VISION**

A navigation system that pinpoints stars in broad daylight

VISION aims to demonstrate the feasibility of a star-tracking navigation system. Built around a hybrid inertial system with one or two star pointers, this system operates day and night on aeronautic carriers. Permanent and undetectable, with no radio-electric signals emission, it will enable precise, secure and very sovereign navigation.

Manufacturers : Safran Electronics & Defense and Sodern. Project under development.



ACCELERATE

CALL FOR INNOVATIVE SOLUTION PROPOSALS IN THE FIGHT AGAINST COVID-19

In the framework of the governmental plan to fight against Covid-19, the Minister for the Armed Forces, via the Defence Innovation Agency, launched a call for proposals on March 19, 2020 to provide innovative solutions, of a technological, managerial or adapted industrial process nature, to fight against the pandemic. Open to any stretch of the imagination, the call for proposals was open to all themes capable of contributing to this fight. Among the **2 584 propositions received and analysed in less than a month**, **36 projects were retained**, proposed by SME, start-up, laboratories, major groups and also by personnel from the Ministry for the Armed Forces and the Gendarmerie Nationale. Volunteers from the whole ministry were quickly organised to deal with

10M€^{budget}

 **2 584 projects registered**

 **36 projects retained**



COVIDIAG

—
High-resolution serology test, with nasal-pharangal swab, enabling visual and precise characterisation of a patient's immunology profile by detection of anti-SARS-CoV-2 anti-bodies (concerning several antigens). These diagnostic tests validated by the High Health Authority and the National Reference Centre are now commercialised.

Piloted by the Innobiochips company.



WAKED-CO

—
A platform conceived to support researchers and the medical professions in the fight against Covid-19. By the use of artificial intelligence it enables the analysis and reduction of time required to research the vast quantities of scientific and technical documentation on this virus. This tool is now integrated into the Covid-19 platform of the Ministry for Solidarity and Health and will be hosted on the servers of the Ministry of Higher Education.

Piloted by the General Secretariat for Administration and the Armed Forces Health Services

MAKAIR

—
An innovative respirator, modular, open-source and open-design, initially designed for the emergency treatment of patients suffering from acute respiratory distress, through Covid-19 infection, offering today the integrality of functions of a traditional respirator.

Piloted by Nantes's university and CHU and by the Makers for Life group.

ONADAP

—
Digital decision support tool, based on artificial intelligence, to model the sanitary situation of health-care providers on the scale of a hospital or a hospital department and anticipate the spread of the virus within it. Deployed in the Percy Army Teaching Hospital (Hôpital d'Instruction des Armées de Percy).

Piloted by the Borelli Centre, Paris-Saclay ENS and Percy Army Teaching Hospital.

ACCELERATE

WITH THE INNOVATION DEFENCE LAB

- The Innovation Defence Lab invites, structures and sets up innovation acceleration projects in order to promote enhanced technological and user maturity.
- The Defence Innovation Lab is situated outside the Ministry's infrastructure ground, thus favouring exchanges between innovation stakeholders from the ministry, the Innovation Defence Lab, the defence ecosystem and civilian sector innovation..
- In 2020, in spite of the context of the health crisis, the activity of the Innovation Defence Lab did not slacken, producing :



220 events, mainly organized on-line



3 800 visitors on site or on-line



35 projects sponsored



13 market studies rendered



HELMA-P

Experimentation of a laser system in the fight against drones

Laser destruction tests on drones were carried out for the first time by the DGA Missile Tests, based on scenarios coordinated with the armed forces. Results are promising, notably concerning neutralisation time, which proved to be very rapid.

Piloted by CILAS.



VIRTUAL MAP

Experimentation of the advantage of virtual reality in mission preparation.

Virtual MAP is an experimentation to test and evaluate the advantages provided by virtual reality in the framework of collaborative work in mission preparation, using a virtual command post. It has successfully shown many aspects of the solution, of which the feasibility, user-acceptance and the emergence of new functionalities.

Piloted by Thales

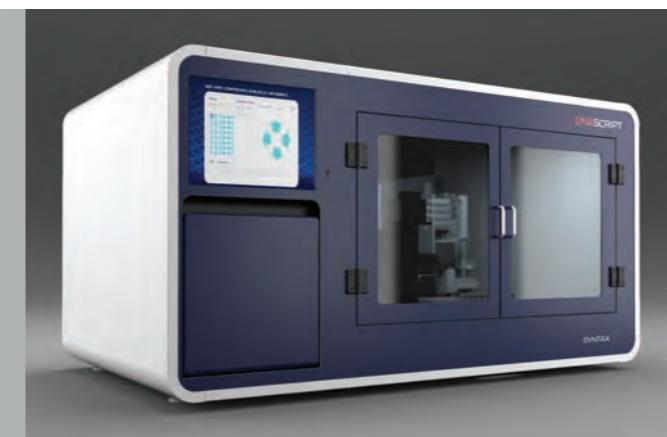


P3TS

Multi-constellation synchronisation and geo-localisation militarised system

This project emanating from participative innovation, then accelerated by the Innovation Defence Lab, enabled the development of a radio-navigation receiver based on civilian sector technologies, is equipped with interfaces that are compatible with military standards. This project has led to several thousands units being ordered by the DGA.

Piloted by Lieutenant Colonel Nicolas from the Army Staff and by Pierre-Henri, a DGA engineer.



SYRTAQI

A rapid bio-reactive technique for the detection of highly pathogenic bacteria and viruses

This project aims to develop a rapid production prototype for primers and probes in synthetic DNA. These reactants are the key to rapid detection and diagnostic of pathological biological agents. The rapidity of the process will be a real time-gain when confronted by new threats.

Piloted by DNA Script.

ACCELERATE

INNOVATION WITH THE CIVILIAN SECTOR ECOSYSTEM

The Defence Innovation Agency, resolutely focused on the civilian ecosystem, aims at detecting and harnessing innovations or innovators, initially not addressing the Defence market, but whose technologies can meet the specific requirements of the Armed Forces.

AID clearly distinguishes the phase when an innovation is detected, from the moment that AID works with the innovation, to initiate 'the right product', at the 'right time'. To do this AID takes into account the technical, market and user-maturity of the innovation. The Agency has two main innovation collectors: the universal access gateway ('fishing') and the detection and harnessing cell ('hunting'). The latter provides an innovation overwatch and tracking system (models and demonstrators destined to stimulate and alert capability roadmap orientations).



SIMROS

Develop the surveillance of Over The Horizon maritime zones with a Surface Wave Radar simulator

SIMROS proposes a software programme designed to rapidly establish multiscale transforms to dimension a High Frequency surface wave radar system and evaluate the long-range distance detectability of ships where the curve of the Earth does not permit conventional microwave radars to respond to the problem.

Project piloted by the XLIM research Institute, the GeePs laboratory, ONERA, CISTEME and the IEEA.



SYSCO

Develop a no-paint system to ensure aircraft longevity

Sysco enabled the development of CorsoPatch Aircraft, a dry aeronautic paint fast-repair patch on metallic or composite substrata meeting the very strict specifications of chemical, mechanical and climatic durability (corrosion, fluid immersion, UV exposure, ...).

Piloted by the Corso Magenta company.



DENOTER

Chemical and Biological decontamination system

The DENOTER project aims at developing a multi-purpose emergency or ready-to-use decontamination system. The final product has to be efficient, on all types of surface against CBRN chemical and biological agents.

Piloted by LAGEPP and LEM (two academic teams from Lyon) and the Ouvry company.

127 Certified innovation acceleration projects

IN 2020, 233 START-UP WERE IDENTIFIED, OVER HALF OF WHOM HAVE BEEN COLLABORATIVELY INTERVIEWED

CONFIRMA

A counter-disinformation software programme

CONFIRMA enables Storyzy to add two innovative modules to its counter-disinformation software programme. It notably provides a new dimension by assisting the elaboration of better response strategies.

National and international organisations already use it.

Piloted by Storyzy, Inria Wimmics laboratory, and the Jean Nicod Institute.



ACCELERATE

THROUGH PARTICIPATORY INNOVATION

2020 was a dynamic year for participative innovation. Not counting calls for projects in the fight against Covid-19, 75 projects were followed-up in 2020, 32 of which have been financed.

In order to promote the opportunities presented by innovative participation as well as the associated process, a travelling presentation the IP Tour, was set up. In 2020, the IP Tour reached operational stakeholders from all horizons within about thirty different units, all of which potentially contain innovators. More than ten projects were fostered in this framework.



HANGI

The indoor crime scene investigation drone

This drone, equipped with an onboard camera, was developed to meet crime-scene investigative requirements. Powered by Helium, it provides the required images without risking the alteration of the scene and is used before criminal identification technicians intervene.

Developed by Colonel Nicolas, Lieutenant Colonel Fabien, MAJ Thierry from IRGN and by Captain Laurent from the National Gendarmerie Region, and with the INANIX company.



ZEPHYR-H

A collaborative system used to carry out 'helicopter-ship' pairing qualification trials

This collaborative digital tool is designed to facilitate and smooth operational experimentation trials for embarked French Navy helicopters and optimize their operational use in order to use their full operational capability of their combat system.

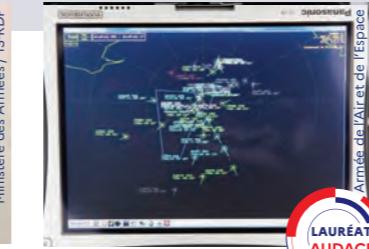
Developed by Navy Lieutenant Commander Jean-Baptiste and Navy Lieutenant Nicolas, assigned to CEPA-10S, with Daedalus Aero-space and SII companies.



DAPCO

Landing system aid for HALO operators

DAPCO is an emmitter project enabling parachutists to land without visual reference points thanks to a unit emitting radio waves towards the ground with a receiver plugged into the V60 INVISIO unit that emits sounds in the soldier's PELTOR helmet. Developed by the 13eRDP Special Forces trooper Corporal Nicolas, with the BE Electronique® company.



ELIA

Air situational awareness on operations

ADS-b signal detection and treatment emitted by aircraft. Complementing modern radars, this sovereign system, independent from the civilian sector, is modular and optimised for the requirements of the armed forces and has been deployed since November 2018. Developed by LTN Julien, from the Air and Space military staff.

ACCELERATE

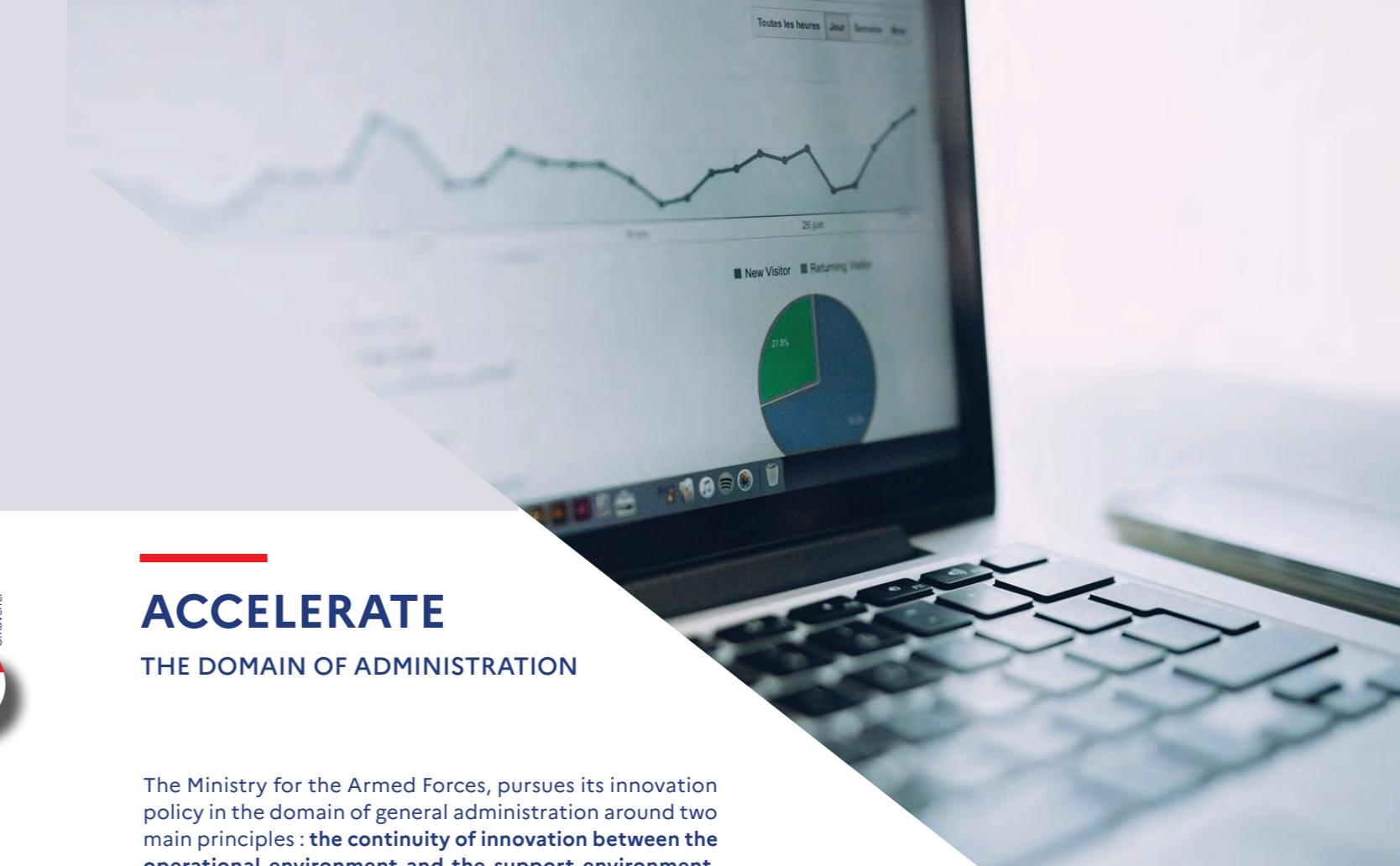
THE DOMAIN OF ADMINISTRATION

The Ministry for the Armed Forces, pursues its innovation policy in the domain of general administration around two main principles : **the continuity of innovation between the operational environment and the support environment, and the administrative agility contributing to permanently adapt and simplify the defence tool as much as necessary.** Project management is overseen by the Delegation for ministerial Transformation and Efficiency of the Secretariat General for Administration (SGA).

The SGA's business intelligence and big data innovation lab, within the framework of the WAKED-Co innovation project, enabled the automatic analysis and mapping of numerous scientific publications concerning Covid-19, with a view to helping researchers, thanks to the use of artificial intelligence. This project, conducted with the Armed Forces Health Service, was awarded the 'Victory of Innovation' price for public stakeholders.

In the archives domain, the DTPM carried out an experiment of automatic detection of objects in historic images in view of their automatic tagging.

The Lab 'Rendezvous' organized by the DTPM, enable companies and administrations to share ideas about their respective innovations. These exchanges can lead to experimentations around the innovations presented, notably around the five main themes serving the modernisation of administration professions (user satisfaction, process simplification, digital office, data-powered management, change management).



EXPLORE

EXPLORATORY RESEARCH

In 2020, The decision to focus Ministry investments more on major Defense interest themes, by placing them in a valorisation framework, is particularly evident in the **ADAMANT shared research Chair created with ONERA and SAFRAN**, to explore the new technologies and research methods for high temperature materials for military aircraft engines. **Four new research chairs on Defence Artificial Intelligence** have also been set up on passive acoustic analysis, the verification



Armée de l'Air et de l'Espace / J. Fecther

NEW INVISIBILITY CLOAKING FOR AIRCRAFT

This thesis has shown that a structure built around successive layering of materials leads to better cloaking of electromagnetic waves.

The use of meta materials in the aircraft coating significantly reduces the equivalent radar signature (SER) and provides better stealth capability for aircraft.

Thesis undertaken by Geoffroy Klotz, Phd student in DGA/CEA with the Marseille Fresnel Institute.



The digital artist pikaby

ELOCANS

Analysis of ocular movements in man-machine interaction

ELOCANS aims to enhance the functionalities of pilot's helmets to be able to follow the psycho-physiological state of the operator, without an eye-tracking system, just by using the electric energy produced by the eyes.

Piloted by ISAE-Supaéro, and the Air Academy.

of facts and the detection of controversies; the robustness of networks faced with 'adversary' attacks, and the intelligent exploitation of distributed heterogeneous data. 2020 was also marked for the signing of two partnerships with major research stakeholders in France : one with the CNRS, identifying in particular as a common interest domain, the components and sensors, quantic technologies, artificial intelligence;

the other with CEA, concerning innovation and the valorisation of research studies, to together develop projects for the European Defence Fund and on domains such as energy, components and artificial intelligence. The agreement with the CNRS has already led to an initial application agreement, illustrating the long-term nature of certain research necessitating an in-depth effort, specifically, the exploration of new Gallium

Nitrate technologies, essential for radars, active antennas, communication or electronic warfare systems. Lastly, 180 new research projects were launched in 2020; among these, a specific call for ASTRID proposals led to four projects being selected on **atomic interferometrics, the detection of microwave fields, encrypted quantum communications and the evaluation of quantum calculators**.



Armée de Terre / Frédéric Thouveron

MISTIC

A multi-spectral Terahertz by conversion THz → IR instrument

MISTIC aims to develop a Terahertz sensor that is: real-time, transportable, energy autonomous and low-cost, which will be deployed in different, very varied environments, both civilian and military (detection of explosives, non destructive investigative checks, plant maturity, skin analysis). Piloted by ONERA and the R&D Vision company.



Armée de Terre / Jérôme Sales

BLAST

Vulnerability and efficiency of composite structures to blast effects

BLAST proposes a high-performance anti-IED up-armour flooring protection package, 30% lighter than its equivalent in steel.

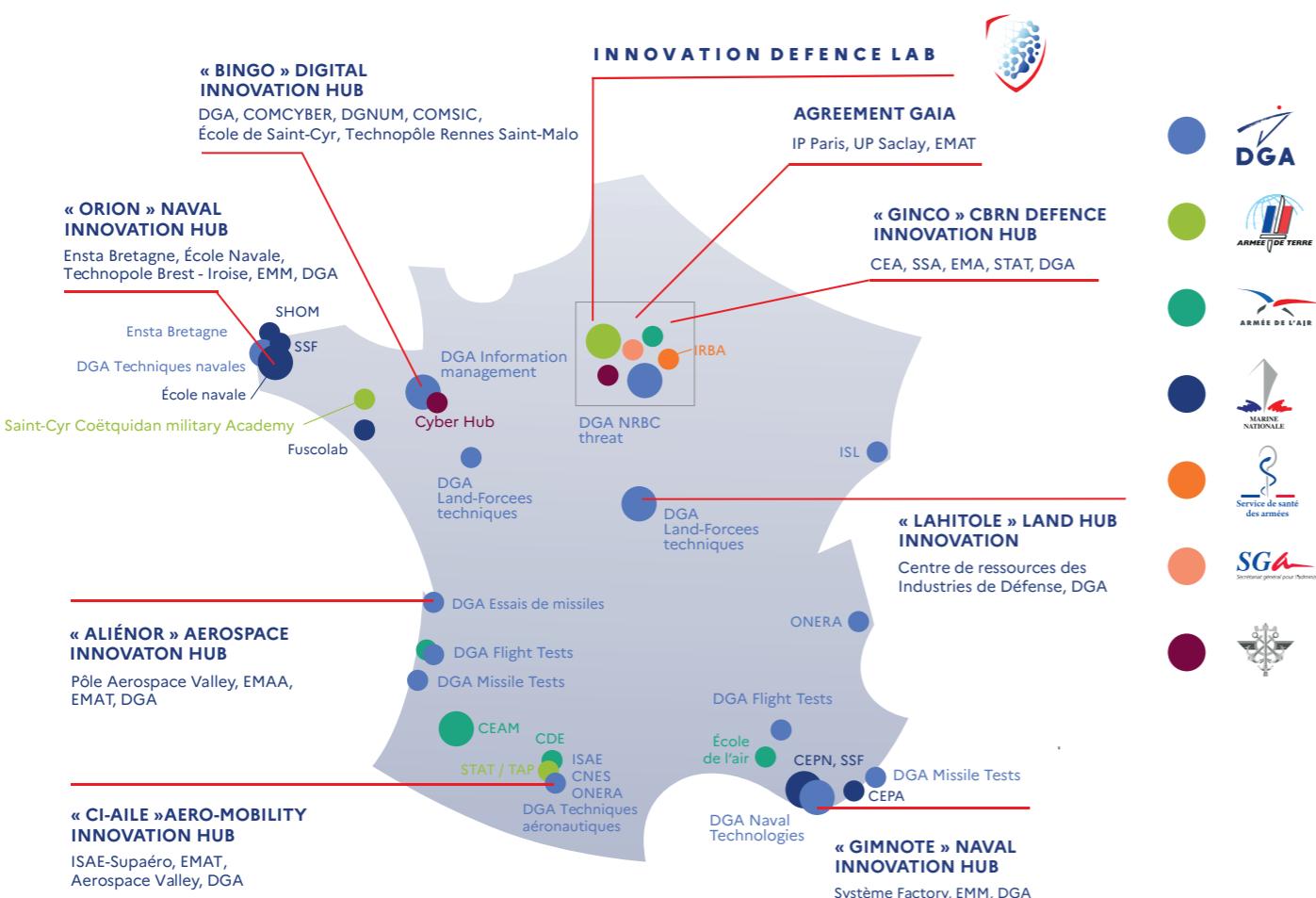
Piloted by the Clément Ader Institute, the Federal Toulouse-Midi-Pyrénées University, the UMR CNRS 5312, with the Composites Expertise & Solutions company and the CEA.

ANIMATE

THE NATIONAL DEFENCE INNOVATION NETWORK IS GROWING

The AID signed partnership agreements with the three main Defence Industry professional groups: the GICAN-Industrial Group for Construction and Naval Activities, the GICAT-Industrial group for Land and Air Defence and Security and the GIFAS-French Aeronautic and Space Industries Group. These conventions provide

a lasting collaborative framework between AID and the manufacturers by working together on the information for industries and the detection of innovative projects. 2020 was also marked by the signature of a convention partnership with the Young IHEDN association. This convention is the response to include the youth in the thinking about the future of our defence.



VALORISE

DEFENCE INNOVATION DIGITAL FORUM 2020

The Defence Innovation Forum, the Defence innovation showcase, brings together all the ministerial stakeholders and their partners around innovation projects supported by the Minister for the Armed Forces. Inaugurated by Florence Parly, Minister for the Armed Forces, the 2020 edition of the Defence Innovation Forum was held from December 2 to 4 in a digital format for the first time due to the health crisis.



8 ROUND TABLES ORGANISED :

- Winning the war of tomorrow
- Augmented soldier : ethics and technological challenges
- Winning the war of energy
- Winning the fight against COVID-19 : the Ministry for the Armed Forces' contribution
- Invest in innovative strategic companies
- Digital usage transformations
- Anticipate to win thanks to new technological breakthroughs
- Presentation of the first Red Team scenarios

+ 8h^{live}

+ 20 valued projects

Conferences available on the Defence Innovation Agency's Youtube channel .

4 777 connected



NURTURE

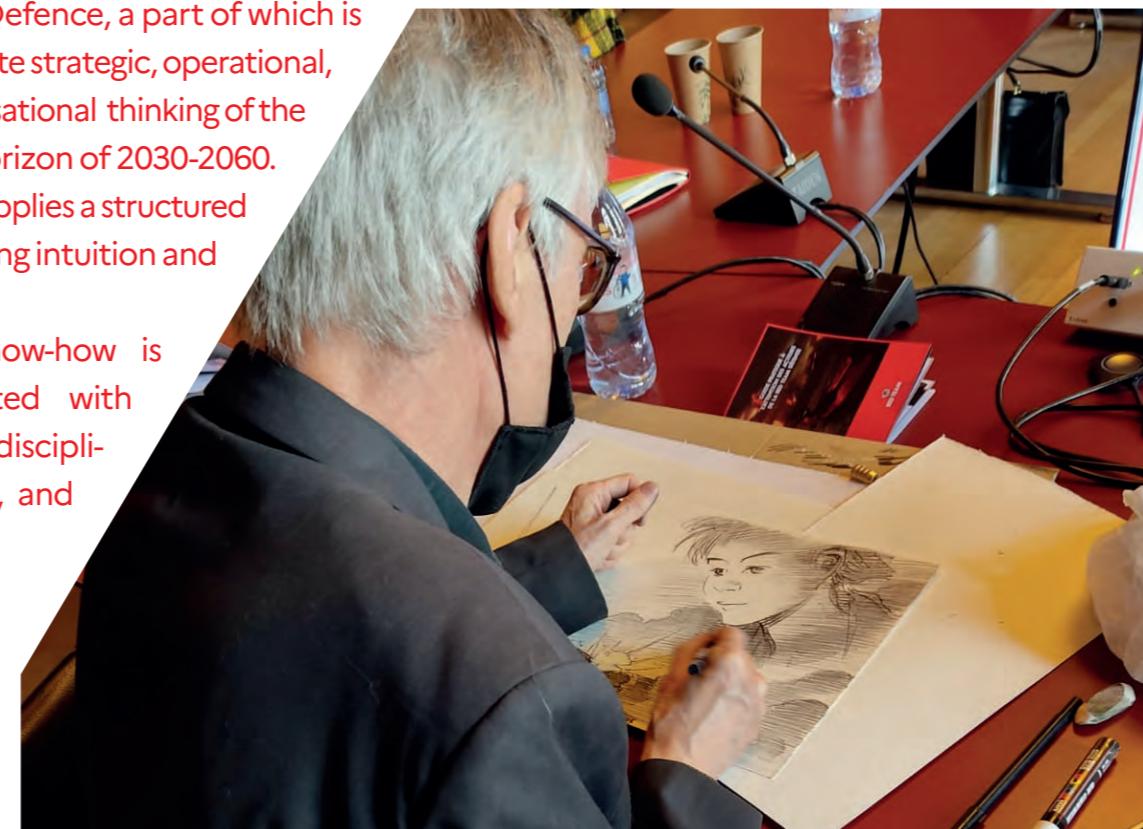


The initiative was taken in the summer of 2019 with the Armed Forces Staff, the Armament General Directorate and the General Directorate for International Relations and Strategy, the Red Team presented its « season 0 » work during the Digital Defence Innovation Forum in December 2020.

They work on the 'New Pirates' thematic, based on the universal history of piracy, transposed to modern times and integrating present-day stakes and technologies.

The work of Red Team Defence, a part of which is classified, aims to stimulate strategic, operational, technological and organisational thinking of the Armed Forces, on the horizon of 2030-2060. The Defence Red Team applies a structured iterative process, favouring intuition and creativity.

Traditional military know-how is consequently confronted with science-fiction, multi-disciplinary scientific research, and the arts.



SCÉNARIO A - P-NATION

The P Nation, or Pirate Nation, has 100 millions stateless climate refugees, all of whom are "de-chipped", living in floating mega-cities, ferociously politicised against post-colonial European order that they contest, and are heavily armed by enemy powers. In this scenario, we find a space transporter system based in Kourou, designed to exploit the wealth of minerals on asteroids, an attack against a chemical cargo ship, systematic micro-chipping of populations, future weapons like the railgun, and many other adventures.

SCÉNARIO B - BARBARESQUES 3.0
The action in this scenario, takes place in the Mediterranean region, the home-base for the 'Sunset Pirates', whose leader, Alia N'Saadi, a modern-day heroine, is very much in the news. Set against a back-drop of contested oil reserves and anti-Western propaganda, she has rallied to her cause an army of pirates, ready to risk all for the cause. The action of this scenario mixes pinhole strategy, Cyber-piracy, an attack against a frigate and against Valetta, in a political context that is 'red-lining' due to the scarcity of fossil fuels.

Both scenarios are available at the link : www.redteamdefense.org

The first Red Team Defence season was launched on January 27, 2021. The restitution of work from this season (in particular the risks and threats within the scenarios) for the benefit of the Armed Forces is planned for the summer of 2021.



2ND PART

**ACTUALISATION 2021
OF DEFENCE
INNOVATION
ORIENTATION**

EDITORIAL EMA & DGA



Armament Engineer General Jean-Christophe Videau
Chief of Defence System Directorate - DGA



Lieutenant general Vincent Pons,
Head of department for Capability
Planning Joint defence staff

In the never-ending fight between the sword and the shield, innovation must contribute to both one and the other so that our Armed Forces, today and tomorrow, will hold the upper-hand over their potential adversaries and respond to the challenges of a world where tensions are multiplying. As we can see from the updated strategic review, the hypothesis of a major engagement has become more than just an academic hypothesis. Long-term Defence planning is thus, more than ever, the decisive condition for a capability approach able to structure our Defence system. It is based on a judicious mixture of exploratory research, programme preparation and civilian innovation harnessing. Every year, the Defence Innovation Orientation Directive (DrOID) provides a synthesis of priority objectives and lines of effort stemming from a collaborative approach between the Armed Forces, AID and the DGA. The approach aims to both identify, anticipate and develop technologies,

notably disruptive technologies, most suited to reply to the capability requirements of our Armed Forces and pre-empt the risk of being outclassed or taken by surprise.

The results are easy to see. The abundance of ideas from the civilian sector opens up new fields of interest to our approach towards capability preparation. The permanent challenge of a better approach to open innovation has to be met. It questions our aptitude to articulate open innovation with creativity, agility, reactivity, and the programmed development of tomorrow's major technologies. The success of scaling up, integrating and rapidly generalising throughout the Defence system, the innovation stemming from technological evolutions in the civilian world, or from operations, is today an imperious necessity. The logic of continuous improvement which henceforth infuses the new armament programmes renders this possible and puts innovation at the tip of the spear.

ORIENTATIONS 2021

Serving operational superiority of the Armed Forces and the strategic autonomy of the Nation, Defence innovation is both a short-term and a long-term process. It spans the exploration of emerging technologies to current innovations, to provide the Armed Forces with advantages in the short-term, while paving the way for our future military capabilities. It requires both a long-term commitment with stable stakeholders and the detection of opportunities in an open innovation dynamic, and the internal creativity of the Ministry (participative innovation).

The current health crisis has however exposed new challenges, consequence of the weakening caused to industry. The importance given to the support of critical know-how for our strategic autonomy has thus been increased, with for example, the doubling of the Definvest Fund. If certain dual sectors benefit from the economic recovery plan, others, like certain branches of critical components and materials, necessitate dedicated investments from the Ministry for the Armed Forces.



PRIORITISED THEMATICS STEMMING FROM THE UPDATED LPM

CYBERDEFENCE

Cyberspace is a more and more hostile environment, where the whole spectrum of threats (cyber pollution, cyber crime, advanced targeted threat) is constantly present. At the same time, the Defence system, globally speaking, (weapon systems, digital bases, logistic supply chains) is increasingly reliant on cyberspace. Innovation policy in the cyber domain must consequently prepare the approaches, the tools and equipment necessary to guarantee our capability to operate when under cybernetic attack.

THE FUTURE INVESTMENT PROGRAMME (PIA4)

The Investment Programme for the Future (PIA) is a major investment programme in innovation, which has proved its worth these past ten years.

Funded by 20 Bn € over five years, the 4th PIA has contributed 11Bn Euros to the economic recovery plan to date, in order to accelerate the dynamics of innovation.

It also supports the entire life-cycle of an innovation, from the emergence of an idea in a research laboratory or a university, right up to its diffusion in the form of a product or a service, after having passed the stage of its technological valorisation. Through national acceleration strategies, the State finances targeted substantial investments in various emerging priority-fields and technologies.

These strategies are defined in the framework of inter-ministerial steering groups thus reinforcing the alignment of public efforts and the efficient and rapid application of the defined measures.

The Ministry for the Armed Forces is associated with the governance of the PIA, and is directly implicated in several strategies: cyber-security, quantum technology, artificial intelligence, 5G, Cloud, re-emerging infectious diseases, industrial bio-sourced products and bio-technologies -sustainable fuels, sustainable cities and innovative buildings.

ANTI DRONE WARFARE

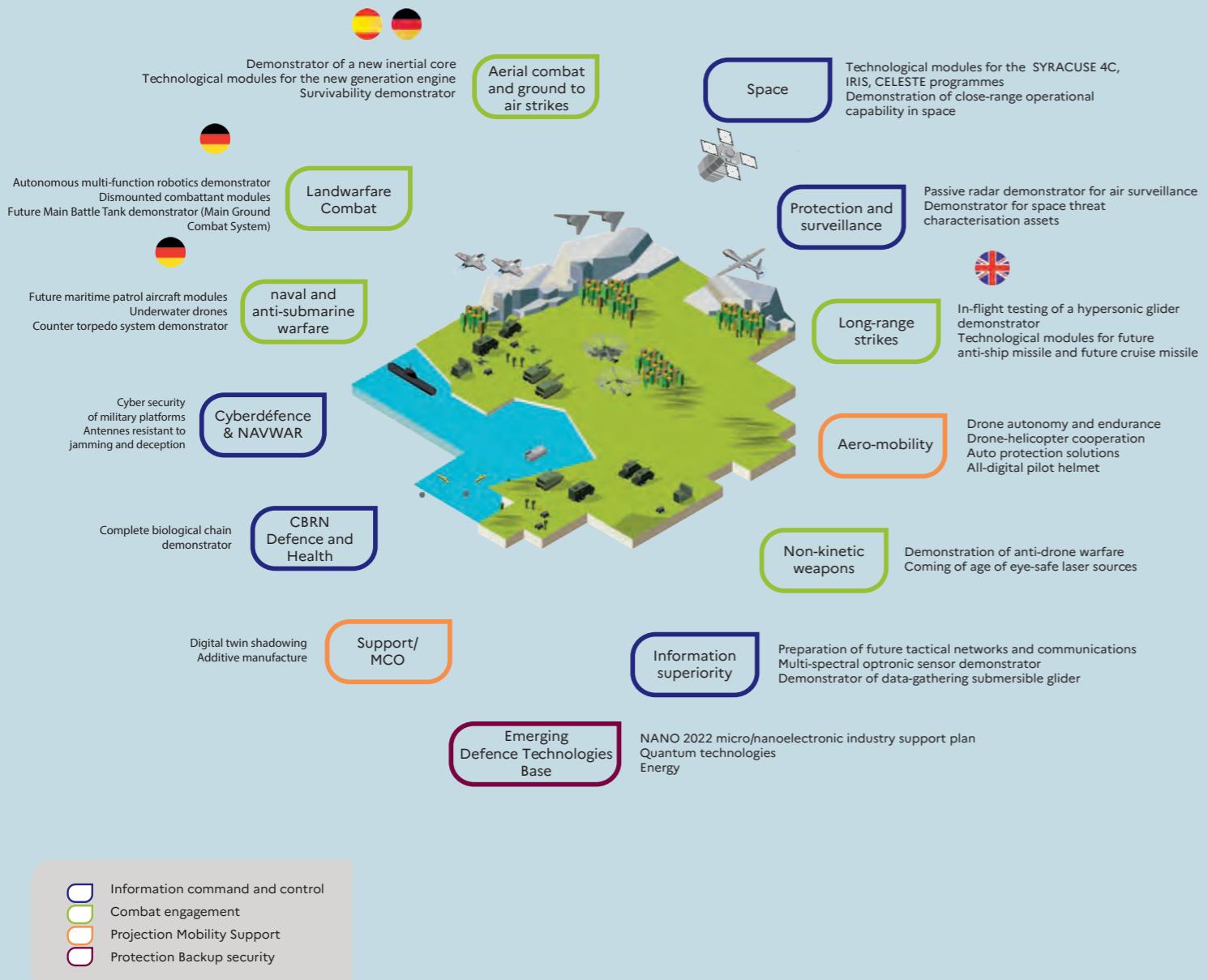
As a major evolution factor, the malicious misuse of drones stemming from civilian-sector innovation, rephrases the question of the sword and the shield. For the shield, the resolute preparation of new anti-drone warfare capabilities requires a range of defensive capabilities, both from innovation detection and harnessing and from the continuation of research on radically-new technologies and architectures, susceptible to counter threats that have become multi-form and wide-spectrum.

CHEMICAL, BIOLOGICAL, RADIOPHYSICAL AND NUCLEAR DEFENCE (CBRN)

CBRN has taken on a new dimension over the past few years due to the proliferation of multi-form threats used by state or non-state entities, including against our forces on operations : no-taboo usage, new chemical agents, new technologies, new dissemination methods...

The pandemic has underlined the need for physical and medical protection, for decontamination as well as the appearance of shortages linked to the dependence on foreign suppliers of certain single-use products that are difficult to store in the long term. For all of these issues, innovation must prepare the renewal of NRBC equipment.

PLANDMARK PROJECTS 2022 - 2024



*NAWWAR : Naval Information Warfare Systems Command / NRBC : Nuclear, Radiological, Biological, Chemical / *MCO : Maintenance inoperational condition



The Hydrone project is equipped with a mini recharging station that works with hydrogen. Piloted by the Ergosup and Delair companies.

RELATIONS WITH DEFENCE INDUSTRIES

A better use of public investments in Defence innovation requires State-Industry dialogue over the long-term, in partnership mode, with as a central keystone, shared state and industrial road-maps, whenever this is possible. The impetus created in 2020 will be consolidated: the theatics of preliminary work carried out by operators under supervision, but also by research projects (or in some cases acceleration projects), will be shared, in order to identify adherence to

MINISTERIAL ENERGY STRATEGY

Unveiled in September 2020, the Ministerial energy strategy aims to turn the energy transition into an operational asset, by consuming safely, less, and better to enable the armed forces to gain in operational efficiency and resilience.

Innovation should enable less consumption by optimising the energy management of military infrastructures, and more efficient consumption, for example, by using hybrid engines in ground-forces vehicles: a hybrid Griffon demonstrator project will thus be launched in 2022.

In order to benefit from major civilian investments currently underway in France and in Europe, the harnessing of civilian innovation should be a priority, knowing when to exploit the new technological opportunities at the right time to respond to military requirements.

technological road-maps, and develop potential synergies. The ADAMANT industrial research chair is the best example of this partnership process : it should be an example to follow. To make the most of the profusion of civilian sector innovation, the two-way state-industry dialogue will help the Ministry to better identify the theatics where more open modes of action will be particularly well-adapted and could be applied rapidly.

EUROPEAN DEFENCE FUND (FEDEF)

After a three year preparatory phase, materialised by two precursor projects in the domain of industrial development, (EDIDP) and Defence research, (PADR), the European Union launched the European Defence Fund in 2021 (FEDef), which opens up a new dimension to European Defence cooperation.

Allocated some 8 Bn € over the period 2021-2027, the FED will finance projects at different levels of maturity, by earmarking about 2/3 of the fund to a 'research' portfolio. This entails investing in structuring that corresponds to the needs of the Armed Forces without duplicating existing capabilities already under development within the Union. As well as this capability dimension, the FED also includes a European Defence industrial base development competitiveness objective, the guarantee of the continent's strategic autonomy.

The unprecedented level of resources allocated by the EU to this fund makes it possible for France, over and above everything else, to access projects that France could not have financed alone, not even within bilateral or multinational cooperation, considering the limited R&D defence budgets of the other EU countries.

The projects launched under the preparatory framework, such as the FED work programme, clearly illustrate all of these objectives : the MALE drone shows the progress made towards strategic autonomy, the PILUM railgun, breakthrough innovation, the TWISTER early warning system, the structuring capabilities...

Within the framework of the European Capability process, France is driving the TWISTER project, which aims to develop, with European cooperation, anti-missile defence capabilities, based in particular on a space-based early warning system and an endo-atmospheric interceptor capability, thus contributing to NATO's anti-missile defence.

Over and above the projects themselves, it will be necessary to ensure the right synergy between civilian-sector programmes and (Horizon Europe) Defence sector programmes (FED).

The issue is to eliminate the risk of redundancy and the reciprocal analysis of two programmes must lead to maximum exploitation of the results achieved compared to the efforts made, respecting the limits of each programme.

The domains of energy and space will figure among the main lines of interest in this perspective.

EARLY WARNING TWISTER

The emergence of new threats such as maneuvering ballistic missiles or hyper-sonic cruise missiles or gliders is a new challenge for today's anti-aircraft defence systems, in land or maritime theaters.

Within the framework of the European Capability process, France is driving the TWISTER project, which aims to develop, with European cooperation, anti-missile defence capabilities, based in particular on a space-based early warning system and an endo-atmospheric interceptor capability, thus contributing to NATO's anti-missile defence.

THE WORK PROGRAMME FOR THE EUROPEAN DEFENCE FUND

The 2021 work programme is built around 17 categories, covering the whole spectrum of capability domains while leaving room for innovation capture with regards to small and medium sized companies and exploration with breakthrough or disruptive technology.

This type of structuring is very important for France as it guarantees the coherence and continuity of effort throughout the programme life-span. It contains the major themes for which France advances its capability development policy and technological expertise through cooperation.

Each of the categories deals with a particular defence domain and focusses on one or several subjects or topics ; the selected projects will aim to provide European industry the means to

develop the prototype of a future military capability, or to advance a less mature project which could be pursued in a future work programme.

The topic « Next Generation Vertical Take-Off and Landing » (VTOL) in the Air combat category, launches the work announcing a future combat helicopter.

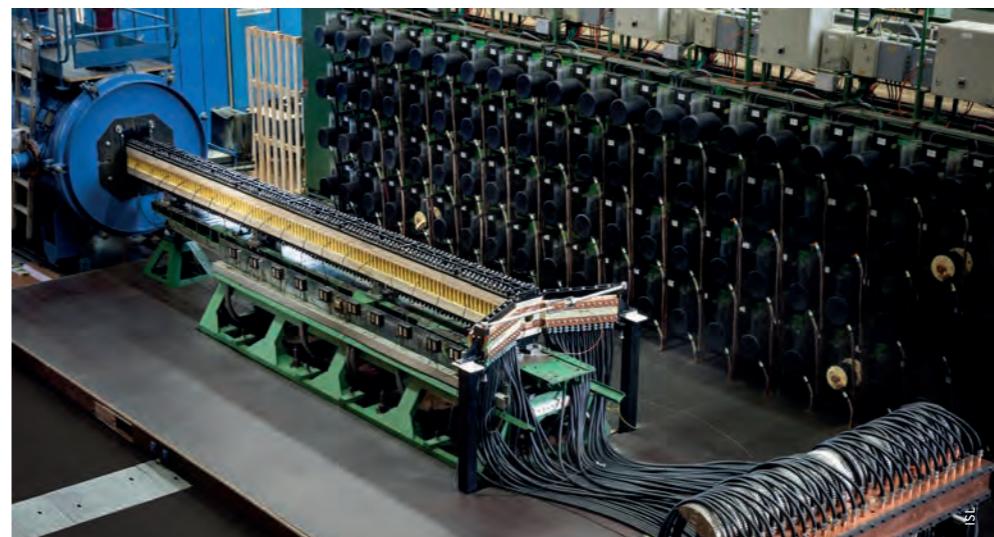
The topic « endo-atmospheric interceptor » in the « Air and Missile Defence » category, corresponds to the missile component of an anti-missile defence early warning system. (TWISTER).

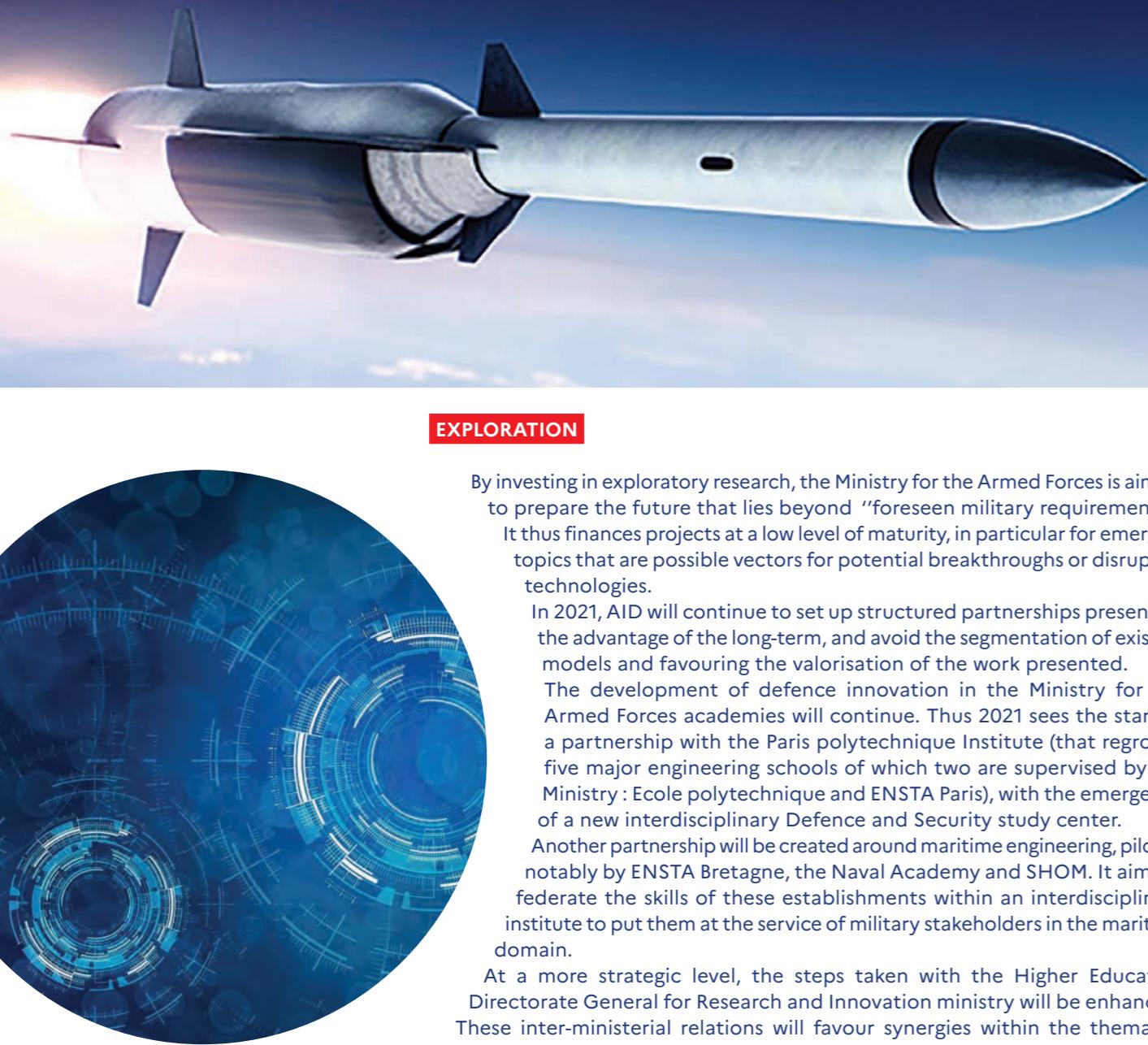
From a more 'technology' oriented aspect, the category 'energy resilience and environmental transition' contains the topic « independent energy systems for military infrastructures ».

PILUM RAILGUN

Launched in 2020 within the PADR, PILUM aims to show that the railgun concept is capable of firing precision hypervelocity projectiles over a distance of several hundred kilometers and that it has sufficient potential to create a technological breakthrough in long-range artillery support.

Developed by the French-German research institute with its partners.





EXPLORATION

By investing in exploratory research, the Ministry for the Armed Forces is aiming to prepare the future that lies beyond "foreseen military requirements". It thus finances projects at a low level of maturity, in particular for emerging topics that are possible vectors for potential breakthroughs or disruptive technologies.

In 2021, AID will continue to set up structured partnerships presenting the advantage of the long-term, and avoid the segmentation of existing models and favouring the valorisation of the work presented. The development of defence innovation in the Ministry for the Armed Forces academies will continue. Thus 2021 sees the start of a partnership with the Paris polytechnique Institute (that regroups five major engineering schools of which two are supervised by the Ministry : Ecole polytechnique and ENSTA Paris), with the emergence of a new interdisciplinary Defence and Security study center. Another partnership will be created around maritime engineering, piloted notably by ENSTA Bretagne, the Naval Academy and SHOM. It aims to federate the skills of these establishments within an interdisciplinary institute to put them at the service of military stakeholders in the maritime domain.

At a more strategic level, the steps taken with the Higher Education Directorate General for Research and Innovation ministry will be enhanced. These inter-ministerial relations will favour synergies within the theatics justifying joint investment.

THE IA ROADMAP

Artificial Intelligence (AI) is destined to play a larger part in defence systems, contributing to operational and technological superiority objectives of the Armed Forces. It is also a major vector for the Ministry's digital transformation in order to increase its efficiency.

As a highly-developing dual technology in the civilian sector, the AI roadmap of the Ministry for the Armed Forces, fits perfectly into the national AI strategy announced by the President of the Republic in 2018. Strategic partnerships, concluded with INRIA, the CNRS and the CEA – make it possible to accompany and develop an AI Defence ecosystem, at national and European level (within the framework of FEDef in particular). The stimulation of this dynamic ecosystem, as well as the maturation of promising technological modules, are highly important in order to guarantee successful integration of AI in major Defence systems.

AI will provide, for example, decisional aid for complex situations, or for planning missile trajectories, detect computer system attacks...

THE QUANTUM ROADMAP

The high stakes of sovereignty and economic growth linked to quantum technologies know-how led the government to launch a road map in this domain, based on the conclusions and propositions made by the parliamentary mission led by the Member of Parliament Paula Forteza. This national acceleration strategy was presented on January 21 by the President of the Republic and the Minister for the Armed Forces is closely linked to this work aiming to allocate 50 m Euros to quantum technologies over the Military Planning Law period 2019-2025. This budget will enable the financing of a large spectrum of projects going from exploratory research right up to the integration of quantum technologies in armament operations.

The quantum curve is set to shake up our companies by the multiplicity of application domains (medicine, chemistry, finance, climate change, communication, IT information Technology, simulation, transport...) It is structured around a wide array of technologies (flaws in diamonds, cold atoms, trapped ions, superconductor materials, photonics...)

This implies maintaining active overwatch for all domains in order to anticipate technological breakthroughs that will have an impact on Defence, or to detect new applications, or uses of them. This overwatch requires the financing of academic theses or cooperation with major research organisations like the CEA, ONERA or the CNES.

The Ministry can thus draw on an academic community at the highest level, and on industrial stakeholders with proven capabilities in the quantic domain. The aim is to guarantee, timely access to technological solutions adapted to Defence use, which often include specific problems linked to the environment and miniaturisation.

To these operational challenges we can add the challenge of strategic autonomy as the industrial environment is today dominated by foreign companies. The high stakes of sovereignty rely notably on the control of data management (from data capture to valorisation). The Naval Data Service Center (CSD-M) constitutes an initial initiative towards securing the capitalisation of operational data. The overall efficiency of the Ministry also benefits from these efforts in the data domain (with, for example, the DATANRJ360 project, piloted by the SGA).

The integration of new AI technologies will necessitate an agile approach, capable of reacting rapidly to technological evolutions. The ARTEMIS platform will play an important role in these developments, while taking into account not only the technological aspects but also the doctrine, training and apprenticeship ; technique appropriation , etc...

Lastly, the Ministry aims to be a model example of efficient use of artificial intelligence.

The methodological guide produced by DGA follows a trust-based approach.

In order to maintain a high ethical level, France has chosen to systematically maintain military command responsibility in the use of weapons.

OPEN INNOVATION ORIENTATIONS

It could seem paradoxical to orientate open innovation which by its very nature is unpredictable. That being said, if the objective of Defence open innovation is to detect innovations that are not necessarily destined for defence and apply them for use within the scope of the Ministry's activities, then an orientation focus makes sense. The Defence Innovation Agency actually conducts two types of complementary open innovation projects: firstly, the innovation acceleration projects detected with a Defence use, secondly, those projects which are not destined to integrate a complex capability process due to their scope or the time-scale it would take.

In the first case, the desired effect is innovation detection and capture, in the sense of its convergence with the Ministry's roadmap with the identified innovations, in the second case, the challenge and desired effect is to rapidly provide a satisfactory answer to the requirements of the Armed Forces, directorates and services by mobilising versatile project management. The diversification of well-known innovations or their assembly from other sectors on Defence applications holds real disruptive innovation potential for Defence.

The original methodology, conceived and put in place immediately when the Agency was set up, is the following : to detect and track those innovations that are not necessarily tailored to Defence and initiate the right co-development projects when the time is ripe (maquettes, demonstrators or even prototypes), taking into account the level of technological maturity, the market and Ministry end-user.

These co-development projects consist in real terms, in accelerating the civilian sector roadmap of detected innovations.

In other words, they do not distract the companies from their research, and the project is used as a catalyst to converge their roadmaps with those of the Ministry.

Contrary to the stock approach, (work with the innovations when they are detected) the Defence Innovation Agency , has adopted a flux model, that separates the detection phase from that of project collaboration.

This distinction enhances in quite an original way, an economic intelligence approach with innovative project management. The objectives of innovation acceleration being the operational superiority of the Armed Forces and efficiency throughout the Ministry, it is fundamental to orientate the detection of non-defence specific primary innovation. Based on an expression of needs for detection, a permanent overwatch cycle operated by the AID leads to the orientation of collectors, gathering information, management of that information and its diffusion.

This retroaction cycle applies both to overwatch deliverables and also to acceleration projects piloted by the Agency, notably maquettes and demonstrators. The primary open innovation thematic, documented by the three Armed Forces and made public by the AID as of 2019, also serve to frame the overwatch programme and the acceleration projects initiated or proposed by the Agency itself, complementing those projects provided by the Armed Forces.



The Defence Innovation Fund is part of a global Defence innovation development strategy and is articulated with the other innovation support processes applied by the Defence Innovation Agency.

With this framework, the Agency responds to the need to finance growing innovative companies who have transversal technologies likely to be of interest to Defence.

For these companies the support of private investors, notwithstanding a certain reluctance towards the Defence sector, is sometimes difficult, because the investments themselves are substantial and the return on investment comes in the longer-term, longer than the short / medium term. The Defence Innovation Fund should fill this investor gap and provide, over and above its own participation, the effect of leverage.

The Defence Innovation Fund complements the Definvest Fund by providing the means to act towards these technological companies, whose applications are sometimes a long way away in the future, and have not yet been identified as strategic or critical in our BITD (Industrial Technological Defence Base).

The Defence Innovation Fund investments are specifically used in companies going through a period of growth, start up, small medium-sized companies (SME) and Intermediate-sized companies developing dual and transversal technologies interesting the world of Defence, and notably, energy, artificial intelligence, quantum technologies, electronics and components, health and materials.

The funds allocated to the Defence Innovation Fund represent some 200 m Euros, minimum, over a six-year period. It caters to investments of up to 20 m Euros maximum.



The Defence Innovation Fund made its first investment in the Pasqal company, a leading French company in the domain of quantum computers.



PASQAL

SUPPORT FOR SME'S PROJECTS

Support provided to SME takes various forms in the Agency. The SME can apply for a variety of calls for projects : RAPID, ASTRID, ASTRID Maturation, CIFRE Defence theses. The SME can also be supported in the framework of an ad hoc acceleration project, piloted by the Defence Innovation Lab. The SME also have the possibility to submit a project or a request to be put in contact with a Ministry for the Armed Forces' stakeholder through the Agency's universal access portal online.

Since January 2021, the Defence Innovation Agency has taken over the complete organisation and management of the RAPID process, from the selection phase to a written understanding agreement, right up to their financing. The global process is the same but the interlocutors are all from the Ministry for the Armed Forces.

Lastly, AID continues with its RAPID-Expé process, for experimentation at the end of a project, enabling technology appropriation by experienced military personnel.



THE CALL FOR PROJECTS IN 2021

For the Ministry for the Armed Forces, thematic calls for proposals present the advantage of a wide diffusion for potential innovation emanating from academic / industrial networks, to respond to a high-priority request from the Ministry.

The parameters of these requests are defined so as to introduce the specific issues for Defence, for example, the specifications for use in an operational environment (increased complexity, specific and changing data, partially explored environments, uncooperative environments, real-time mission execution imperatives or narrow mission windows...)

ASTRID CALL ON ROBOTICS

The call for proposals will open up perspectives in terms of autonomous decision-making in complex environments, of using multirobot collaboration with robots of different kinds and multi-terrain capable, of localisation for low-cost sensors and support for missions and security by a human operator.

CALL "DRONE INTERCEPTOR FOR DRONES"

This call for proposals aims to identify innovative solutions in the domain of the anti-drones defence. It calls for the presentation, the demonstration of a system (composed of one or several drones) able to intercept, to capture or neutralise, in flight, one or several drones from the commercial sector considered as non-compliant by an external target designation system.

ASTRID CALL ON ARTIFICIAL INTELLIGENCE

The call for proposals is focused around three axes: defence transversal artificial intelligence methods (simplicity in terms of data for training, evaluation and verification techniques guaranteeing viability and robustness, onboard intelligence) : massive data management from heterogeneous sensors (multi-modal incomplete or non-verified data fusion) language processing (including non-structured data search capabilities and information search).

**"Let us not be afraid of our own ideas, or the ideas of others
In a word, let us always innovate,"**
Florence Parly, Minister for the Armed Forces



innovation.defense.fct@intradef.gouv.fr
www.defense.gouv.fr/aid

