DAIO Defense AI Observatory

Harnessing the Potential

Defense AI in Greece

Nikolaos Karampekios, Konstantinos Sakalis, and Iraklis Oikonomou

DAIO Study 23|19

Ein Projekt im Rahmen von

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About the Defense AI Observatory

The Defense AI Observatory (DAIO) at the Helmut Schmidt University in Hamburg monitors and analyzes the use of artificial intelligence by armed forces. DAIO comprises three interrelated work streams:

- Culture, concept development, and organizational transformation in the context of military innovation
- Current and future conflict pictures, conflict dynamics, and operational experience, especially related to the use of emerging technologies
- Defense industrial dynamics with a particular focus on the impact of emerging technologies on the nature and character of techno-industrial ecosystems

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1 Summary

Greek defense policy officials have recognized Artificial Intelligence (AI) as a potential force enabler/disabler on the modern battlefield. Considering the country's geostrategic risk landscape and in view of harnessing technological opportunities, the Greek defense ecosystem – i.e., the armed forces and the defense industry – has launched three main lines of effort to prepare for and adopt defense AI: research and development (R&D) collaboration, procuring defense AI from key partners, and providing a holistic approach to training and education.

First, Greece makes maximum use of actively participating in European defense research, development, and innovation (RDI) projects and launching national R&D initiatives to enable the domestic ecosystem to get access to cutting-edge knowledge and technologies and/or tests them under real operational conditions.

Second, procuring top-notch defense material (including land, air and naval assets) that exploits AI techniques and processes will enable the armed forces to understand its operational capabilities, significantly expediting the learning curves of both military officers and engineers as well as closing capability gaps that emerged from the country's systematic underinvestment during the 2009–2018 economic crisis. In addition, the defense industry will benefit as well. As subcontractors to international procurement projects or as main contractors to various export cases, exploiting AI will increase their production capacity and upgrade their list of products.

Finally, Greek is stepping up efforts to advance the education of its military personnel. Both within the confines of standard military education or subsequent civilian post-graduate degrees, a growing AI-related educational, research and entrepreneurial ecosystem to which they can link to and get hands-on experience is becoming visible, thus creating beneficial feedback loops.

In line with the platonic "necessity being the mother of invention," the Greek defense establishment has been a quick adopter of AI and its defense promises, for several reasons, both negative and positive. Long-standing bilateral problems with neighboring countries, the potential to apply defense-related AI into the civilian realm and vice versa, as well as an innate understanding of the need to ride the current scientific and technological wave are some of them.

2 Thinking About Defense AI

AI is defined as the next general-purpose technology that will shape the technological and economic evolution of the 21st century, affecting a wide range of industries and societies at large. Increasingly seen as an enabling condition, AI boosts and heightens the performance of other cutting-edge technologies, such as robotics, in addition to 'educating' decision support systems linked to applications, such as autonomous vehicles, by way of crunching ever increasing amounts of classifiable data. This reality has been well recognized at the top political level in Greece[1] and initial exercises mapping the domestic AI-related capabilities have been initiated.[2]

Defense is a field that could not remain immune to the potential benefits of AI. This has not evaded Greek policy makers, both civilian and defense alike. Additionally, AI has been recognized as one of the main strategic axes of the Digital Transformation Bible, the flagship policy report that drives the digital transformation in Greece developed by the Ministry of Digital Governance.[3] As for the definition of AI, the document refers to it as "a collection of technologies that, by combining data, algorithms and increased computing power, is able to learn and make decisions that until recently were made solely by humans, with the aim of achieving defined goals."[4]

At the time of writing this study, the Ministry of Digital Governance is preparing a National Strategy on AI (NSonAI) scheduled to be published by the end of 2023.[5] While the NSonAI has not been made public yet it is believed that it touches upon the relevant security and military challenges and offers strategic outlines for developing a robust defense AI strategy. The NSonAI is expected to

> set a framework for a holistic policy on the future development and application of AI in Greece, which will be structured in a set of coordinated and interrelated actions. It will set out the conditions for the development of AI, including the skills and trust framework, data policy and ethical principles for its safe development and use. It will outline national priorities and areas for maximising the benefits of AI to address societal challenges and economic growth.[6]

Additionally, a high-profile team of experts was created at end of October 2023, under the auspices of the Prime Minister's office. It has been tasked with offering

1 Mitsotakis, "Η Ελλάδα το 2040, μια χώρα στην πρώτη γραμμή της Ευρώπης," p. 4.
2 Sahini et al., Εντοπισμός και ανάλυση των ελληνικών επιστημονικών δημοσιεύσεων στον τομέα της Τεχνητής Νοημοσύνης με τεχνικές Μηχανικής Μάθησης.
3 Ministry of Digital Governance, "Digital Transformation Bible 2020–2025." According to OECD's AI Observatory, AI has been included as one of the main "strategic intervention axes" in the Digital Transformation Bible, the published reference document that drives the digital transformation of the country. Available at: https://oecd.ai/en/dashboards/policy-initiatives/http:%2F%2Faipo.oecd.org%2F2021-data-policyInitiatives-26788 (last accessed 9 October 2023).
4 Ministry of Digital Governance, "Digital Transformation Bible 2020–2025," p. 158.
5 Van Roy et al., AI Watch - National strategies on Artificial Intelligence: A European perspective, pp. 70–71.
6 Ministry of Digital Governance, "Digital Transformation Bible 2020–2025," pp. 159–160.

propositions on how Greece should best position itself in relation to AI, exploring avenues for the latter to be incorporated into multiple policy domains, including defence. While announcing the establishment of the advisory team, PM Mitsotakis referred explicitly to "artificial intelligence and the armed forces" as "a great challenge for the transformation of the deterrent capacity of our country."[7]

Development and implementation of a Greek defense AI strategy must center on the key specificities and considerations, including external threats, as laid out by the Ministry of National Defense (MoD). Indeed, traditional security considerations loom large in the country's decision to embrace AI. As AI is considered a game-changer and Greek's competitors have already adopted and implemented defense AI strategies, Athens has embarked on a path to incorporate AI in defense as well. Although a comprehensive defense AI strategy has not yet been published, this view is reflected in two preceding MoD documents: the National defense Industrial Strategy[8] and the Strategic Analysis of Developments after 2030.[9] Authored in the previous decade, both documents seek to position the domestic defense industrial base and the force structure (respectively) in relation to cutting edge technologies that can influence defense affairs. As of September 2023, both are being updated.

While such systemic documents are being re-authored, they indicate an operational reality that domestic defense policy makers have been quick to grasp and appreciate. In numerous high-profile meetings, AI has been pointed out by high-ranking officials as a key technological objective,[10] an objective that Greek Armed Forces should be increasingly aligning with in order to address the challenges emanating from its geostrategic environment. Therefore, Greece is preparing to incorporate AI into 21st century defense scenarios and projections, attribute robotics and other unmanned vehicles a larger role in warfare and paving the foundation to accomplish military objectives in multi-domain operations. Or, as former Deputy Defense Minister Nikos Hardalias, pointed out:

> The importance of new technologies, and in particular Emerging and Disruptive Technologies, is crucial, and we need to exploit them at all levels. These technologies, such as quantum technologies, AI, robotics and autonomous weapon systems can have a catalytic effect on the battlefield as we know it… We see how important weapons systems and technologies such as drones, satellite internet and cyber weapons have become today.[11]

7 Hellenic Republic, "Ενημερωτικό σημείωμα για τη συνεδρίαση της Συμβουλευτικής Επιτροπής για την Τεχνητή Νοημοσύνη."
8 General Directorate for Defense Investment and Armaments, "National Defence Industrial Strategy."
9 Hellenic National Defence General Staff, "Στρατηγική Ανάλυση Εξελίξεων για την Ελλάδα μετά το 2030, ΣΑΕ 2030."
10 Hellenic National Defence General Staff, "Ομιλία του Αρχηγού ΓΕΕΘΑ στο Πανεπιστήμιο Πειραιώς με θέμα "Σύγχρονες Απειλές και Προκλήσεις Ασφάλειας""; Ministry of Defence, "Συμμετοχή ΥΕΘΑ κ. Νίκου Παναγιωτόπουλου στην Άτυπη Σύνοδο Υπουργών Άμυνας της Ε.Ε.; "Συμμετοχή ΥΕΘΑ Νικόλαου Παναγιωτόπουλου στη Σύνοδο Υπουργών Αμύνης του ΝΑΤΟ.
11 Hardalias, "Ομιλία ΥΦΕΘΑ Νικόλαου Χαρδαλιά στην Ημερίδα "Τεχνολογία-Καινοτομία, Άμυνα & Στρατηγική."

Significantly, this rationale has been taken up by the incoming Minister of National Defense Nikos Dendias, who has already signalled his acute understanding of the need for Greek armed forces to continue strengthening their digital and tech-savvy footprint in relation to AI and cybersecurity. Indeed, enhancing the production capabilities of the domestic industrial sector and a much more holistic and institutionally rounded approach on innovation has been indicated. As of November 2023, a dedicated legislation is in the making.

Another prominent individual whose strategic thinking can be seen as reflecting the broader understanding of the Greek techno-military establishment is Panagiotis Kikiras, Head of Unit, Innovative Research, at the European Defence Agency. In the absence of a formal strategic document, it is worth quoting his thinking in detail

> AI has the potential to be a game changer for the defence sector (…). Today, changes at the technological, operational and economic levels are leading to the emergence of all those technologies that can optimise functionality and minimise technological and economic risk. The application of AI shares the above characteristics, reducing the risk of loss of human lives on the battlefields, offering better efficiency than human soldiers, and the cost of its introduction is 10 times less than the corresponding cost of training soldiers. Moreover, today AI technologies are more mature and driven by investments in non-military sectors. This trend, and because of the rapid maturation rates of products in consumer markets, has led to the exponential growth of AI technologies, which has allowed its immediate introduction into defence without the slow and short maturation time of typical military products.[12]

As addressed in the following chapters, Greek defense planning has been systematically incorporating AI in its daily business in the form of developing and participating in AI-related research, development, and innovation (RDI) projects to get access to cutting-edge knowledge and/or testing this new technology under real operational conditions. Importantly, policy makers have realized that such cutting-edge technologies are being developed by both the defense and civilian ecosystem, thus trying to "spin-in" commercial solutions into their wider military planning by way of instigating synergies within the domestic civilian R&D ecosystem.[13]

Also, the Greek Armed Forces seek to acquire operational application(s) of AI by way of procuring top-notch defense material from global industry players. A third channel, and perhaps more important since it points to sustainability, is through

12 Kikiras, Interview to Giannis Mouratidis.
13 Hardalias, "Ομιλία ΥΦΕΘΑ Νικόλαου Χαρδαλιά στην ημερίδα "Συνδέοντας την Έρευνα με την Αμυντική Βιομηχανία"."

educating personnel. Seeking to expand knowledge boundaries, personnel of the armed forces are presented with a pluralism of study options in relation to AI. Either within the confines of standard military education or subsequent civilian post-graduate degrees military personnel are faced with a growing AI-related educational, research and entrepreneurial ecosystem to which they can link to and get hands-on experience, thus, obtaining relevant skills and dexterities.

In advancing national defense AI capabilities, Greek takes a slightly different path on one important aspect: ethics. Although ethical considerations on the wider use of AI have been pointed out in Greek society, on its military applications a much more pragmatic approach has been the norm. Overcoming a decade of near-zero new entries of defense equipment and the continuous strategic rivalry with Turkey are the key considerations for policy makers. These have sidelined any societal debate about ethical questions surrounding defense AI. Nevertheless, MoD should keep track of the international debate on the ethics of defense AI and in-house reflections on the ethical challenges of AI during warfare.

3 Developing Defense AI

3.1 Defense AI Ecosystem

While a defense AI strategy is still in the making, it should be noted that parallel digitalization-relevant steps are being institutionalized within MoD. Accordingly, a Data Protection Officer has been named by the Army, signaling a more up-to-date approach in relation to data protection. However, there is no defense data strategy in place by the MoD.

Greek's defense AI ecosystem consists of two broad groups. First is the public administration mainly comprising the national armed forces and the homeland security (roughly falling under the auspices of the Ministry of Citizen Protection) apparatus, not the least because many foreign threats are inextricably linked with civilian security considerations. The second group consists of private and publicly owned firms engaged in providing the "tools" for defense. All in all, the commonly accepted understanding is that the country

> consistently supports cooperation with the private sector and the academic community to promote innovation and the exploitation of Emerging and Disruptive Technologies to the maximum extent possible, in line with the operational requirements and specifications of the armed forces[14]

Obviously, this macro-analysis can be broken down. The armed forces are not just a "consumer" of AI products. With a highly educated profile and increased operational experience and participation in NATO and EU agencies the armed forces actively shape the AI-related discussion in relation to needs and requirements. Moreover, as an end-user of cutting-edge RDI projects, officers get to test AI-enhanced equipment and acquire first-hand experience during the development phase. As their exposure to AI increases, their proficiency in evaluating the pros and cons of this new technology will mature as well.

Equally, defense firms constitute an important aspect of the defense AI ecosystem. Increasingly active in RDI activities and starting to capitalize on their export potential, Greek firms are engaged in the production of defense services and products of various technological levels and capabilities. With an industry structure having a few large companies that are export oriented and/or work as contractors for global defense firms, most are SMEs focused on the delivery of specific parts in the domestic defense value chain. Most established companies are active in both civilian and defense markets. This is not only a consequence of the growing focus on providing dual use technology. Furthermore, the decision to serve two different

14 Hardalias, "Ομιλία ΥΦΕΘΑ Νικόλαου Χαρδαλιά στην Ημερίδα "Τεχνολογία-Καινοτομία, Άμυνα & Στρατηγική."

markets also originates from the fact that during the decade-long economic crisis, firms had to diversify in order to survive. Moreover, established companies operate parallel to start ups and spin offs offering innovative new products and solutions.

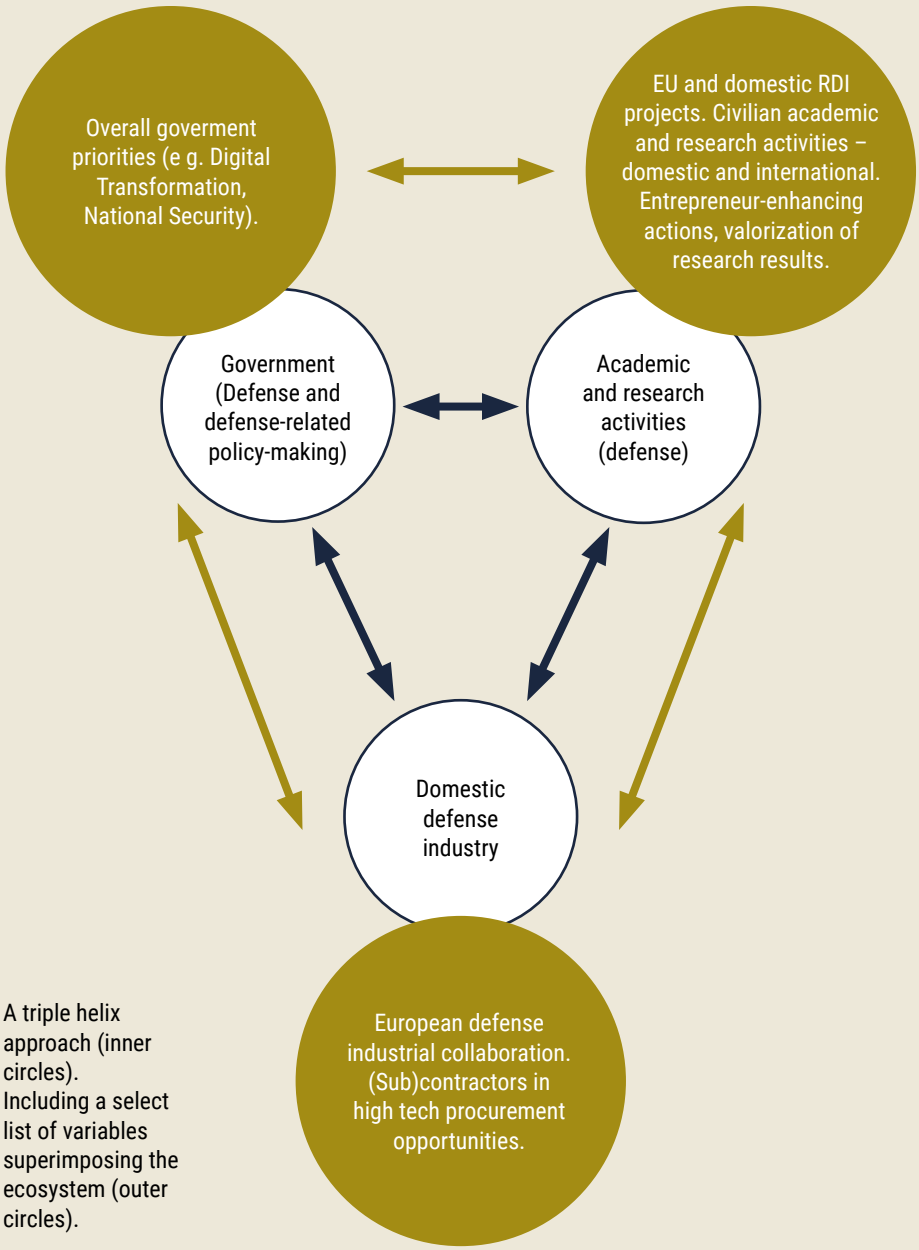
Among others, the following defense companies have been active in the field of defense AI:

- Hellenic Instruments is a specialized defense electronics company[15]
- Planetek offers remote sensing solutions[16]
- Intracom Defense works on missile electronics, tactical communications, C4I systems, and unmanned systems[17]
- Space Hellas designs and supports integrated ICT and security solutions[18]
- Terra Spatium offers remote sensing and geoinformation solutions[19]
- Eight Bells is a research and consulting company focusing on AI, cybersecurity, optical networks, and sensors[20]
- FEAC Engineering provides virtual engineering services through computer aided engineering and simulation techniques[21]
- Lambda Automata develops advanced sensor-fusion capabilities to combine legacy and novel sensing solutions[22]
- Olympia Electronics offers electronic safety and security solutions[23]
- Prisma Electronics develops smart sensor wireless network technology[24]
- Spirit Aeronautical Systems develops unmanned systems technology[25]
- Satways develops integrated geospatial C2 solutions[26]

In addition to these companies, the Greek defense AI ecosystem also includes several leading research institutes, different directorates of the Greek MoD and the armed forces as well as international partners as highlighted in Figure 1 and Table 1.

15 For more information, see: https://www.hellenicinstruments.com/ (last accessed 9 October 2023).
16 For more information, see: https://www.planetek.gr/ (last accessed 9 October 2023).
17 For more information, see: https://www.intracomdefense.com/ (last accessed 9 October 2023).
18 For more information, see: https://www.space.gr/en (last accessed 9 October 2023).
19 For more information, see: http://www.terraspatium.gr/ (last accessed 9 October 2023).
20 For more information, see: https://www.8bellsresearch.com/ (last accessed 9 October 2023).
21 For more information, see: https://feacomp.com/about-us/company/ (last accessed 9 October 2023).
22 For more information, see: https://www.lambda-automata.eu/ (last accessed 9 October 2023).
23 For more information, see: https://www.olympia-electronics.com/ (last accessed 9 October 2023).
24 For more information, see: https://www.prismaelectronics.eu/index.php/en/ (last accessed 9 October 2023).
25 For more information, see: https://www.sas-tech.gr/ (last accessed 9 October 2023).
26 For more information, see: https://www.satways.net/ (last accessed 9 October 2023).

Figure 1: Conceptualizing the national defense AI ecosystem



A triple helix approach (inner circles). Including a select list of variables superimposing the ecosystem (outer circles).

Source: Authors

Table 1: Actors in the Greek defense AI ecosystem

• NATO **• EU Directorate-General for Defence Industry and Space (DGDEFIS)** **• European Defense Agency (EDA)**	**• Lockheed Martin (USA)** **• Dassault Aviation (France)** **• MBDA (France)** **• Israel Aerospace Industries (IAI)** **• Rafael Advanced Defense Systems (Israel)**	**• NATO's Defence Innovation Accelerator for the North Atlantic (DIANA)** **• National Centre of Scientific Research "Demokritos"** **• Elevate Greece** **• Hellenic Manufacturers of Defense Materiel Association (SEKPY)**
• General Directorate for Defense Investments and Armaments (GDDIA) • Directorate for Defense Investments and Technological Research • Directorate for Defense Programs and Principal Contracts • General Directorate of National Defense Policy and International Relations (GDNDPIR) • Land Forces: Communications Division • Hellenic Air Force: C' Branch (Support) D' Branch (Policy and Planning)	• Hellenic Aerospace Industry (HAI) • Hellenic Instruments • Planetek • Intracom Defense • Space Hellas • Terra Spatium • Eight Bells • Lambda Automata • Olympia Electronics • Prisma Electronics • Sunlight • Satways • SKYTALIS • THEON	• Hellenic Army Academy • Naval Cadets School • Hellenic Air Force Academy • National Technical University of Athens (NTUA)

Source: Authors

3.2 Important Defense AI Projects in Development

Currently, several AI-related defense projects are in various stages of development. A useful distinction for the purposes of this analysis is the source of funding with projects being funded by European competitive funds, co-funded by European and national funds, including Recovery and Resilience Facility, and nationally funded projects including procurement contracts.

International Development Projects

By way of international development projects, the lion's share refers to European projects aiming at establishing a common defense R&D and industrial capability. Indeed, it should be noted that participation in EU projects is a significant pathway for Greek actors to obtain both funds (this holds also for those co-funded projects) and top-tier know-how. This pathway is more important in relation to other EU countries, and a pathway wherein Greek actors exhibit particular success.[27] The following overview includes projects with Greek partners as coordinators and/or members:[28]

- CTIRISP (Cyber Threats and Incident Response Information Sharing Platform) focuses on sharing cyber threat intelligence through a networked member-state platform, with the aim of strengthening cyber defense capabilities.[29]
- DECISMAR (Development of a Decision Support Toolbox for enhancing the feasibility study of the Upgrade of Maritime Surveillance) aims at developing a decision support toolbox (DSTx), implemented as a cyber-secured and future-proofed integrated IT environment.[30]
- d-THOR (Digital Ship Structural Health Monitoring) develops a system based on innovative utilization of large amounts of load and response measurements from robust and advanced sensors, a digital framework complying with recognized open standards for data exchange, and hybrid analysis and modelling which combines physics-based and data-driven models.[31]
- FaRADAI (Frugal and Robust AI for Defence Advanced Intelligence) focusses on frugal learning, i.e., the ability of a system to adapt and learn from its environment, including from user supervision, for a reasonable cost and without intervention from expert developers. Within the FaRADAI project, current advances in AI technologies will be thoroughly researched in parallel with a

27 Defence Redefined, "Greece in 5th place for funding from European Defence Fund."
28 We chose to include programs that capture the dominant perception of defense AI in relation to the set of emerging technologies in the field of defense, i.e., development of UAVs and decision-making process automation systems, rather than projects in which Greek institutions participate solely based on the descriptions using the term AI. The length of the list is indicative of Greece's emphasis on securing European funding and expanding the network of international partnerships.
29 PESCO, "Cyber Threats and Incident Response Information Sharing Platform (CTIRISP)."
30 European Commission, "DECISMAR."
31 European Defence Fund, "dTHOR."

detailed study of the main challenges imposed by a defense system. FaRADAI is coordinated by the Center for Research & Technology Hellas (CERTH).[32]

- GEOMETOC (Geo-Meteorological and Oceanographic Support Coordination Element) enhances the acquisition of geospatial, meteorological and oceanographic data through Geo-Data Infrastructure and the provision of related services through Services based on advanced analytics and big data.[33]
- HARMSPRO (Harbour & Maritime Surveillance and Protection) provides Member States with the ability to conduct surveillance and protection of specified maritime areas, from harbors up to littoral waters, to obtain security and safety of maritime traffic and structures. It delivers an integrated system of maritime sensors, software and platforms (surface, underwater and aerial vehicles), which fuse and process data, to aid the detection and identification of a range of potential maritime threats.[34]
- LOTUS (Low Observable Tactical Unmanned air System) addresses feasibility issues, including the detailed design, prototyping and testing of a low-observable, airworthy and interoperable tactical Remotely Piloted Air Systems system targeted at ISR missions with increased data processing capabilities.[35]
- MAS MCM (Maritime Semi Autonomous Systems for Mine Countermeasures) will develop autonomous vehicles, using cutting-edge technology and an open architecture to counter the threat of sea mines. Indeed, the technologies were tested in the field during the Robotic Experimentation and Prototyping Augmented by Maritime Unmanned Systems (REPMUS22) exercise.[36]
- MIRICLE (Mine Risk Clearance for Europe) addresses the main components of a stand-off mine warfare solution such as a mission system, communication network, mine countermeasures vessel and robots, using AI for supporting decision making.[37]
- PANDORA (Cyber Defence Platform for Real-time Threat Hunting, Incident Response and Information Sharing) contributes to EU cyber defense capacity building, by designing and implementing an open technical solution for real-time threat hunting and incident response, focusing on endpoint protection, as well as information sharing.[38]
- PRIVILEDGE (PRIVacy and homomorphic encryption for artificiaL intelligence) focuses on developing encryption techniques of confidential military data by way of exploiting AI.[39]

32 European Defence Fund, "FaRADAI."
33 PESCO, "Geo-Meteorological and Oceanographic (GEOMETOC) Support Coordination Element (GMSCE)."
34 PESCO, "Harbour & Maritime Surveillance and Protection (HARMSPRO)."
35 European Commission, "LOTUS."
36 PESCO, "Maritime (Semi-) Autonomous Systems for Mine Countermeasures (MAS MCM); Defence Industry Europe, "PESCO maritime mine counter measures project tested in multinational exercise."
37 European Commission, "MIRICLE."
38 European Commission, "PANDORA."
39 European Commission, "PRIVILEDGE"

- USSPS (Development of Unmanned Semi-fixed Sea Platforms for Maritime Surveillance) develops a system to improve Maritime Surveillance by exploiting unmanned semi-fixed platforms at sea.[40]

National Development Projects

Through several co-funded operational programs, such as the 2021–2027 Partnership and Cooperation Agreement, the Recovery and Resilience Facility as well as national funds, Greece has invested in developing systems related to security and defense AI along three lines of efforts: big data and data fusion to enhance situational awareness, unmanned systems, and safety and predictive maintenance.[41]

Big Data and Data Fusion

The THORAX integrated information system is one of the flagship projects.[42] The system aspires to provide "an 'umbrella' of protection, combining all kinds of information and will contribute to the defense armoring of the country," as the Deputy Minister of Research and Technology has said on multiple occasions. THORAX aims to connect domestically produced research, innovation, and technology with the pillars of National Defense, Security and Civil Protection. The system will transmit real-time information concerning search and rescue operations, border security, illegal immigration or earthquakes to the MoD's National Operational Center, thus enabling decision-making at the government level commensurate with the needs of emerging crisis situations. AI will be used for real-time data fusion of information obtained through multiple, air, land, and sea-based sensors.

Unmanned Systems

Greece has been aspiring to develop unmanned systems for use in different military domains.[43] First, Greek needs to leap-frog to cover the lost as use of unmanned systems in various operation theaters is widening. In addition, Turkey, Greece's strategic competitor, has become highly adept at developing and using these systems thus raining global prominence. The Greek inability to counter these systems entails a tactical disadvantage in addition to know-how deficiency in a cutting-edge field. Moreover, Greece has established a privileged partnership with both the United States and Israel to make use of their unmanned systems to cover the country's tactical deficiencies as a short-term, stop-gap measure. Against this background, the following projects are worth mentioning:

40 European Commission, "USSPS."
41 The selection process is highly dependent upon end user requirements. That is, the Greek MoD, after an internal review process, has pushed forward for a select list of projects based upon its tactical and future oriented needs and priorities.
42 Ministry of Development & Investments, "Μνημόνιο συνεργασίας μεταξύ των Υπουργείων Ανάπτυξης & Επενδύσεων και Εθνικής Άμυνας; Nedos, "'Thorax' κατά υβριδικών απειλών – Νέο σύστημα στο ΓΕΕΘΑ."
43 Ellinikos Stratos, "Προγράμματα ανάπτυξης ελληνικών UAV."

- Efforts to develop Greek unmanned aerial vehicles go back to 1982, with the first flight of the HAI E1-79 Pegasus followed by its second version (Pegasus II) in 2005 which is currently part of the arsenal of the Hellenic Air Force.[44] The HCUAV RX-1 was developed in the context of a collaborative project in the 2007–2013 National Strategic Reference Framework, led and coordinated by Fluid and Turbine Engineering Laboratory of the Mechanical Engineering Department of AUTH.[45] The DELEAR RX-3 platform which emerged from RX-1 was produced as part of the above mentioned LOTUS project.[46] The RX-3 vehicle will adopt AI to perceive the environment (situational awareness) and to autonomously execute parts of its mission (autonomy).
- A second and parallel attempt emerged from a joint venture project involving the Naval Cadets School, the National Technical University of Athens and the EFA Group of Companies,[47] which strive to develop the Greek UAV ARCHYTAS.[48] According to public sources, a TRL-8 prototype is expected within Q4 of 2023 and industrial production is expected within Q1 of 2024.[49]
- A third attempt concerns the development of the first Greek UCAV. Named GRYPAS, it was initialized in January 2023 with the signing of a Memorandum of Cooperation between the Ministries of Finance (financial provider) and National Defense, the Hellenic Aerospace Industry, and several Greek universities.[50] This development project takes into consideration the operational needs of the armed forces for a medium-altitude long-endurance UAV, specifically for intelligence missions (detection of enemies) or strike missions. AI will be implemented for automated navigation and/or recognition of certain (types of) targets.

Predictive Maintenance and Safety

An additional source of European and national co-funding comes from the Hellenic Foundation for Research and Innovation. A relevant project of the Naval Cadet School is NAVMAT. A knowledge-based system that goes beyond simple keyword-based indexing and retrieval, NAVMAT is a platform for recording, indexing, comparing, assessing, and retrieving information, history of operations and maintenance, evidence and testimony for incidents of failure in the Naval environment. Based on materials failure ontology, it makes use of AI algorithms and cutting-edge approaches in data handling and aims at optimizing naval materials failure management and supporting decision making in Maintenance and Repair Operations by the Naval Cadets School.[51]

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44 Hellenic Air Force, "Pegasus II."
45 Defence Point, "Αερόχημα HCUAV RX-1 από την ελληνική εταιρία Space Sonic με ηλεκτρονικά IDE."
46 DELAER, "The DELAER concept"; Intracom Defense, "LOTUS: Next Generation Tactical UAV from INTRACOM DEFENSE for ISR missions."
47 This consortium includes Theon (electro-optical sensors), SCYTALIS (data links), and UCANDRONE (design and manufacturing of the aircraft).
48 Nikitas, "Το ελληνικό UAV 'ΑΡΧΥΤΑΣ' της EFA VENTURES.
49 Ministry of Defence, "Απάντηση ΥΕΘΑ Νικόλαου Παναγιωτόπουλου σε ερώτηση Κοινοβουλευτικού Ελέγχου.
50 Defence Review, "Το ελληνικό UCAV με την ονομασία "Γρύπας" ανακοίνωσαν από κοινού τα Υπουργεία Εθνικής Άμυνας και Υπουργείο Οικονομικών."
51 NAVMAT, "AI-powered NAVMAT prototype at ICEAF VII."

Procurement Projects

During the last three to five years, Greek has signed approximately 200 major defense procurement contracts.[52] The need to overcome a decade of near-zero new entries of defense equipment and a long standing strategic rivalry with Turkey have been the main drivers to sign these contracts. These external drivers have been coupled with a more utilitarian approach: procuring ready-to-use high tech defense systems from foreign contractors requires the national defense industrial base to be involved to ensure smooth operation. In addition, there is a growing interest in using international procurement projects as avenues to help mature local defense companies and provide them springboards into entering more digital product segments.

Importantly, these objectives are in line with a wider political understanding with the governments of the states where the respective industrial groups, from which the procurement(s) will take place, are headquartered. Countries such as the United States, France, and Israel have recognized the increased geopolitical significance of Greece and maintain strategic interests that are in line with Greece's objectives. In the words of former Deputy Defence Minister Hardalias, exploring the possibilities and investing in AI-related systems and technologies

> is a security issue that is both national and supranational, and therefore concerns both NATO and the EU. But it can only be carried out effectively through international cooperation with partners with whom we share common principles and values.[53]

This has dripped down to a more collaborative approach in matters of industrial production. Importantly, a conscientious effort is being undertaken to transform this "one-way street" of high-tech procurement from such countries to an industrial production scheme wherein Greek defense industry will participate in product development for the purposes of the specific procurement contract and as part of the production value chain globally. It is to be noted that this geopolitical alignment is further exhibited in EU RDI projects, wherein Greek entities extensively collaborate with French, Italian and Spanish actors.

Regarding industrial production, Naval Group's 3 Belharra-type frigates (FDI-HN), Dassault Aviation's 24 Rafale, the modernization of 4 MEKO-type frigates as well as the acquisition of 20 Lockheed Martin-made F-35 fighter jets are of special interest as most of these assets are/will be data-powered and sensor-enabled. These projects will require the local industry to make substantial efforts in view of sensor fusion capabili-

52 e-Amyna, "Συμβάσεις - συμφωνίες ΥΠΕΘΑ/ΓΔΑΕΕ 2019–2023."
53 Hardalias, "Ομιλία ΥΦΕΘΑ Νικόλαου Χαρδαλιά στην Ημερίδα "Τεχνολογία-Καινοτομία, Άμυνα & Στρατηγική."

ties and other types of decision support tools operators can use for integrating disparate sensor and information data, optronics for target acquisition, as well as parsing of Failure, Reporting, Analysis, and Corrective Action (FRACAS) data. However, if and to what extent local industry partners can contribute is still under discussion and needs to be assessed in view of local competencies and international supplier requirements. This includes a detailed understanding of the domestic defense industry's research and technological capabilities – a task that is currently being undertaken and aims to map the technological, innovation and industrial existing potential.

In addition, MBDA's contract to provide ASTER 30 B1area air defense and MM40 Exocet Block 3C anti-ship missiles for the FDI-HN as well as the Meteor air-to-air missile, the SCALP cruise missile, the MICA air-to-air missile, and the AM39 Exocet anti-ship missile in Rafale are linked to collaborating with domestic parties. One such case is, for example, the contribution of the National Technical University of Athens to develop AI-relevant technologies. This case, as well as the case of MBDA seeking to establish R&D partnerships with the domestic industry and academia through its "R&D Booster" initiative, indicates the aforementioned geopolitical alliance between France and Greece, through which France as the supplier is seeking to broaden its footprint in Greece's defense relevant ecosystem for the purposes of knowledge transfer.[54]

54 MBDAi "MBDA awarded two contracts by Greece for naval and aircraft weaponry"; MBDA, "MBDA to boost cooperation with Greek Defence industry."

4 Organizing Defense AI

Greek's defense institutions are reorganizing for the advent of defense AI. As discussed above, the new NSonAI will be published later this year. But early indications suggest that this strategy will cover defense AI issues in relation to inter-ministerial and cross-departmental arrangements as well as security and military considerations. These aspects notwithstanding, the MoD currently lacks a single, unitary coordinating authority responsible for defense AI. Rather the respective policies as well as the gathering of knowledge related to defense AI are being carried out within multiple centers within MoD structure:[55]

- The General Directorate for Defense Investments and Armaments (GDDIA), and more specifically the Directorate for Defense Investments and Technological Research (DDITR), is responsible for managing state-funded and European R&D projects, including those that are AI-focused. As such, this Directorate is familiar with the EU's AI-related priorities, the capabilities of participating Greek actors, and the respective project results.
- In collaboration with DDITR, the Directorate for Defense Programs and Principal Contracts within the same General Directorate manages major procurement projects, including sub-contracting the domestic industrial base. Given that most – if not all – of the current procurement projects, including those that were detailed in chapter 3, do entail a domestic co-production aspect, GDDIA is highly engaged in organizing technological and industrial actions on defense AI.
- Moreover, given the hybrid security threats posed by both state and non-state actors in Greece's land and sea borders, additional operational centers and assets performing multiple data-collection missions are being operated in tandem by defense, police, and coast guard forces. Thus, the Hellenic National Defense General Staff is also exposed to AI-relevant assets and technologies that are being deployed within the context of security-relevant R&D and procurement projects.
- As of end of October 2023, a new Joint Center for Research and Technological Development & Innovation (KETAK) has been established by the MoD that seeks to address real, operational requirements by all branches of the armed forces. Although only few details have been revealed, one can assume that setting up KE?AK was a way to create economies of scale among the R&D centers of each branch and pool resources.
- Lastly, the General Directorate of National Defense Policy and International Relations (GDNDPIR) is responsible for addressing the policy-relevant issues on AI, as well as other cutting-edge technologies, thereby considering the

55 The MoD's National Defence Industrial Strategy and the Strategic Analysis of Developments after 2030 do not mention AI as part of the cutting edge technologies that can influence defense affairs. It should be noted that the first was authored in 2017, while the second in 2015. At the time of writing this study, both papers were under review.

country's international relations, allied obligations, and requirements stemming from bilateral defense cooperation agreements.

This multiplicity of administrative entities within MoD creates several inroads for the MoD to be educated on defense AI and to reflect on how operational needs shape Greece's defense AI understanding and approach. In addition, there are several service-specific inroads via the Communications Division of the Land Forces, the Submarine Directorate of the Hellenic Navy and C' Branch (Support) in coordination with the D' Branch (Policy and Planning) of Hellenic Air Force General Staff. Service-specific insights gained through these avenues can – at a later stage – inform the set up and implementation of new R&D projects, thus creating a positive feedback loop. Although this decentralized and horizontal approach is beneficial, thought should be given to setting up an overarching single point of entry within the MoD. As our concluding chapter will argue, such an approach could also streamline inter-agency interaction and help overcome institutional inertia.

As argued before, the defense industry is an important economic and policy actor in relation to defense AI and an essential part of the defense ecosystem. Firms are engaged in several ways in organizing AI-relevant defense activities:

- First, by participating in and, thus, acquiring know-how on such matters through EU, national and in-house R&D projects. In addition to funding and know-how, being part of EU RDI consortia offers significant networking and collaboration opportunities. Indeed, certain private firms have been exhibiting a steady participation in such projects. These companies can serve as national "transmission mechanisms" that help diffuse international experience among national partners and enable them to develop competitive future products and services.
- Second, by participating as a (sub)contractor to the domestic procurement process. Being part of the production pipeline, Greek firms stand to gain by becoming trusted partners of the main contractor(s) on similar procurement contracts globally.
- Third, by participating in global tenders. This is due to the in-house innovation and technological prowess. Defense is a highly regulated market. As the GDDIA is responsible to regularly update the Registry of Manufacturers of Defense Material,[56] the MoD is familiar with each firm's AI-related capabilities. This is also relevant for the Hellenic Manufacturers of Defense Material Association (SEKPY), which is the largest national defense cluster with more than 200 member companies. To further promote the commercial interest of

56 General Directorate for Defense Investments and Armaments, "Registry of Manufacturers of Defense Material."

their members, industrial associations should undertake all relevant measures to regularly map, increase and disseminate the technological capabilities and skills of its members in relation to such cutting-edge technologies. This syncs with GGDIA's objectives and offers a validated set of data to be incorporated to the country's (defense) technology and industrial policy. Even though the MoD maintains an overview of available technological capabilities, such mapping would bring added value to the equation. For instance, an industry-led initiative could help highlight faster the strong innovative elements of the sector, thereby informing dual-use industrial policy. Also, attracting talent and locating skills gaps will also be assisted, enabling the provision of additional training / upskilling opportunities. Lastly, potential bureaucratic obstacles in the effective and timely monitoring of industrial capabilities by the MoD can be more effectively bypassed in this way.

Being knowledgeable about the AI capabilities of the domestic defense industrial base is important, as a new AI-focused domestic ecosystem is emerging. Dedicated platforms such as Elevate Greece and a renewed emphasis on innovation, as set out by the Minister of National Defense Nikos Dendias, and his explicit aim to set up a dedicated Project Management Office in his upcoming legislation, will potentially streamline and boost existing good practices, such as the MoD's defense-related start-up competitions and Defense Innovation Challenge, thus providing a comprehensive overview of the national defense AI ecosystem.

Moreover, the new NATO Defense Innovation Accelerator for the North Atlantic (DIANA) is expected to provide Greece's ecosystem with a further boost. Operating as a start-up incubator/accelerator and building on existing test facilities,[57] DIANA has enlisted four Greek research centers.[58] These will focus on AI, autonomous technologies, quantum technologies, biotechnology, and novel materials. In combination with new NATO Innovation Fund, the objective is to kick-start deep-tech startups, including spin offs, and to bring them into technology development projects relevant for NATO. Thus, it is to be hoped that activities at the four Greek research centers will help create operational, educational, and entrepreneurial synergies.

57 NATO, "NATO sharpens technological edge with innovation initiatives."
58 Foundation for Research and Technology - Hellas (in Crete and in Patras), National Centre for Scientific Research Demokritos (in Athens), Centre for Research and Technology Hellas (in Thessaloniki).

5 Funding Defense AI

Broadly speaking, an increase in R&D investment has been the new norm within the Greek RDI ecosystem. Despite the existing shortfalls that originate from the fallout of the economic crisis 2009–2018, political decision-makers agree on the need and the relevance of increasing Greece's participation in European RDI projects and advancing the proficiency of the local workforce as key enablers of the country's long-term economic vitality. Or, as the National Defense Industrial Strategy puts it:

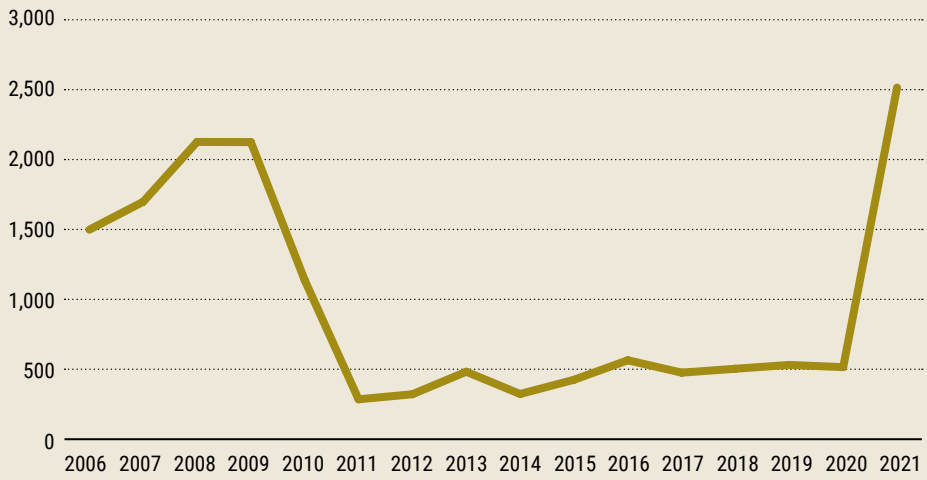
> Regardless of the type of research, the participation of the armed forces in research programs, funded either by the state budget or externally, as a strategic partner or contractor with significant operational experience, specialized personnel, infrastructure and means should be encouraged.[59]

Among other things, this understanding has become the guiding principle to set up the Hellenic Foundation for Research and Innovation and the Deputy Ministry of Research and Technology, the creation of Elevate Greece, a state registry on startups and an informed gateway for potential investors, a large portion of the 2021–2027 Partnership and Cooperation Agreement, the Recovery and Resilience Facility as well as other national funds being directed towards R&D. A pro-business climate spurred domestic R&D spending (from 0.68% of GDP in 2011 to 1.45% of GDP in 2021), which, in turn, helped renew the attention of global investors to engage in Greece's high-tech sector.

Consistent with the abovementioned pattern, spending on defense procurement and R&D has been on the rise as of recently. Historically, Greek Armed Forces has been a procurer of foreign defense material, but even defense purchases plummeted during the crisis years. Similarly, R&D activities attracted low interest from policy officials. As indicated in Figure 2 and Figure 3, both trends have been reversed. Procurement has spiked since 2020 with the government signaling its willingness to buy top defense equipment. Overall, awareness of the importance of RDI as a "vertical" theme of activities has increased. To be part of global value chains and long-term partners of global firms, domestic companies have realized they need to engage in knowledge-intensive activities that initiate in-house learning processes that are critical for product/services development. However, despite a general uptick in defense RDI spending it is impossible to provide a financial breakdown of Greece's spending on defense AI as the respective figures are classified. Nonetheless, the projects discussed in chapter 3.2 underline the seriousness with which the country strives to engage on defense AI and expand the armed forces respective knowledge and capabilities.

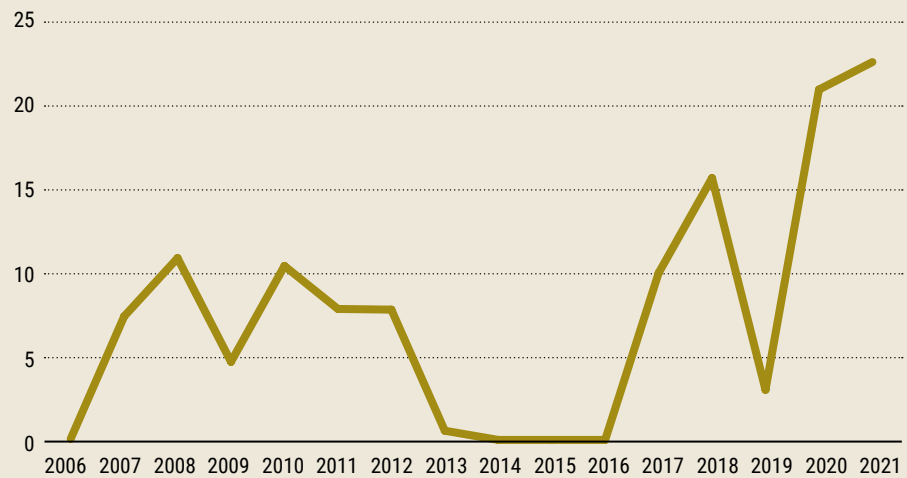
59 General Directorate of Defense Investment & Armaments, 2017, p. 2.

Figure 2: Greece's Defense Equipment Procurement Expenditure 2006–2021 in million Euros



Source: EDA; authors' calculation

Figure 3: Greece's Defense R&D Expenditure 2006–2021 in million Euros



Source: EDA; authors' calculation

6 Fielding and Operating Defense AI

Gauging the true state of fielding and operating defense AI is difficult. Although Greece participates in AI-relevant R&D activities, the production and operation of AI systems is not particularly developed. Based on open-source information we contend that some of the R&D projects discussed in chapter 3 have been turned into field experiments. In addition, Greece's purchase of off-the-shelf defense systems and future defense procurement plans include integrated AI components. Both lines of effort thus serve as proxy indicators for the primary use cases of defense AI solutions that are about to be fielded. In this regard we see three focus areas for the use of defense AI: improving situational awareness and situational understanding, augmenting existing defense capabilities, and advancing border security. Defense AI also becomes more important to enhance training as we will discuss in chapter 7.

6.1 Situational Awareness and Situational Understanding

A case in point here concerns the streamlining and operationalizing of multiple data sources for real-time command and control. This has been the focus of the new Intelligence Fusion Cell (IFC) of the Special Warfare Command, funded by the Hellenic National Defense General Staff. Populated by personnel from the country's security and defense establishment, IFC focuses on providing full-spectrum, multi-domain operational and strategic intelligence through AI and upgraded equipment, thus achieving interoperability and enabling intelligence sharing among multiple authorities within the country as well as NATO allies.[60]

6.2 Augmenting Existing Capabilities

Like other countries, Greece also strives to advance existing defense capabilities with the use of defense AI. In this regard, the following projects are worth mentioning:

- Press statements issued by the Greek MoD[61] during the Parmenion-21 exercise in September 2021 suggest that the ARCHYTAS UAV has significantly matured and is ready for operational demonstration. Transferring this system into the

60 Hellenic National Defense General Staff, "Εγκαίνια του Κόμβου Πληροφοριών Δυνάμεων Ειδικών Επιχειρήσεων της Διοίκησης Ειδικού Πολέμου του ΓΕΕΘΑ."
61 Ministry of Defense, "Παρουσία ΥΦΕΘΑ Νικόλαου Χαρδαλιά στην τελική φάση της ΤΑΜΣ 'ΠΑΡΜΕΝΙΩΝ-21'."

portfolio of the Greek Armed Forces will significantly advance intelligence collection and assessment capabilities.

- Also, the Hellenic Air Force, in June 2021, procured HERON UAV from Israel Aerospace Industries[62] to conduct intelligence, surveillance, target acquisition and reconnaissance (ISTAR) missions.[63] These missions are built upon the ability to combine and enhance open-source maritime (as well as other types of terrain) data with AI-driven insights to quickly identify patterns of vessel behavior and anomalies. This advances the tipping and cueing capabilities of the Greek Armed Forces to identify and track large objects such as ships and calculate mission-relevant risk levels.
- The Hellenic Air Force is using IRIS-T missiles.[64] These missiles are carried by F-16BLK 52+ and F-16BLK 52+ADV aircraft. They provide improved accuracy as the imaging IR seeker head in conjunction with intelligent image processing allows for autonomously identifying the target in order to select the best aiming point.
- Sixth generation SPIKE non-line of sight (NLOS) missiles provide a similar capability improvement. This advanced electro-optical/infrared missile system can integrate data through machine-learning techniques with multiple ground, aviation, or maritime platforms, enabling a highly accurate target image acquisition process even for NLOS targets. Coupled with Orbiter 3 UAV systems as target designators, SPIKE NLOS systems will increase the operational capabilities of the Greek defense force.[65]

6.3 Border Security

At the intersection of defense and national security, border security is a strategic priority for Greece as the prevention of irregular immigration proves most challenging. Consequently, Greece is emphasizing deterrence through introducing border surveillance technologies. These systems implement automated information management in the field through data collection. Surveillance solutions, which were field-tested in 2021, consist of a network of long-range cameras and radars installed along the Greece-Turkey border, transmitting real-time image and data on border conditions.[66]

Due to the increased pressure by irregular immigration, the land border with Turkey in Evros is heavily populated with advanced technological products and

62 IAI, "Heron Multi-Role MALE UAS."
63 Nikitas, "UAV Heron: Άριστη η πρώτη εμπειρία επιχειρησιακής αξιοποίησης."
64 Hellenic Air Force, "AIM-2000 (IRIS-T) Infrared Imaging Seeker – Tail."
65 Egozi, "Aeronautics to deliver Orbiter 3 drones to Greece."
66 Souliotis, "Ηλεκτρονική ασπίδα στον Εβρο – Σε λειτουργία κάμερες και ραντάρ."

know-how exploited by the Greek police and border control. For example, RE-ACTION (Real-time ArtifiCial InTelligence for Borders Surveillance via RPAS data aNalytics to support Law Enforcement Agencies) is a follow-up of multiple EU projects (CERETAB, AIDERS and ROBORDER). Operated by the Ministry of Migration and Asylum and developed by CERTH-ITI, REACTION aims to build a comprehensive platform and intelligence architecture for border surveillance by way of fusing multiple data streams obtained from UAVs through AI (Ministry of Migration & Asylum, undated). AKRITAS and NESTOR are two further cases of advanced border surveillance systems in use by Greek security forces. Both aim to provide pre-frontier situational awareness beyond maritime and land borders for early warning through thermal imaging and AI-enhanced radio frequency spectrum analysis technologies.[67]

Similarly, sea borders are being monitored by the Hellenic Coast Guard making use of advanced EU projects such as PROMENADE (Artificial intelligence and big data for improved maritime awareness).[68] It focuses on automatic vessel detection, tracking and behavior analysis based on machine-learning. This multi-sensor and multi-source environment is being streamlined with AI-data fusion techniques to operational rooms operated in tandem by defense, police and coast guard forces to provide for increased situational awareness against state and non-state actors, among others. A further case in point is ARESIBO, a research project in which the Naval Cadet School participates in conjunction with the National and Kapodistrian University of Athens and CERTH. This project is meant to

> enhance the current state-of-the-art through technological breakthroughs in Mobile Augmented Reality and Wearables, Robust and Secure Telecommunications, Swarm Robotics and Planning of Context-Aware Autonomous Missions, and Artificial Intelligence (AI), to implement user-friendly tools for border and coast guards.[69]

Although these systems mostly concern officials of the Ministry of Citizen Protection and the Immigration Policy, they do not exclude the participation of the Ministry of National Defense, since Greek Army personnel is involved in joint patrols with the police, as press reports covering the immigration situation in Evros suggest. Obviously, joint patrols offer the armed forces opportunities to gain first-hand experience in operating non-defense electronic surveillance systems used by the Greek State. In addition, the External Border Control and Surveillance System, estimated to cost almost €30M, is a very important project aimed at strengthening the national ability to control and monitor the external borders and, by extension,

67 Frontex, "Horizon projects, NESTOR;" Cordis, "aN Enhanced pre-frontier intelligence picture to Safeguard The EurOpean boRders.
68 Cordis, undated b.
69 ARESIBO, "ARESIBO - AR for field and C2 activities."

the security of the country. It concerns the supply of equipment, accompanied by the necessary software. Media reports also suggest that officers belonging to the security and defense branches of the Greek state are jointly working in the respective control rooms. This suggests a need for inter-agency information sharing mechanisms and interoperability requirements. Moreover, the operational deployment of THORAX (see chapter 3.2) will advance data sharing as defense, police, and coast guard forces will use a common approach to data dissemination.

7 Training for Defense AI

Training for and with AI has been high on the MoD's priorities list. On several public occasions, top civilian and military decision-makers of the MoD have underlined the value of AI (as well as quantum technologies, robotics, and autonomous weapon systems) as a means towards enabling military prowess and turning the tables on the battlefield. Subsequently, they have emphasized the value of lifelong learning, continuous education, and training as a means for countering modern threats and gearing up for the complexity of modern operations.[70]

Against this background, MoD personnel are actively encouraged to seek relevant educational opportunities. Training for and with AI takes place via simulation-based training, in operational settings, within the military academies, at the postgraduate level, through conferences as well as other entrepreneurial-minded activities.

7.1 Simulation-Based Training

A case in point regarding enhanced operational training has been the inauguration of the Synthetic Training Squadron (Moira Epixeirisiakis Synthetikis Ekpaideysis) on Andravida Air Base.[71] The squadron aims at enhancing interoperability between Special Forces and air power by way of exploiting the operational characteristics of its eleven simulators. Making use of Augmented Reality technology coupled with AI allows for the training squadron to offer for a richer and more realistic behavior of simulated individuals, teams and platforms in target-rich and complex environments as well as enabling network-centric operations.

It is noteworthy that Hellenic Air Force personnel has completed the operational deployment of the simulators, thus underlining the proficiency of the staff in using and developing advanced technology systems. In addition to the launch of the Synthetic Training Squadron, the establishment of the Flight Training Center (FTC) in Kalamata Air Base with its Mission Training Center will upgrade the operational training of aircrew by way of using new technologies and flight simulators.[72] Cutting-edge technologies exploited in FTC will use data-driven tools for optimizing training delivery built on adaptive training platforms that are powered by AI.

70 Hellenic National Defense General Staff, "Ομιλία του Αρχηγού ΓΕΕΘΑ στο Πανεπιστήμιο Πειραιώς με θέμα "Σύγχρονες Απειλές και Προκλήσεις Ασφάλειας"."
71 Hellenic Air Force, "Εγκαίνια των Εγκαταστάσεων της Μοίρας Επιχειρησιακής Συνθετικής Εκπαίδευσης του Κέντρου Αεροπορικής Τακτικής"; Hellenic Air Force, "Μοίρα Επιχειρησιακής Συνθετικής Εκπαίδευσης."
72 Mononews, "Elbit Systems: Προχωρά το έργο του Διεθνούς Κέντρου Εκπαίδευσης Πιλότων στην Καλαμάτα."

7.2 Military Education

Education in military academies, participation in postgraduate programs on new technologies, the development of educational programs for officer schools, as well as the organization of conferences currently constitute the main avenues for the personnel of the Hellenic Armed Force to acquire (new) skills and resources, including AI.

Training and Education at Military Academies

The Hellenic Army Academy, Hellenic Naval Academy, Hellenic Air Force Academy provide the basic education of new officers. These academies have incorporated themes of disruptive and emerging technologies in their educational programs. In addition to acquiring advanced mathematical skills (as the necessary scientific prerequisite for AI) in functional analysis, numerical methods, or probability theory during early semesters, students proceed to advanced AI-relevant topics such as optimization problems by way if using neural networks, distributed systems, signal processing and data fusion.[73] Respective theses treat the subject placing emphasis on making use of AI in applied subjects such as detection of noise propagation, data distribution and border control systems.

Post-Graduate Training and Education

Historically, Greek military officers have been actively seeking postgraduate educational opportunities both within and outside of their core military competencies and stages of the operational training necessary for their grade. As such, officers study at purely civilian university schools and departments obtaining postgraduate degrees that treat the mathematical aspects of AI (i.e., degrees in Applied Mathematics), seek optimization in real-life problems (e.g., Machine Learning and Deep Learning in structural engineering, geotechnical engineering, bridge engineering) as well as its core IT-relevant aspects (in multiple Computer Science departments).

The Hellenic Army has formalized cooperation agreements with Greek Universities for offering postgraduate opportunities to its personnel. A case in point is the Hellenic Army Academy's participation in two Masters of Science with the School of Production Engineering and Management of Technical University of Crete.[74] Entitled "Master of Science in Intelligent Systems Engineering" and "Master of Science in Operation Research and Decision Making" both treat AI within the scope of computational intelligence, machine learning, big data analytics, and

73 Hellenic Air Force Academy, Undergraduate Study Programme 2022–2023; Hellenic Army Academy, Undergraduate Study Programme 2022–2023; Hellenic Naval Academy, Πρόγραμμα Σπουδών ΣΝΔ – Κατεύθυνση Μάχιμων – Έτος Εισαγωγής 2023–2024."

74 Hellenic Army Academy & Technical University of Crete, 'Master in Intelligent Systems'.

data science in relation to real-life operational conditions such as tracking of unmanned systems. A "Master of Science in Cryptography, Security and Information Systems" is offered by the Hellenic Army Academy to its army officers. Herein, analysis and evaluation of symmetric crypto methods using AI (cryptanalysis) as well as methods for privacy-preserving machine learning and inference are a few domains of cryptography that are addressed through AI.[75] Also, the Hellenic Naval Academy has recently signed a cooperation agreement with the National Centre of Scientific Research "Demokritos," a leading Greek research center, for educational and R&D purposes in the fields of AI, machine-learning, big data analytics and new materials.[76] Indicative of the increased focus on AI by the academic and research community has been the recent foundation of the "Archimedes" Center for Research in Artificial Intelligence, Data Science and Algorithms. Operating as a Research Unit of the Athena Research Center it can provide research capabilities on relevant issues.[77]

The Senior War Colleges of the three military services as well as other educational institutions Supreme Joint War College (Anotati Diakladiki Sxoli Polemou – ADISPO) and National Defense College (Sxoli Ethnikis Amynas - SETHA) provide extra avenues to educate active-duty senior officers. These educational institutions provide courses that cover a wide range of topics related to national defense and security, military strategy in conjunction with defense AI and new technologies.

An equally important avenue for attaining educational experience is through NATO's postgraduate opportunities offered to Greek officers. While there is no open-source data on the number of the officers attending such courses nor the exact subject(s) of the offered post-graduate courses, a simple digital search, for example, in Monterey's Postgraduate School indicates that AI has been introduced as a key subject.[78] In the EU context, AI-relevant educational opportunities should be explored in the context of the European Security and Defence College (ESDC).

Extracurricular Training and Education

In relation to extracurricular activities, one case has been the Common Module on Unmanned Aerial Systems provided by the Hellenic Air Force Academy in collaboration with the ESDC.[79] Therein, the technological principles of Unmanned Aerial Systems and their applications, specifications and classification of different categories, types and sensors were presented.

75 Hellenic Army Academy, Postgraduate Study Programme.
76 Hellenic Naval Academy, "Υπογραφή Πρωτοκόλλου Συνεργασίας μεταξύ Σχολής Ναυτικών Δοκίμων και ΕΚΕΦΕ "Δημόκριτος"."
77 ATHENA Research Center, "ARCHIMEDES Unit."
78 Naval Postgraduate School, AI for Military Use Certificate; America's Navy, "Artificial Intelligence Summit at NPS Accelerates Critical Capabilities."
79 Hellenic Air Force Academy, Common Module on Unmanned Aerial Systems.

7.3 Conferences

Educational activities in the form of conferences on topics related to defense AI have been taking place. For example, the Hellenic Air Force has been organizing its Annual Air Power Conference, inter alia, with the goal to discuss early technology adoption to preserve operational advantage. The topic of AI has received attention in multiple conferences.[80] In a special section entitled "Artificial Intelligence and Man in the Loop: Opportunities - Capabilities - Prospect" the panel discussed how AI can influence developments in military conflicts and delved into relevant topics such as Machine Learning Methods on Noisy and Sparse Data.

An additional conference entitled "Technology – Innovation, Defense and Strategy," aimed at senior officers, was organized in 2023 by the National Defense College. The purpose was to broaden the knowledge of the participants with an emphasis on the impact of innovation and the application of new technologies in the armed forces. The conference also addressed the use of AI in defense.[81] The topic was presented by researchers at the National Centre of Scientific Research "Demokritos" further indicating the formal and informal links between the domestic research ecosystem and armed forces.

7.4 Entrepreneurial-minded training activities

In 2022, the MoD conducted the Defense Innovation Challenge focusing on situational awareness. The overall goal was to stimulate innovative in-house ideas that can help transform the operational horizon.[82] AI-related projects that sought to identify submarines (Submarine Identification with Artificial Intelligence) were shortlisted for future proofing.[83] In addition, the challenge made it clear that officers and their innovative ideas constitute a valuable source that the MoD should systematically tap into to enhance ongoing force transformation activities.

80 Hellenic Air Force, "8ο Συνέδριο Αεροπορικής Ισχύος."
81 Hellenic National Defense General Staff, "Ημερίδα με Θέμα "Τεχνολογία – Καινοτομία, Άμυνα και Στρατηγική"."
82 General Directorate for Defense Investments and Armaments; "1st Competition of Innovation and Technology of the Ministry of National Defence."
83 Association of Graduates of Hellenic Air Force Technical NCO Academy, "ΥΠΕΘΑ: 1ος Διαγωνισμός Καινοτομίας και Τεχνολογίας."

8 Conclusion

This report shows that Greek defense policy officials have actively taken steps to harness the potential of the technological and operational "window of opportunity" that AI presents. Several factors – such as long-standing bilateral problems with neighboring countries, looming tactical and operational gaps coupled with technological obsolescence due to the decade-long economic default – have prompted the MoD to actively seek industrial and defense materiel upgrades. In combination with the strive to revitalize the dormant defense industry and capitalize upon the highly educated military personnel, these drivers have pushed the defense establishment towards riding the current scientific and technological wave. Despite notable progress, several long-term challenges remain to be tackled to seize AI's potential for the Greek military ecosystem.

First and foremost, Greek defense planners and officers should remain alert of the scientific breakthroughs in the field. Operating a "black box" where algorithms and key optimization techniques remain unknown to military engineers, data scientists, and mathematicians is problematic for sustaining long-term operational advantages. Enhanced cooperation with the science establishment, focused bibliometric and technometric analysis and network and centrality analysis to locate knowledge-rich areas of expertise should be the norm.

Second, participating in collaborative RDI projects is an important avenue to access top-notch know-how and accumulate experience. Importantly, current and future operational requirements should systematically guide the selection of RDI projects the Greek Armed Forces want to participate in. While such a future oriented, technology-based, tactical list is currently not publicly available, the aforementioned actions indicate a conscientious approach in both closing existing operational gaps and leveraging technologies to leapfrog. This pattern should continue, and such know-how should start being transposed into the strategic and tactical planning of the country's defense forces and the production lines of Greek firms.

Third, procuring cutting-edge defense material, among others, entails a significant learning curve for military personnel. Thus, the MoD should move swiftly to become a proficient end user in current and future R&D projects. To the extent possible, Greek defense procurement officials should actively negotiate with foreign contractors specific conditions to ensure that Greek Armed Forces are granted "enhanced" user rights related to new defense equipment. In addition, domestic defense contractors should be given access to proprietary know-how in case they engage with international partners in co-production agreements. Enabling an operational relationship with domestic civilian universities and the country's highly performant science diaspora is yet another channel to gather cutting-edge scientific and technological information on AI. This will also advance Greece's understanding related to increasing vulnerabilities that are bound to

appear to interconnected systems – ranging from cyber-attacks, manipulated and corrupt data as well as data transmission flows.

Fourth, the MoD should adopt a more systemic view to monitor defense AI-relevant policy discussions in NATO, European agencies, and in other bilateral and multilateral formats. Greek military delegates should "tag" and send AI-related information to a single point within the ministry for the latter to keep track of all concurrent activities. Indeed, this international aspect of accumulating AI knowledge is important. For example, NATO's new Data and Artificial Intelligence Review Board (DARB) is a key forum to exchange best practices and views on AI.[84] Greece will be appointing a representative to DARB and should thus use this forum to systematically gather information on international defense AI developments. The same holds true for European institutions like EDA, the European Space Agency (ESA) and the European Network and Information Security Agency (ENISA) that have begun incorporating AI as key missions within their scope.[85]

Finally, while multiple military units engage in AI for a number of both narrow and/or wider objectives, establishing a new function similar to the US DoD's Chief Digital and Artificial Intelligence Office should be explored. A single administrative point would help to establish and implement a unified defense AI vision in line with the wider national ambition, collect and document all relevant information in a structured manner and – potentially – recognize and streamline interagency overlap and push back organizational inertia and institutional turf war. Further, this office can push towards greater collaboration with domestic academic and research institutions as well as international partners.

In addition to AI being a scientific, technological, and operational challenge, first and foremost it presents a learning challenge. This report has discussed the Greek defense establishment's ability to 'learning to learn'. While much remains to be done, there is reason to be optimistic.

84 NATO, NATO's Data and Artificial Intelligence Review Board.
85 See respectively: European Space Agency, "Artificial intelligence in space"; Artificial Intelligence Applications & Innovations, "The 2nd Workshop on Defense Applications of AI (DAAI)"; ENISA, "Ad-Hoc Working Group on Artificial Intelligence Cybersecurity."

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