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DEFENSE IN THE AGE OF DEEP TECH

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TABLE OF CONTENTS

03	POLICY BOX—EXECUTIVE SUMMARY
04	INTRODUCTION: DEEP TECH AS THE NEW DEFENSE FRONTIER
06	TECHNO-POWER, GEOPOLITICAL COMPETITION, AND EUROPE’S STRATEGIC AWAKENING
11	DEFINING DEEP TECH: TECHNOLOGIES SHAPING TOMORROW’S DEFENSE
14	MAPPING THE CURRENT STATE: EU AND NATO DEFENSE DEEP TECH EFFORT
19	STRUCTURAL CHALLENGES IN DEFENSE DEEP TECH: FROM LAB TO REAL WORLD USE
23	FINDING SOLUTIONS: BUILDING A STRONG DEFENSE DEEP TECH INNOVATION CHAIN
28	LIST OF REFERENCES

POLICY BOX— EXECUTIVE SUMMARY

WHAT'S AT STAKE

- Europe faces growing geopolitical fragmentation amid accelerating technological shifts.
- Defense deep tech represents a generational opportunity to strengthen Europe's strategic position.
- AI, quantum, space or advanced materials have the potential to shape Europe's security for decades.

WHY IT MATTERS

- Technological readiness underpins Europe's sovereignty, competitiveness, and defense.
- Traditional metrics fall short: deep tech's value lies in its systemic impact, not in short term financial returns.
- Misreading deep tech risks hyping the short term while overlooking the transformative long-term effects.

WHERE THE GAPS ARE

- Europe lacks a coherent, long-term deep tech strategy aligned with its sovereignty ambitions.
- A defense-wary culture and risk-averse mindset continue to slow innovation.
- A fragmented regulatory landscape—combined with inefficient public procurement—creates barriers for deep tech startups.

WHAT TO DO

- Develop a European Technology Diplomacy Strategy to align innovation, investment, and defense priorities.
- Adopt smart regulation and foster a culture of calculated risk-taking to accelerate innovation.
- Build a new public-private investment model tailored to defense deep tech, unlocking scalable, long-term solutions.

INTRODUCTION: DEEP TECH AS THE NEW DEFENSE FRONTIER

We are in a time of transformation. The very meaning of technology—especially frontier technology—is in flux. Artificial intelligence epitomizes this dynamic: it is generative now, agentic next, and it may become general in the future.

Accordingly, novel, high-risk frontier technologies are often referred to as “deep tech”, distinguishing them from regular or legacy tech. Their appeal stems from their transformative potential, disruptive promise, and profound challenge (Basilio, Murray, & Frolund, 2022; Brigl, Heimbach, Do, Stöhr, & Rachuth, 2024; Hafied, 2022). What is considered deep tech today may not be seen that way tomorrow (Blázquez-Navarro et al., 2025). Misjudging deep tech—overestimating its short-term impact while underestimating its long-term change—reveals a shallow understanding of its relentless, intricate, and far-reaching influence.

From lab research to product development, market entry, and scaling, deep tech transforms pioneering ideas into world-changing innovations. Frontier technologies catalyze deep industrial and societal change, creating new industries, forging new value chains, and driving industrial renewal that reshapes Europe’s technological and industrial base (Bobier et al., 2022; Jacobs et al., 2023).

As the European Commission’s Joint Research Centre (JRC) underscores, frontier technologies require assessment metrics distinct from traditional financial or user-based indicators. Their value lies in systemic impact across scientific, technological, and industrial domains, not short-term market returns.

Given these characteristics, effective policy must therefore support integrated innovation ecosystems that connect research, entrepreneurship, industry, and investment—fostering scalable solutions with long-term strategic impact. This, in turn, requires tailored frameworks that prioritize systemic influence and cross-sectoral coordination.

In the current geopolitical climate, the development of a resilient deep tech ecosystem with defense applications has become an urgent imperative for both the EU and NATO. Against this backdrop, **this policy brief offers a strategic reflection on the role of deep tech in shaping the future of European and transatlantic defense. Developed by IE University’s Center for the Governance of Change, this brief builds on insights from the side event it co-hosted with the NATO Defense College at the 2025 Munich Security Conference.**



Divided into **two main pillars**, the document first maps the current landscape of the deep tech and defense ecosystem in NATO and the EU. It then outlines strategic pathways to a transatlantic deep tech innovation ecosystem capable of meeting tomorrow's security and defense challenges head-on.

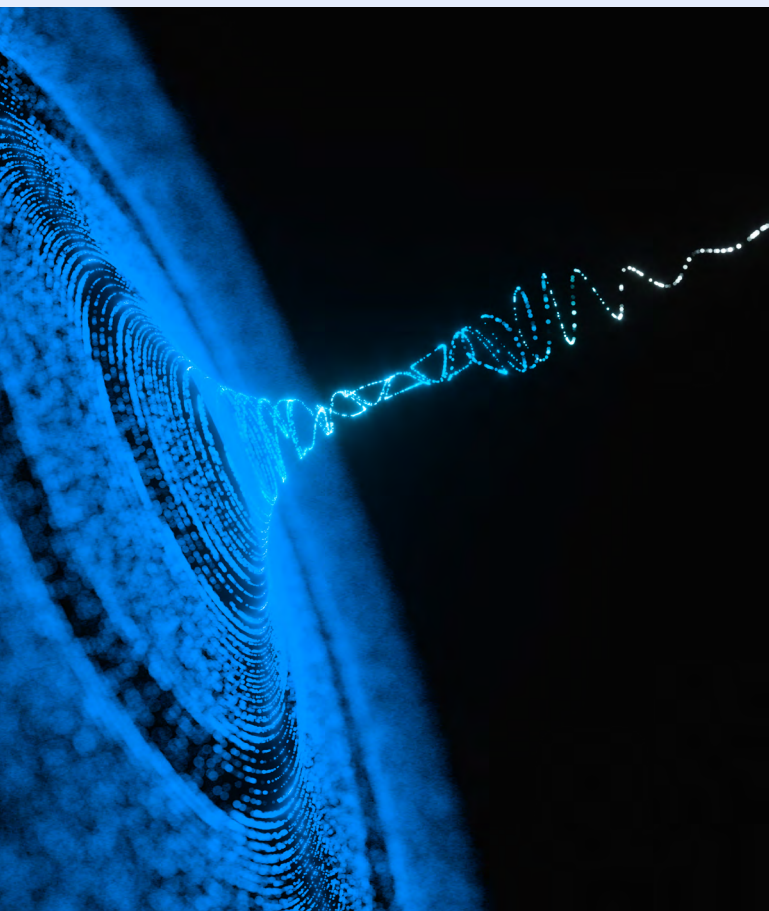
1 The **first section** (*Techno-Power, Geopolitical Competition, and Europe's Strategic Awakening*) contextualizes defense deep tech within the broader transformation of global power, outlining how technological disruption, shifting alliances, and renewed defense ambitions are redefining Europe's strategic landscape.

2 **Section two** (*Defining Deep Tech: Technologies Shaping Tomorrow's Defense*) then defines deep tech identifying the technological domains with the greatest potential impact—ranging from quantum and AI to space and advanced materials. This working definition builds on existing research and sets clear boundaries for the analysis, ensuring a focus on technologies that can truly transform defense capabilities.

3 **Section three** (*Mapping the Current State: EU & NATO Defense Deep Tech Efforts*) presents a situational overview of EU and NATO defense deep tech initiatives. It highlights key actors, capability gaps, and promising projects that are already addressing these gaps, providing a concise but comprehensive view of the ecosystem.

4 **Section four** (*Structural Challenges in Defense Deep Tech: From Lab to Real-World Use*) examines structural barriers to integrating deep tech into defense capability development. It highlights the strategic, cultural, and market-level obstacles that currently constrain innovation and limit the effective transition from research to deployment.

5 **Section five** (*Finding Solutions: Building a Strong Defense Deep Tech Innovation Chain*) presents the key strategic levers required to mature Europe's defense deep tech ecosystem. It proposes an integrated set of solutions spanning strategy, regulation, culture, and investment to strengthen the innovation chain and bolster Europe's ability to shape the future in an increasingly complex security landscape.



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There is no denying that technology is increasingly reshaping the balance of political, economic, societal, and military power. Technological advancement—often disruptive—has emerged as a global macrotrend that is transforming the geopolitical and economic landscape at an unprecedented pace. At the same time, challenges to multilateral governance have become more acute than ever (Blázquez-Navarro, 2024).

This macrotrend—what we may call “techno-power”—is redrawing the global map of state power. Classical centers of authority are shifting along an uncertain path toward multipolarity, sometimes *nonpolarity*, and at times regionalized bipolarity, while power is diffusing rapidly among corporations and individuals. As a result, any contemporary analysis of geopolitics must account for the tech–business nexus as well as the rise of a mobilized, multidimensional civil society that is becoming an influential global actor.

This transformation coincides with intensifying rivalry among states with divergent security visions, alongside with commercial confrontation, a resurgence of industrial policy, and economic security strategies that are redefining national security and defense postures (European Commission, 2025).

Geopolitical competition is increasingly translating into military confrontation, as seen in Russia's aggression against Ukraine and the protracted conflict in Gaza, with cases on international crimes now *sub iudice* before the International Court of Justice.

Great power confrontation is accelerating the development of emerging military technologies and driving a new technological arms race. Emerging and Disruptive Technologies (EDTs) are reshaping the nature and character of conflict—particularly in hybrid and grey-zone contexts, where aggression combines military and non-military means below the UN Charter's Article 2(4) threshold prohibiting the use or threat of force. EDTs are acquiring strategic weight, turning into pivotal battlegrounds in global competition.

Military “hard” competition among major powers continues, closely intertwined with economic and trade policy uncertainty—as illustrated by the 2025 US–EU tariff accord (Benson, Bergman, & Steinberg, 2025). Strategic risks across defense, security, economy, and trade are expected to endure, remaining central to states, corporations, and societies alike.

Frontier technologies remain largely ungoverned by global architectures. Their rise coincides with a weakening multilateral system and the erosion of cooperative mechanisms for peace and dispute resolution. At the same time, liberal democracies and market economies face growing systemic competition vis-à-vis autocratic regimes that some perceive as more effective in delivering global public goods.

Since Russia's aggression against Ukraine, the debate on European defense has become central to the Union's strategic autonomy agenda.



The debate on European defense policy is canonical—indeed, consubstantial with the very conception of the European project, founded on the pooling of coal and steel production, the raw materials of war, between France and Germany. This debate resurfaced with renewed intensity under the **EU's Common Security and Defense Policy (CSDP)** and the **2016 EU Global Strategy**. Strategic autonomy was then understood both as the availability of military capabilities for an “active European defense” and as the development of a distinct politico-military posture—allowing the Union to act independently of allies or other organizations. **Permanent Structured Cooperation (PESCO)** and the mutual assistance clause under **Article 42(7) of the Lisbon Treaty** embody these two dimensions (Blázquez-Navarro, 2024; Fiott, 2025; Simón & Fiott, 2025).

Since Russia's aggression against Ukraine, the debate on European defense has become central to the Union's strategic autonomy agenda. This includes the challenge of rebuilding Europe's defense industrial base after years of underinvestment, supply chain dependencies, and fragmentation, as well as the absence of a genuine single market for the joint procurement of military capabilities (Subran et al., 2025).

The discussion has intensified under the totemic theme of *military spending and defense investment*, particularly after **NATO's Hague Declaration** (25 June 2025), which called for Allies to allocate 5% of GDP to defense, including 3.5% to core spending and 1.5% to defense-related investment in infrastructure and resilience. Within the European context, these commitments must be considered together with the **European Council conclusions of 26 June 2025**, which set out the EU's approach to defense readiness, industrial capacity, and long-term investment.

Even before the Hague Declaration, Europe was already pursuing the strategic reindustrialization of defense in the name of sovereignty. Despite longstanding criticism of underinvestment, many European NATO members have substantially increased defense spending since 2021. According to the European Defence Agency's annual report (2024), total EU defense expenditure rose to €326 billion by the end of 2024, representing 1.9% of EU GDP, and the Agency projects that this trend will continue, with spending expected to reach €381 billion in 2025 (CARD report, 2024). Other studies confirm this data and provide further context on member states' allocations (SIPRI, 2025; European Parliament, EGOV, 2025; European Parliament, EPRS, 2025).

While debates often focus on the percentage of GDP allocated to defense, this metric alone is insufficient and must be embedded within a broader strategic framework that reflects the evolving threat landscape and balances deterrence, defense, and offensive capabilities.

The von der Leyen Commission (2024–2029) made defense a core EU priority by appointing the first Defense and Space Commissioner, launching the **European Defense Industrial Strategy** to drive more effective joint investment by Member States by 2030, and advancing the European Defense Union.

Building on this momentum, in March 2025, the **ReArm Europe / Readiness 2030 plan** was unveiled to mobilize up to €800 billion in defense investment by 2029, drawing on multiple sources: SAFE EU-backed loans (€150 billion), a national escape clause allowing an additional 1.5% of GDP in defense spending, redeployed EU cohesion funds, European Investment Bank (EIB) support, and private capital. The plan combines innovative financial engineering with a clear political signal of Europe's strategic intent—aligning fiscal rules, defense investment, and sovereignty (Cunha, 2025).

A **Defense White Paper** (2025) followed, addressing capability gaps, industrial resilience, innovation, and sustained support for Ukraine. However, definitional divergences between EU and NATO frameworks continue to complicate budgetary comparisons.

Since then, the EU Council Presidency has further prioritized strengthening European defense capabilities, while European Council President António Costa has emphasized that economic strength and security are once again inseparable—a message fully aligned with the Strategic Agenda, which places competitiveness and defense as twin priorities at its core.

The role of companies will be pivotal in this emerging governance of defense—extending well beyond traditional defense actors—as global supply chains exert both direct and indirect influence across a wide array of industries (Reyes, 2025).

At the same time, the nature of warfare is shifting—profoundly reshaping the battlefield in technological ways (Krelina, 2025; NATO, Science and Technology Organization [STO], 2025). Understanding future conflict is key to effective defense and security planning and investment. While debates often focus on the percentage of GDP allocated to defense, this metric alone is insufficient and must be embedded within a broader strategic framework that reflects the evolving threat landscape and balances deterrence, defense, and offensive capabilities.

Moreover, as noted, the NATO Hague Summit marked a turning point for European defense policy in the context of the new Trump-affected transatlantic relationship. Numerous analyses have dissected the European defense ecosystem, converging on a shared matrix of structural vulnerabilities across the contours of Europe's defense (Arnal & Blockmann, 2025; Bean, 2025; Castilla, 2025; Wolff, Steinbach, & Zettelmeyer, 2025).



These vulnerabilities are both strategic-political and material.

Strategic-political vulnerabilities include:

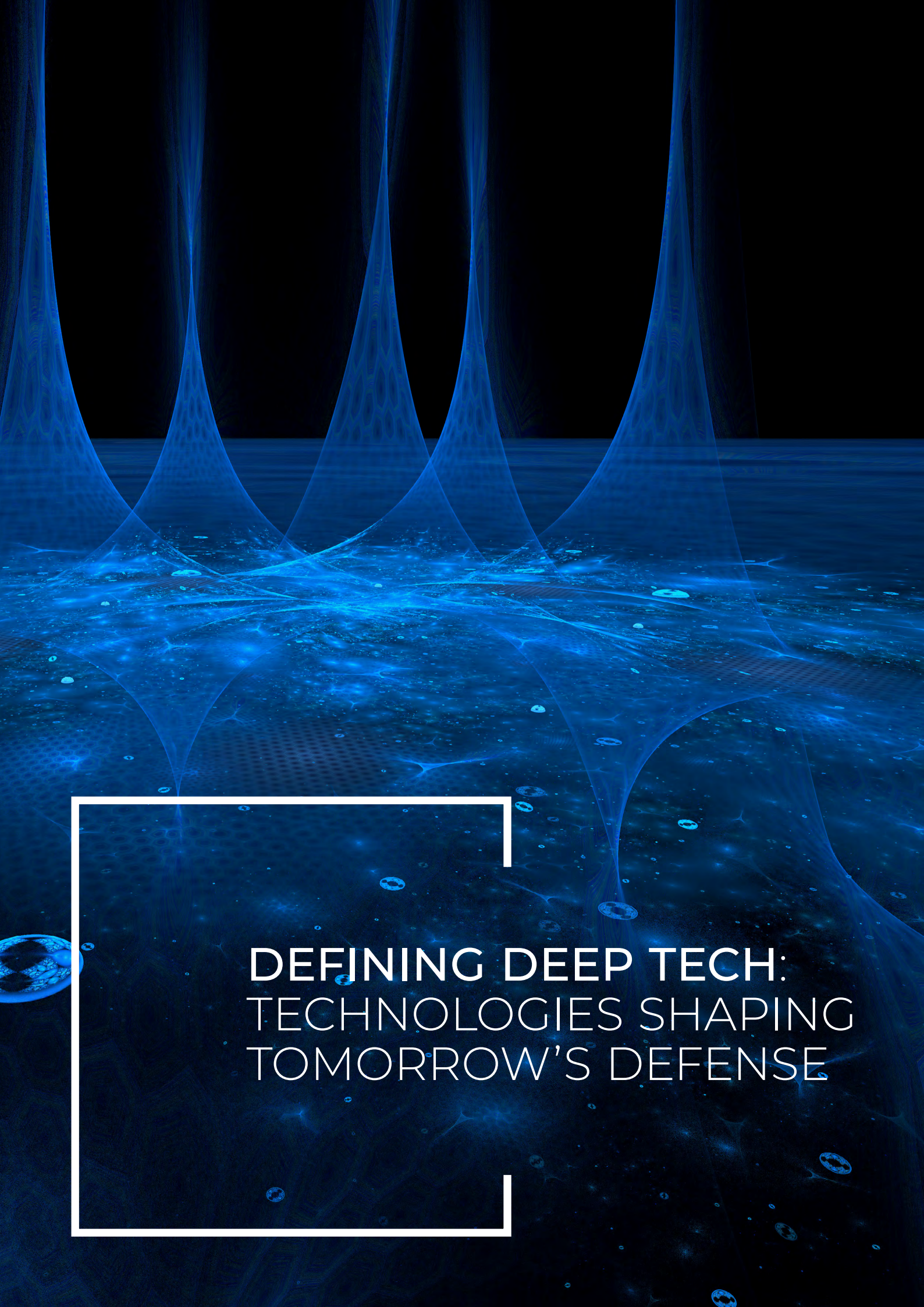
- the absence of a unified European technology diplomacy strategy;
- the need for a robust reorientation of the transatlantic relationship;
- the establishment of pathways toward technological strategic autonomy, grounded in a new conception of global and resilient supply chains;
- and the pursuit of a strengthened defense and defense industrial policy, supported by treaty revisions.

Material vulnerabilities relate to the internal market, financing, and fiscal frameworks, and include:

- the lack of a genuine single defense market due to national barriers;
- the absence of a coordinated joint procurement system that prioritizes interoperability, urgent European capability acquisition, and the development of a truly autonomous European defense industrial base: EU militaries operate 178 weapon systems versus 30 in U.S. forces, with duplicated systems increasing costs by 50–90% (Fiott, 2018);
- the absence of a sustainable public-private financing model;
- and a fiscal framework dependent on temporary clauses and ad hoc measures.

The question, then, is whether this map of vulnerabilities in the European defense ecosystem also applies to the defense deep tech subsystem. At first glance, one might expect a symmetrical picture. Yet the distinct nature of deep technologies introduces dynamics that both complicate and sharpen this assessment. **The next section examines what makes deep tech distinctive—and why its relevance for defense merits separate analysis.**



The background is a dark blue, almost black, space filled with glowing blue elements. Several large, translucent, blue, cone-like or funnel-like structures rise from the ground, tapering towards the top. The ground itself is a complex, glowing blue surface with a grid-like pattern and numerous small, bright blue circular and star-like particles scattered across it. The overall effect is one of high-tech, futuristic, and digital connectivity.

DEFINING DEEP TECH: TECHNOLOGIES SHAPING TOMORROW'S DEFENSE

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Deep tech is defined as innovations that merge cutting-edge engineering with scientific advancements to tackle major societal challenges, from climate change to cybersecurity. They are not mere technological improvements, but what economists often refer to as “technological frontier innovations” (Hafied, 2022).

Despite their disruptive potential, they face significant barriers to development, primarily due to two key factors: (1) the high capital intensity required for investment and (2) the considerable uncertainty surrounding future returns (Hafied, 2022).

There is no clear consensus on which innovations qualify as deep tech, as the relentless pace at which science and technology progress redefine what is considered cutting-edge and revolutionary (Glover & Urwin, 2025). In the past, for instance, a technological breakthrough such as electricity or the combustion engine would have been considered deep tech. Today, the term is often associated with advancements in the fields of artificial intelligence, quantum computing, novel materials and advanced manufacturing, energy, space, biotechnology, and next-generation communications.

While the gap between deep tech and regular tech development has narrowed in recent years, start-ups involved in developing, scaling, and deploying such deep tech innovations still face distinct challenges (Brigl et al., 2024).

01/ Longer time-to-market:

Deep tech start-ups typically require over a third more time than regular ventures to move from early to mid-stage revenue growth—taking longer both to scale from \$1 million to \$5 million, and again from \$5 million to \$10 million, largely due to technological and regulatory challenges.

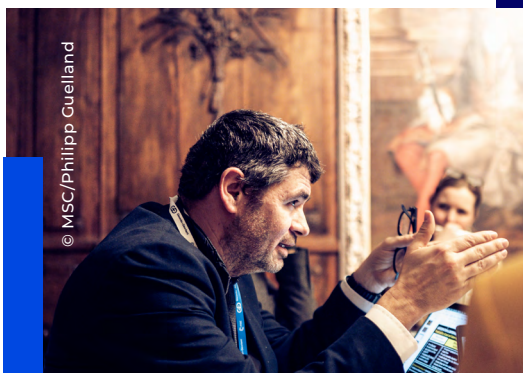
02/ Capital intensity:

Reaching the \$5 million revenue mark usually entails nearly 50% higher investment needs compared to non-deep tech start-ups, reflecting the high cost of R&D and specialized infrastructure.

03/ High risk and low survival rates:

Only half of deep tech startups make it past the seed funding stage compared to regular tech start-ups, as both technical feasibility and commercial viability remain uncertain.

Despite these challenges, deep tech will play a decisive role in shaping the future of European defense and its alliances. In this context, deep tech encompasses not only scientific breakthroughs but capabilities that can fundamentally alter deterrence, logistics, and command systems—turning technological advantage into strategic superiority.



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Control over deep tech development and deployment can significantly strengthen strategic deterrence and operational readiness (Table 1), ultimately shaping the balance of power in the coming decades.

While technology has long been a fundamental driver of power and geopolitical influence, the speed and scope of today’s technological innovations is significantly reshaping offensive and defensive capabilities, transforming the very character of conflict and becoming a key arena of competition between major powers in their quest to shape the emerging global order.

In this race for technological dominance, threats to national security have become simultaneously broader and more sophisticated. From the reduced reaction time resulting from rapid, long-range strikes enabled by hypersonic missiles to the risks of disinformation and cognitive warfare exacerbated by the advent of social media, generative AI, and emerging neurotechnology, the battlefield is evolving at an unprecedented pace (Pujol & Dinh, 2024). At the same time, economic security is increasingly at risk, as nations compete over critical supply chains, semiconductor dominance, and

the control of key technologies that underpin technological and industrial infrastructure.

The difficulty of commoditizing deep tech and the long-term investment and specialized expertise it demands takes these dynamics to another level. Control over deep tech development and deployment can significantly strengthen strategic deterrence and operational readiness (Table 1), ultimately shaping the balance of power in the coming decades.

For the EU and its allies, investing in deep tech is therefore not just an economic imperative, but a matter of security and sovereignty—essential to reducing external dependencies and maintaining a durable competitive edge in an increasingly volatile global landscape. **The next section presents an overview of promising initiatives in that regard as well as persistent capability gaps across the EU and NATO.**

DEEP TECH INNOVATION	DEFENSE APPLICATION
 Autonomous Vehicles and Robotic Systems	Enable military logistics, surveillance, and combat operations in hazardous environments, reducing the risk to military personnel and allowing for precision strikes and continuous monitoring (Weinberger & Somerville, 2024)
 Quantum Communications	Have the potential to enable ultra-secure communication networks, link quantum sensors, computers and other systems. All in all, enhancing system coordination and overall performance (Saylor, 2024)
 Advanced Materials (such as nanomaterials and metamaterials)	Can improve the durability, weight, and resistance of military equipment, resulting in enhanced protection and camouflage, thus increasing the survivability of military assets

MAPPING THE
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MAPPING THE CURRENT STATE: EU AND NATO DEFENSE DEEP TECH EFFORT

In recent years, funding for defense tech startups across Europe has grown significantly. This surge has been driven by new initiatives at both the EU and NATO levels, reflecting the region's growing recognition of these technologies' strategic importance. Yet, capability gaps persist. Europe still struggles to translate its strong research foundation and industrial capacity into scalable, market-ready defense applications.

For many years, defense was a politically sensitive and underfunded domain in Europe, often avoided by venture capital (VC) and absent from mainstream innovation discourse. Over the past five years, however, geopolitical shocks—most notably Russia's aggression of Ukraine, rising uncertainty over the transatlantic alliance, and growing global instability—have catalyzed a reassessment of Europe's strategic vulnerabilities. Governments and companies are now mobilizing to correct long-standing deficiencies and bolster Europe's technological sovereignty.

To this end, a series of new institutions and initiatives have emerged to support the development of defense and deep tech innovation at the EU level, including the **European Innovation Council (EIC)**, the **EU Defence Innovation Scheme (EUDIS)**, and the **Hub for EU Defence Innovation (HEDI)**. Additionally, the **Joint European Disruptive Initiative (JEDI)**, launched in 2018 by a group of entrepreneurs, researchers, and policymakers who were inspired by innovation models like DARPA in the U.S., is seeking to complement EU policy instruments and counter bureaucratic inertia in European R&D funding through risk-embracing investment. Beyond the EU, NATO has also launched two major initiatives: the **Defense Innovation Accelerator for the North Atlantic (DIANA)** and the **NATO Innovation Fund (NIF)**. See Table 2.

A series of new institutions and initiatives have emerged to support the development of defense and deep tech innovation at the EU level.



INITIATIVE	YEAR	ORGANIZATION/ PROGRAM	AIM	TECH FOCUS AREAS	BUDGET
EIC Pathfinder / Advanced Innovation / Transition / Accelerator / STEP Scale-up scheme	2021	European Innovation Council under Horizon Europe's program.	To support game-changing innovations throughout their lifecycle and address funding gaps for deep tech scale-ups.	For 2026: Advanced Materials for Miniaturized Energy Harvesting Systems; Biotechnology for Healthy Ageing; DeepRAP, Physical AI; Translating Disruptive New Approach Methodologies into Practice; Advanced Materials for Renewable Energy and Energy Storage Systems; Alternative Concepts and Key Enabling Technologies for Fusion Power Plants; Biotech for Regenerating Agricultural Soils; Boosting the European Critical Raw Materials value chain; Deep Tech for Climate Adaptation.	€10.1 billion (2021–2027)
European Defence Fund (EDF)	2021	European Commission	To incentivize and support collaborative, cross-border research and development in the area of defense, increasing the EU's technological edge and develop the capabilities that are key for the strategic autonomy and resilience of the Union and its members.	For 2025: Ground Combat; Space; Air Combat; Energy Resilience and Environmental Transition; Cyber defense; Naval Combat; Underwater Warfare; Simulation and Training; Advanced Sensor Technologies; Autonomous Triage and Evacuation; Multifunctional Information Distribution Systems; Human-AI Dialogue; and Chiplets for Defense Applications.	€8 billion (2021–2027)
Hub for EU Defence Innovation (HEDI)	2022	European Defence Agency (EDA)	To stimulate and facilitate cooperation on defense innovation among EU Member States and coordinate with NATO initiatives.	Communication Information Systems and Networks; Systems of systems, Battlelab and Modelling and Simulation; Cyber Research and Technology WG; Aerial Systems; Ground Systems; Naval Systems Ammunition Technology; Materials and Structures; Technologies for Components and Modules; Radio Frequency Sensors Technologies; Electro-Optical Sensors Technologies; CBRN Protection and Human Factors; Guidance Navigation and Control; Energy and Environment WG	NA
Joint European Disruptive Initiative (JEDI)	2018	Private non-profit initiative inspired by the U.S. ARPA	To fund and catalyze high-risk, high-reward research and innovation that could lead to disruptive technological breakthroughs across key strategic areas for Europe.	Soil Carbon Sequestration; Disinformation; Oceans and Life Sciences; Critical Materials; AI;	NA/Project-based fundraising
Defense Innovation Accelerator for the North Atlantic (DIANA)	2021	NATO	To find and accelerate dual-use innovation across the Alliance, connecting startups with defense needs through a network of academia, accelerators and test centers.	For 2026: Energy and Power; Advanced Communication Technologies; Contested Electromagnetic Environments; Human Resilience and Biotechnology; Operations in Extreme Environments; Maritime Operations; Resilient Space Operations; Critical Infrastructure and Logistics; Autonomy and Unmanned Systems; Data Assisted Decision Making.	NA / Non-dilutive grants ranging from €100,000 to €400,000 per company through its accelerator programs.
NATO Innovation Fund (NIF)	2023	24 NATO allies (excluding the U.S., Canada and France)	To provide deep tech entrepreneurs in the transatlantic deep tech sector with unprecedented access to 24 allied governments, who have not only invested in NIF, but also work closely with them to provide access to both commercial and government markets.	Energy; Materials Science; AI; Data and Computing; Autonomy, Quantum Computing; Biotechnology; or Space.	€1 billion

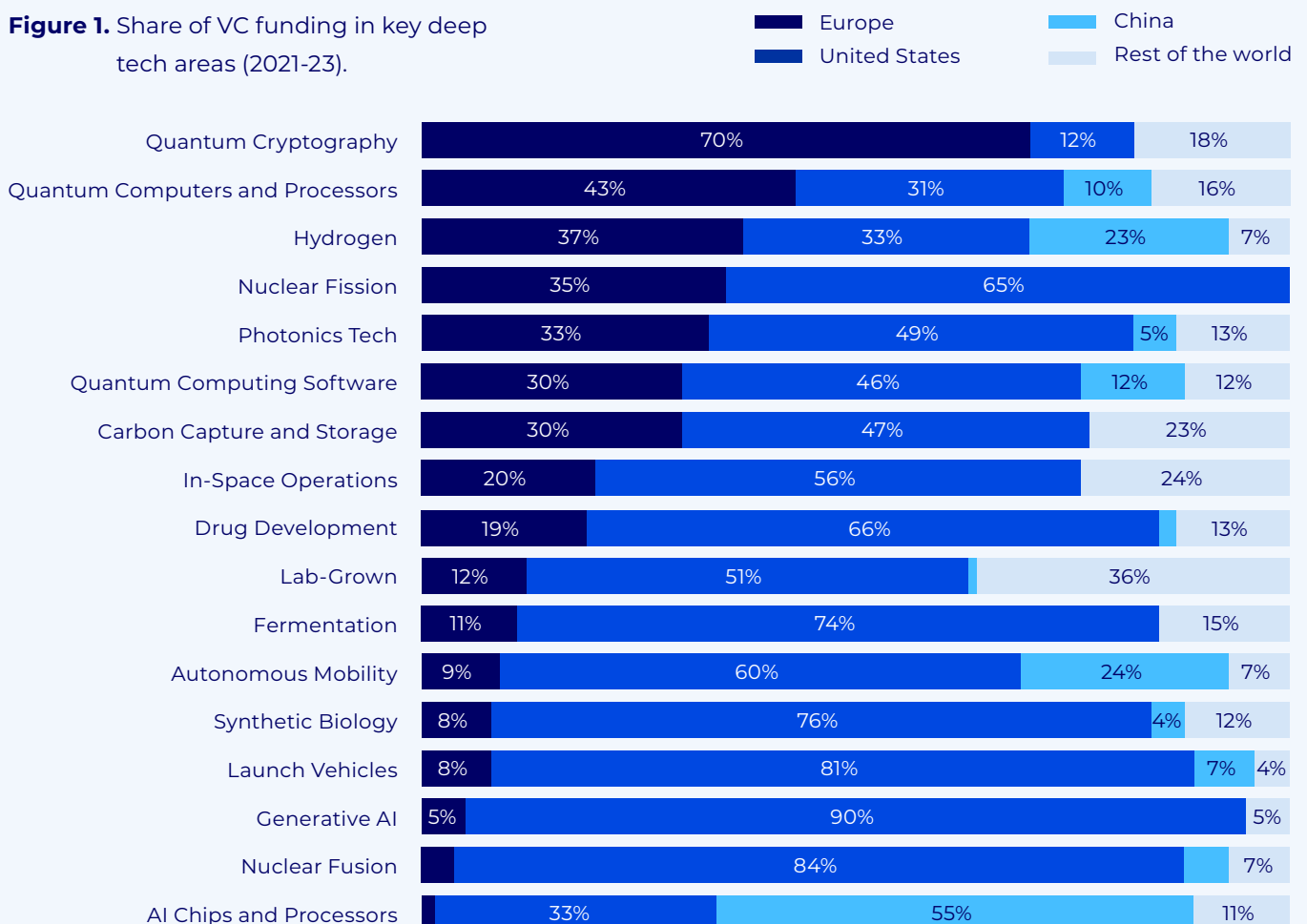
Note. Author's elaboration based on data from European Commission, n.d.; Council of the European Union, 2025; Vincent, 2023; NATO Innovation Fund, 2024.

It is important to note that, despite the growth in investment in recent years, public instruments such as the European innovation Council (EIC), research grants, and national innovation funds are disproportionately focused on early-stage funding, leaving a vacuum at later stages where larger capital injections are essential for scale and commercialization.

This institutional momentum has coincided with a surge in defense tech entrepreneurship and begun to show tangible results. Since 2019, the number of defense tech startups in Europe and NATO countries has grown rapidly, with VC investment reaching \$3.9 billion in 2024—accounting for 2.5% of total VC funding in the region (Dealroom.co, 2024). According to McKinsey & Company (2025), investment in European defense startups increased by over 500% in the 2021 to 2024 period compared to the previous three years. Importantly, the investor landscape has also expanded to include a mix of public, private, generalist, and defense-focused VC actors.

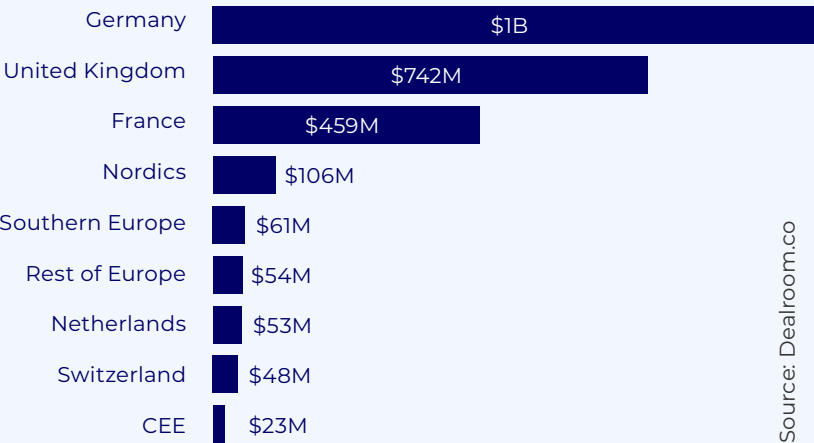
Despite growth, investment patterns in deep tech reveal substantial fragmentation across domains and geographies. Europe’s share of VC funding across deep tech domains is particularly strong in several areas of quantum technologies—particularly quantum cryptography where it is competitive with the U.S. and China (Figure 1). Nationally, Germany, France, and the United Kingdom disproportionately lead in attracting VC funding for deep tech compared to other European countries (Figure 2), with companies like Munich-based Helsing concentrating the largest share of investment (Dealroom.co, n.d.)

Figure 1. Share of VC funding in key deep tech areas (2021-23).



Source: Dealroom.co

Figure 2. Top European countries for VC investment in defense/defense application since 2018.



Source: Dealroom.co

Importantly, a closer examination of investment trends suggests that Europe’s strategic focus in deep tech is still primarily civilian: from 2016 to 2023, deep tech in Health and TechBio (\$20.6B), SaaS and AI (\$17.5B), and transportation (\$14.2B) far outpaced defense and cybersecurity (\$4.3B) (Dealroom.co, n.d.)

Furthermore, it is important to note that, despite the growth in investment in recent years, public instruments such as the European innovation Council (EIC), research grants, and national innovation funds are disproportionately focused on early-stage funding, leaving a vacuum at later stages where larger capital injections are essential for scale and commercialization (European Patent Office, 2025). Consequently, late-stage funding is often filled by non-European investors, with U.S. investors providing 66% of the funding for European defense tech startups. Companies such as Auterion illustrate this dynamic: founded at ETH Zurich, the drone tech firm ultimately relocated its headquarters to Arlington, Virginia.

In fact, in 2024, the U.S. accounted for 83% of total VC investment in defense tech startups within the Alliance, while the European Union and the United Kingdom

combined represented just 14.5% (Dealroom.co, 2024; McKinsey & Company, 2025). This imbalance is particularly troubling at a time when the reliability of the U.S. security umbrella can no longer be taken for granted.

This analysis reveals both growing momentum and persistent capability gaps within Europe’s deep tech defense landscape. Despite major institutional strides and increased funding, a fragmented investment environment, uneven sectoral focus, and continued overreliance on external investors expose vulnerabilities that threaten the long-term sustainability and strategic sovereignty of the ecosystem.

However, important limitations persist, underscoring several structural challenges that Europe must resolve to develop a resilient and autonomous deep-tech defense innovation ecosystem.

The next section examines these limitations in greater depth, identifying key structural challenges that must be addressed to build a truly robust and autonomous deep tech defense innovation ecosystem in Europe.



The background is a deep blue with a grid of white lines that recede into the distance, creating a sense of depth. In the center, a transparent sphere is composed of a complex web of white lines. A bright yellow-orange light source is positioned at the center of this sphere, casting a glow. Several other smaller, out-of-focus light sources in shades of blue and orange are scattered throughout the scene, adding to the futuristic and technological atmosphere.

**STRUCTURAL
CHALLENGES IN
DEFENSE DEEP TECH:**
FROM LAB TO REAL
WORLD USE

STRUCTURAL CHALLENGES IN DEFENSE DEEP TECH: FROM LAB TO REAL WORLD USE

Despite the emergence of promising initiatives and a sharp rise in investment, Europe's deep tech defense ecosystem remains constrained by a series of structural challenges. While many of these issues are common to deep tech industries more broadly, they are amplified in the defense sector. The challenges span from macro-level—the lack of a clear of deep tech strategy—to the micro—the need to strengthen public-private collaboration. Taken together, these obstacles threaten to undermine the momentum generated by recent policy and investment efforts.

CHALLENGE #1

The absence of a clear and coherent deep-tech strategy

Despite growing political attention and emerging initiatives, Europe still lacks a coherent and long-term deep-tech strategy aligned with its sovereignty ambitions—in sharp contrast to the U.S., China and India (see Box 1). This absence results in fragmented procurement, inconsistent prioritization, and limited alignment between national governments, EU institutions, and the private sector—especially in defense.

Without clear signals on strategic priorities, roadmaps for procurement and guaranteed funding commitments, Europe's deep tech ecosystem is struggling to gain traction. The European defense industry—still largely operating on a “built-to-order” model—and venture capitalists alike operate in uncertainty, unable to rely on stable demand and anticipate returns, undermining confidence and disincentivizing private investment in the sector (McKinsey & Company, 2025; Bressa et al., 2024).

BOX 1.

DEEP TECH 4 DEFENSE STRATEGIES BY GLOBAL POWERS

In contrast to Europe's lack of a robust and coherent strategy for developing a deep tech innovation ecosystem for defense, other global powers are advancing rapidly with a clear strategy and goal in mind.

The **U.S.** has prioritized maintaining its technological edge over China, emphasizing emerging technologies through the 2025 National Defense Authorization Act and reinforcing public-private collaboration via entities like the Pentagon's Office of Strategic Capital, the Defense Innovation Unit (DIU), and DARPA (McDonald, 2024; Rodrigues, 2024; Gill, 2023; Swayne, 2025; Hafied, 2024).

China, meanwhile, has made deep tech central to its 14th Five-Year Plan, integrating military and civilian innovation through its Military-Civil Fusion (MCF) strategy (Ye & Wen, 2024; Allen, 2023; Gallardo, 2024).

India is also making significant strides, growing its deep tech ecosystem by 53% in the last decade under its Atmanirbhar Bharat strategy, with defense-focused initiatives like iDEX and the Technology Development Fund. These efforts underscore the growing strategic importance of deep tech globally, something Europe has yet to fully embrace (Dayal, 2023; Press Information Bureau, 2024; Sengupta, 2024; K, 2024).

CHALLENGE #2

A defense-wary culture

Europe's post-war anti-militarist sentiment, its historical reliance on the U.S. security umbrella, and a political culture that has long favored soft power and social investment over military capability have created a constrained environment for defense innovation. This defense-wariness culture extends into the private sector and venture capital: many limited partners, such as pension funds, prohibit investments in lethal or purely military technologies, while start-up entrepreneurs often view defense-related ventures as ethically problematic, further hindering company formation in the sector (Lakestar et al., 2025).

CHALLENGE #3

A risk-averse mindset

Europe is home to 40% of the world's top research institutes (Lakestar et al., 2025), but a deep-rooted aversion to risk and failure continues to limit its ability to translate ideas into impact. Unlike the U.S., where failure is often seen as a stepping stone to innovation, Europe's cultural, legal, and financial frameworks tend to discourage entrepreneurial risk. Strict bankruptcy laws and limited second-chance opportunities discourage founders, while investors remain wary of backing the capital-intensive later stages of deep tech development needed to scale products whose technical and commercial viability is often seen as uncertain (Christanell, 2025; iED Team, 2016; Schneider, 2024).

These challenges are magnified in the defense sector, where decisions carry life-and-death consequences, significant geopolitical stakes, and substantial financial implications. 66% of ministry of defense officials surveyed by BCG report that they do not have an innovative culture that encourages risk taking and does not punish failure (Bressa et al., 2024). A focus on certainty and exhaustive risk assessment slows adoption of novel technologies and reduces the responsiveness needed for modern defense challenges.

CHALLENGE #4

Regulatory hurdles and market fragmentation

Europe's regulatory landscape remains fragmented and administratively burdensome for deep tech start-ups. National and EU-level funding schemes often operate under different rules, timelines, and reporting standards, requiring founders to navigate overlapping criteria and submit excessive documentation—sometimes dozens of reports for a single grant. While support from programs like the EIC is vital, the complexity of access can deter participation, especially among early-stage entrepreneurs with limited resources (Bobier et al., 2022; Christanell, 2025; Letta, 2024; McKinsey & Company, 2025).

These issues are particularly acute for start-ups working on defense-related technologies, due to the lack of a clear and unified strategy mentioned above. As a result, many founders choose to relocate to less restrictive environments such as the U.S. or rely on private foreign capital, discouraging local growth and undermining Europe's ambitions for strategic autonomy.

CHALLENGE #5

Insufficient public-private cooperation in procurement

Europe's defense procurement processes are too slow and rigid to keep pace with the speed of deep tech innovation. Lengthy budget cycles, complex performance requirements, and integration hurdles create multi-year lags between identifying a capability gap and deploying a solution in the battlefield (McKinsey & Company, 2025; Bressa et al., 2024).

This structural mismatch deters private investment and weakens the trust needed for sustained collaboration between governments and start-ups. Without more agile procurement mechanisms and stronger public-private alignment, Europe risks falling behind in deploying next-generation defense technologies—regardless of its scientific or engineering talent (McKinsey & Company, 2025).

The next section advances a set of policy recommendations to overcome such challenges.

The background of the entire image is a close-up, high-angle shot of a glowing electronic circuit board. The board is covered in a dense network of fine, winding lines that appear to be made of a translucent, glowing material in shades of blue and purple. Some of these lines are thicker and more prominent, creating a sense of depth and complexity. In the lower right quadrant, a large, square, three-dimensional component, possibly a microchip or a specialized processor, is visible. It has a grid-like pattern on its top surface and is also illuminated with the same blue and purple glow. The overall effect is one of high-tech, futuristic, and sophisticated technology.

FINDING SOLUTIONS:
BUILDING A STRONG
DEFENSE DEEP TECH
INNOVATION CHAIN

FINDING SOLUTIONS: BUILDING A STRONG DEFENSE DEEP TECH INNOVATION CHAIN

Overcoming Europe's structural weaknesses in defense deep tech requires more than incremental fixes—it demands a coordinated strategy that bridges geopolitical ambition with operational capability. Europe must focus on strengthening the innovation chain end to end—from ideation and prototyping to scaling and deployment—through targeted interventions that close structural gaps and catalyze sustained public-private cooperation.

This section proposes three priority actions to reinforce Europe's defense deep tech ecosystem:

RECOMMENDATION #1

Develop a Cohesive Tech Diplomacy Strategy

The first stepping stone to building a robust deep tech innovation ecosystem for European defense is the development of a cohesive EU tech diplomacy strategy (Box 2). The bloc needs to develop a coordinated, long-term plan of action that aligns diplomatic, regulatory, economic, and industrial tools across EU institutions, Member States, and different ministries to shape global norms, build strategic partnerships with like-minded states, and ensure Europe's values and interests are embedded in the development and governance of deep tech—especially those with dual-use or defense applications.

This requires acknowledging that today, the level of technological development of a country or region greatly influences its degree of geopolitical influence, economic security, and ability to defend itself against foreign threats. The EU and its Member States have already recognized these critical links, as reflected in the 2022 European Council conclusions on digital diplomacy or the recently released European Competitiveness Compass (European Commission, 2025; Council of the European Union, 2022). What is now needed is concrete implementation—by increasing alignment between its digital, industrial, foreign, and defense policies; improving horizontal coordination between different Directorates-General (such as DG CONNECT, DG TRADE, and DG DEFIS); and strengthening vertical collaboration with national authorities and European agencies such as the EIC and the EDF (Center for the Governance of Change, 2025).

Additionally, to ensure strategic coherence and credibility, the EU must strengthen its internal capacity for foresight, diplomatic engagement, and strategic communications—clearly articulating the link between defense technologies, societal progress, and the protection of liberal democracies. This will enable it to identify which tech-related areas (e.g. AI, quantum, cybersecurity) and regions (e.g. Latin-America, Indo-Pacific) are strategic priorities for its tech diplomacy strategy, while sending clear signals to align actions across the defense innovation ecosystem. Consensus around shared objectives will anchor the strategy and reinforce adherence (Blázquez-Navarro et al., 2025). Embedding the strategy's goals and principles into international partnerships, alliances, and multilateral fora is equally vital (Center for the Governance of Change, 2025).

RECOMMENDATION #2

Enhance Regulatory Harmonization and Simplification

Governments must adopt strategies that remove barriers to scaling deep tech solutions across Europe while providing long-term regulatory clarity. The first step is to develop a harmonized and simplified approach to dual-use compliance and defense funding mechanisms across NATO, the EU and its Member States. It is essential to ensure coherence across support programs so that their application criteria, timelines, and reporting requirements do not contradict nor duplicate one another. A centralized European defense innovation portal could also help start-ups by simplifying access to funding, offering clear guidance on eligibility, and streamlining compliance processes. Simplification, however, should go beyond reducing paperwork. It should reassert the core principles behind regulation and the purpose of compliance, which are key to enabling

innovation, de-risking investment, and driving long-term growth (Blázquez-Navarro et al., 2025). Within the defense sector, in particular, shifting from rigid specifications toward broader mission-oriented requirements would empower industry actors to propose innovative, fit-for-purpose solutions.

This approach demands a shift in how public institutions operate—embracing more agility and tolerance for uncertainty. Defense ministries, policymakers, and public funding bodies should learn to function within the “fog of war” and become comfortable making bold, high-stakes decisions without exhaustive certainty. It is necessary to shift the mindset from a culture that fears failure to one that values learning. Incentivizing experimentation, tolerating setbacks, and framing mistakes as opportunities for insight and breakthroughs will be essential to foster a truly innovation-friendly regulatory environment (Schneider, 2024; Bettermann, 2021; Bressa et al., 2024).

BOX 2. TECH DIPLOMACY STRATEGY

A whole-of-state foreign policy that treats technology as a core arena of statecraft—not a mere tool. Its purpose is to shape global rules, standards, and markets so innovation advances security, prosperity, and human rights; reduces strategic dependencies; and aligns foreign, industrial, and defense policy with trusted partnerships.

Governments must adopt strategies that remove barriers to scaling deep tech solutions across Europe while providing long-term regulatory clarity.

RECOMMENDATION #3

Establish a New Public-Private Framework for Deep Tech Investment and Procurement

With a cohesive strategy and a simplified regulatory environment in place, the next priority is to catalyze sustained investment and procurement through stronger public-private cooperation. As highlighted in the Draghi (2024) and Letta (2024) reports, revitalizing European industry—especially in critical technologies—requires moving beyond a purely market-driven approach. This means leveraging targeted public support to crowd in private capital, with coordinated action at the EU level to avoid fragmenting the single market (Zettelmeyer, 2025; Draghi, 2024; Letta, 2024).

Creating European investment vehicles dedicated to deep tech R&D and relaxing EU state aid rules for strategic technologies would allow for larger subsidies, tax incentives or blended finance models to support later-stage innovation. These instruments can help bridge the scale-up gap and encourage institutional investors to allocate capital to ventures they might otherwise view as too risky (McKinsey & Company, 2025; Dugo et al., 2025).

However, funding alone is not sufficient—a strong innovation ecosystem also requires a functioning market. The concept of a Common Market for Defense and Security must evolve into a coordinated demand engine for dual-use innovation (Letta, 2024). Joint capability commitments by EU governments could create the scale and predictability startups need to innovate with confidence. Transforming public procurement into a more agile and strategic instrument—using tools such as dynamic purchasing systems or milestone-based contracts—would also better align government needs with the realities of private-sector innovation cycles (Quattrucci, 2025).

Taken together, these three measures would help Europe move from fragmented initiatives toward an integrated innovation ecosystem capable of translating scientific excellence into defense capability and industrial strength. By coupling strategic foresight with institutional agility and entrepreneurial dynamism, Europe can transform its current vulnerabilities into competitive advantages—anchoring its security and prosperity in technological resilience.

As techno-power reshapes global competition, strategic risks increasingly originate from technology itself, making innovation the key battleground of this century. Deep tech is the arena where Europe's strategic future will be determined. These technologies are inherently transformative: they create industries, reshape value chains, and drive systemic change across scientific and industrial domains. Their importance lies not in short-term financial metrics but in their long-term capacity to secure Europe's competitiveness, resilience, and sovereignty—and, underpinning all of these, its security and defense.

Recognizing this, Europe must move from fragmented initiatives to a coherent strategy that accelerates deep tech development and adoption. This requires integrated innovation ecosystems that align research, entrepreneurship, industry, capital and investment. Only by doing so can Europe position itself as a shaper—rather than a taker—of the geopolitical and technological order that lies ahead.

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