Strength through innovation

A vision for a new innovation ecosystem
for European defense

**Roland
Berger**

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Europe's security environment has become more complex in recent years. Military risks in Europe's vicinity have increased, while geopolitical shifts have led to greater uncertainty in alliance structures and security responsibilities. This has triggered a broader debate about Europe's long-term security arrangements and the future role of NATO.

At the same time, warfare is changing. Alongside evolving hybrid war strategies, a new warfare paradigm born on the battlefields of Ukraine and the Middle East is taking shape, characterized by rapid innovation, smart affordable mass solutions and software-based tools. Europe's defense stakeholders, still geared toward conventional defense strategies, must adjust and adapt to this new environment to ensure the continent becomes – and remains – a deterrent.

In this second major annual defense study, we present a way forward, with innovation at its core. We find that the existing European defense innovation ecosystem is fragmented, sluggish, risk-averse and underinvested. This hinders the rapid scaling of new technologies and suffocates agile startups. Significant improvements in collaboration are required.

We assess two proven defense innovation models – Israel and Ukraine – to derive lessons for Europe. The Israeli experience highlights the benefits of inside-out innovation, driven by a tight-knit academia, military and industry. Ukraine demonstrates the power of outside-in innovation, rapidly adapting existing civil industries to counter threats.

Next, we present our vision for a new European defense innovation ecosystem. It is built around three pillars: an agile regulatory and procurement framework; enhanced collaboration between armed forces, industry, startups and research; and strategically aligned financing.

Lastly, we provide recommendations for individual stakeholder groups to achieve the vision. These include strategies to improve integration, for example, through supra-national innovation hubs; better define operational needs, including by using test units in the armed forces; accelerate procurement, for instance, through spiral development pipelines; and close financing gaps, such as those in AI research. Implemented together, these will allow Europe to out-innovate its adversaries and become a deterrent in an increasingly unstable world.

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Warfare is changing

Europe's defense innovation ecosystem
must change with it

A t the beginning of 2025, Roland Berger published "The defense imperative: Driving innovation and resilience on Europe's path to strategic autonomy". It defined a "deterrence threshold" – the industrial output needed to discourage potential aggressors – that is essential for the future security of Europe.

This study, "A vision for a new innovation ecosystem for European defense", builds on that foundation, serving as the chronological next chapter and the logical continuation of the previous analysis. The main assumption and premise are clear: with hybrid warfare already taking place between Europe and authoritarian powers – and amid increasing uncertainty about the durability of NATO as Europe's ultimate security guarantee or even its potential breakdown – becoming a deterrent (by building up deterrence scenarios and capabilities) is one thing; remaining a deterrent is quite another.

While innovations in defense are just one aspect of becoming a deterrent, the permanent and continuous ability to innovate and stay ahead of adversaries is the decisive factor in remaining a deterrent. Only a strong and responsive European defense innovation ecosystem can achieve the overarching goal: to ensure Europe remains a deterrent. This ecosystem involves all key stakeholders, including the armed forces (on both a national and supranational level), the traditional defense "primes", emerging startups in the sector, civilian players and research institutions. ▶ **A**

A Stakeholders in Europe's defense innovation ecosystem

Armed forces
define operational needs, set priorities and provide user feedback from training and operations. As end users, they anchor innovation in real-world requirements and drive mission relevance.

Defense primes
develop and integrate complex systems, ensure certification and security, and scale production. They act as system integrators and industrial anchors for large platforms and architectures.

Startups
deliver speed, software-centric innovation and cost-effective solutions, often in niche or emerging technology areas. They are key drivers of experimentation and rapid iteration.

Public procurement agencies
translate military requirements into contracts, manage risk and ensure compliance with legal and budgetary frameworks. Their processes critically shape speed, accessibility and scalability of innovation.

Research institutions
provide foundational research, applied science and early-stage technological breakthroughs. They form the knowledge base for long-term capability development and dual-use innovation.

Civil industry
contributes advanced technologies, manufacturing capacity and scaling experience from non-defense sectors. It plays a critical role in dual-use innovation and rapid industrial mobilization.

Others (e.g., financial services, consulting, enabling organizations[1])
enable financing, strategic planning and ecosystem coordination. They provide capital, expertise and structuring capabilities that support scaling and long-term sustainability.

1 For example, industry associations

A NEW WARFARE PARADIGM

From the end of the Cold War until Russia's attack on Ukraine in February 2022, players in the defense sector – especially in Western Europe – lived and acted in the belief that wars in Europe were a thing of the past. This conviction had a profound impact on how innovation in the defense sector was conceived.

New products and capabilities had to be safe, sophisticated and, ideally, technically perfect. Engineers carried out research and development (R&D) in cycles spanning decades, reflecting the long-term planning horizons and procurement cycles of armed forces. The length and duration of innovation cycles mattered less than process adherence and the fulfillment of high-end military requirements.

But what we see today – especially on the battlefields of Ukraine and the Middle East – is a new "warfare paradigm". A product of the current geopolitical situation, this new normal is based on three paradigm changes in innovation: capability innovation realized almost in real-time; smart, affordable mass solutions (mass-producible, software-defined, autonomous) forcing changes in tactics; and more

and more software-based defense solutions that accelerate innovation cycles to unprecedented levels.

Players in the defense sector are trying to get to grips with the new warfare paradigm. But as yet, no consistent way forward has been charted. The goal of this study is to present a concept for it.

We proceed in four steps. In chapter two, we outline the status quo of the European defense innovation ecosystem. In chapter three, we examine two exemplary use cases – Ukraine and Israel – that highlight how defense innovation can function at speed, asking what lessons Europe can draw from their experiences. In chapter four, we develop and describe a vision for a future European defense innovation ecosystem. And lastly, in chapter five, we derive specific recommendations for each stakeholder group to fulfill this vision.

The study is based on findings from a series of in-depth interviews with experts across the military, traditional defense industry, startups, industry associations and research institutions. These insights were then aligned with our client projects and with the independent research of the Roland Berger Institute.

Matthias Wachter
Co-Director Innovation,
Security and Technology, BDI

●● "Breakthrough innovation increasingly emerges from the commercial sector. We need new processes to integrate civilian industry into the defense ecosystem."

Sven Weizenegger
Director, Cyber Innovation
Hub of the Bundeswehr

●● "In reality, technology does not only just change individual capabilities; it fundamentally shapes the operational concepts and doctrines by which we fight."

Olha Sytnychenko
Chief Operating Officer,
Axendra

●● "If you accept a bit more risk, you might get better results, larger returns and more strategic benefits later, including in defense tech."

Dr. Gundbert Scherf
Co-Founder and Co-CEO,
Helsing

●● "The new normal in defense has two heart chambers: traditional major weapon systems with long cycles, and autonomous, highly networked precision systems at scale."

Eric Autellet
Major général des armées (2021–2023), Senior Advisor, Roland Berger

●● "Innovation does not replace legacy, it amplifies it. Europe's edge will be secured through fractal integration, aligning old and new capabilities at multiple scales, rather than forcing a single, top-down architecture."

Dr. Linus Terhorst
Research Analyst, Royal United
Services Institute

●● "Defense innovation also creates prosperity effects: It revitalizes regions through infrastructure, jobs and skills – well beyond the defense sector itself."

Christoph Siegelin
Vice President,
Thales Digital Factory

●● "For defense innovation in Europe, this guiding principle is more relevant than ever: Alone we move faster, together we go further."

Thomas Gottschild
Executive Vice President Strategy
& Future Growth, MBDA

●● "Innovation is the backbone of our long-term superiority."

Europe's defense innovation ecosystem

A work in progress

KEY MESSAGE

Europe's defense innovation ecosystem is fragmented, with limited coordination between stakeholders both domestically and internationally. It also suffers from slow, risk-averse procurement and underinvestment. These structural constraints hinder rapid adaptation and scaling of promising technologies, as well as the integration of startups alongside traditional primes. While successful collaborative projects highlight the potential of joint European efforts, significant reform is needed for Europe to become – and remain – an effective deterrent.

R ecent wars – most notably in Ukraine and the Middle East – have fundamentally reshaped how modern warfare is conducted. Beyond manpower and platforms, the decisive factor has become the speed at which technologies can be developed, adapted and deployed. Software-defined capabilities, autonomous systems, electronic warfare (EW) and data-driven targeting now evolve in weeks or months rather than years, while mass and affordability have regained strategic importance.

These developments have sharpened the urgency for reform in Europe. The continent's existing armed forces and industrial base were largely shaped by decades of relative stability, long planning horizons and procurement systems optimized for bespoke, high-end platforms. While these structures have delivered world-class capabilities, they are less suited to an era characterized by rapid iteration, continuous adaptation and the need to quickly scale production. As a result, Europe risks falling behind in those domains where innovation matters most. Addressing this challenge does not mean reinventing the wheel; rather, it means adapting existing strengths and structures.

EUROPE'S STRENGTHS AND WEAKNESSES

Europe's defense innovation ecosystem is today characterized by a complex mix of strengths and structural bottlenecks.

1 European Defense Industrial Policy 2022
2 Clingendael: Developing European defense capabilities

Collaboration

On the one hand, the continent possesses world-class research institutions, advanced manufacturing capabilities and niche technological expertise in areas from cyber defense to precision engineering. European nations excel in fostering collaborative industrial consortia for high-tech defense projects, particularly in aerospace and missile systems, where shared expertise has delivered advanced capabilities at lower costs. Even so, there is room for improvement in pan-European collaboration. As outlined in the European Union's Defense Industrial Strategy, deeper collaboration has the potential to generate annual cost savings of EUR 24.5-75.5 billion.[1] Programs such as the European Defense Fund have already begun to create mechanisms for cross-border collaboration, encouraging joint projects between member states and stimulating a more integrated innovation environment. These initiatives demonstrate that, when structured intentionally, Europe can achieve both technological excellence and operational impact. On the other hand, the translation of these strengths into operationally relevant, rapidly deployable capabilities remains uneven, partly due to institutional fragmentation and entrenched procurement processes. One of the most significant bottlenecks is the persistent siloing of European defense stakeholders. Unlike in Israel or the United States, where military, industry and academia maintain close, fluid relationships, European defense ecosystems are characterized by silos both between nations and within domestic systems. These limit systematic

cooperation, knowledge exchange and joint problem solving across the innovation lifecycle.

Talent

Siloing has also affected talent. Highly skilled engineers, software developers and data scientists frequently migrated to civilian sectors or international tech companies because defense projects were slow moving and bureaucratic, and rarely provided the high-tempo, high-impact environment that attracts top talent. This resulted in a persistent brain drain from defense innovation, particularly in cutting-edge areas such as AI and cybersecurity. Since Russia's invasion of Ukraine, the dynamic has begun to shift somewhat, with a renewed political focus, higher defense spending and more mission-driven projects making the sector more attractive.

Feedback cycles

Feedback loops for innovative products are often underdeveloped. Many European defense projects follow a linear path: R&D → testing → procurement → deployment.[2] Iterative, rapid feedback cycles that enable startups and small enterprises to experiment, fail fast and improve are rare. Without such mechanisms, Europe risks prolonged development cycles that can result in obsolete solutions by the time they reach operational use.
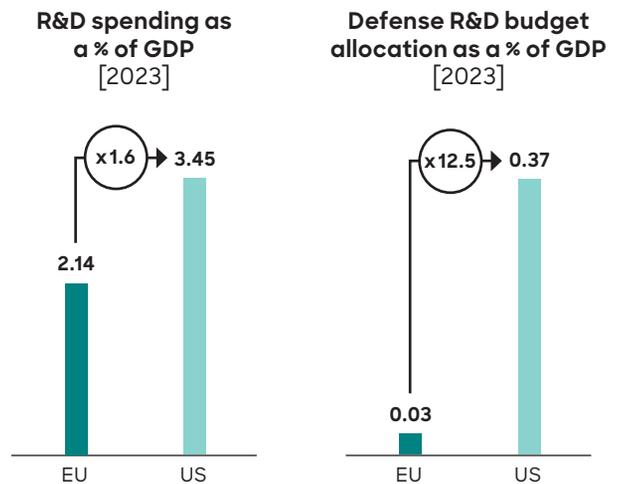
Procurement

Procurement processes and bureaucratic complexity remain a significant hurdle to market entry in Europe, although their impact varies markedly by country. Defense tenders are often complex, regulatory requirements stringent and approval cycles lengthy, favoring established incumbents that have more experience of national procurement systems. However, openness to new entrants varies. The United Kingdom has demonstrated comparatively higher receptiveness to non-traditional and emerging players, while France occupies an intermediate

position, combining strong state steering with selective mechanisms to integrate innovation. Germany, despite hosting one of Europe's most dynamic defense technology ecosystems, remains more conservative in procurement execution, resulting in longer adoption cycles for new capabilities.

R&D

Coupled with historically limited defense spending, especially before Russia's 2022 invasion of Ukraine, the result has been a chronic underinvestment in both R&D and operational experimentation in Europe. Even when funds are allocated, fragmentation across countries and programs reduces the potential for scale and the strategic alignment of investments. ▶ B

B Civil and defense R&D spending in EU and US

R&D spending as a % of GDP [2023]

EU: 2.14 →(x1.6)→ US: 3.45

Defense R&D budget allocation as a % of GDP [2023]

EU: 0.03 →(x12.5)→ US: 0.37
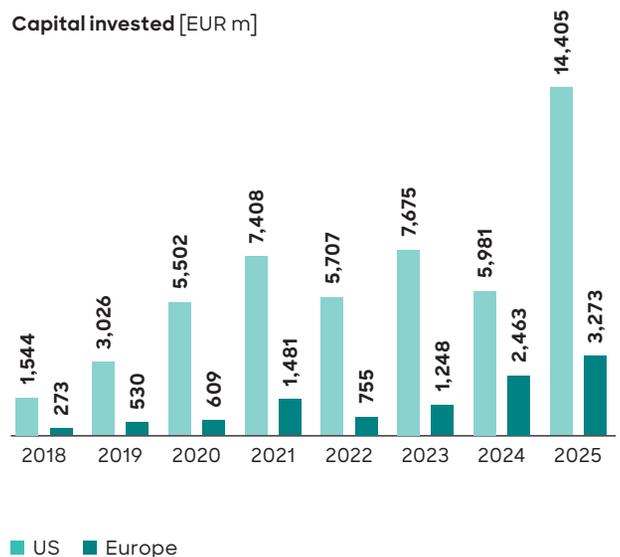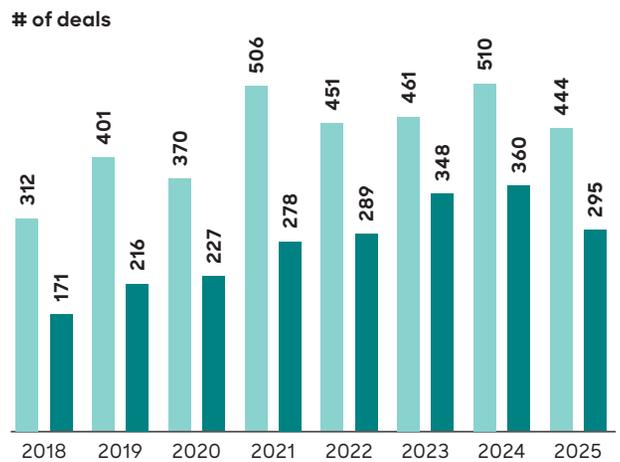
Source: OECD, Roland Berger

This structural financing gap is reinforced by the current private financing landscape for innovative startups. While Europe does not necessarily lag dramatically behind the United States in the number of defense venture capital (VC) deals, the amount of capital invested is significantly lower. As a result, many European defense startups are undercapitalized, limiting their ability to survive the scale-up phase and reinforcing the structural funding gap that prevents promising technologies from reaching operational relevance. ▶ C

This underinvestment is compounded by a repeated inability to meet even internally defined targets. While the European Defense Agency's (EDA) Ministerial Steering Board has set ambitious goals – such as dedicating 20 % of total defense spending to equipment procurement, 35 % of equipment spending to collaborative European projects, 2 % of total defense budgets to research and technology (R&T), and 20 % of R&T spending to collaborative European R&T – Europe frequently falls short of achieving them. Recently, only the first target has been achieved, while collaborative procurement and R&T targets remain largely unmet. ▶ D

Together, these gaps underscore how structural, bureaucratic and political constraints prevent Europe from translating strategic ambitions into concrete outcomes, further slowing the development of a truly agile and integrated defense innovation ecosystem.

By studying how other countries institutionalize speed, scale and risk taking in defense innovation, Europe can shorten its own learning curve and avoid repeating costly mistakes. As such, in the next chapter we look in detail at the defense innovation ecosystems of Ukraine and Israel, two highly successful defense ecosystems that offer many important insights. The lessons learned are then transferred into a European context.

C Defense venture capital activity in Europe and the US

# of deals

Year	US	Europe
2018	312	171
2019	401	216
2020	370	227
2021	506	278
2022	451	289
2023	461	348
2024	510	360
2025	444	295

Capital invested [EUR m]

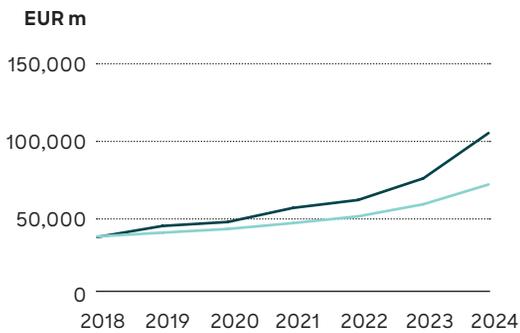| Year	US	Europe
2018	1,544	273
2019	3,026	530
2020	5,502	609
2021	7,408	1,481
2022	5,707	755
2023	7,675	1,248
2024	5,981	2,463
2025	14,405	3,273

■ US ■ Europe

Source: PitchBook, Roland Berger

D Collective defense investment benchmarks set by Ministerial Steering Board of EDA
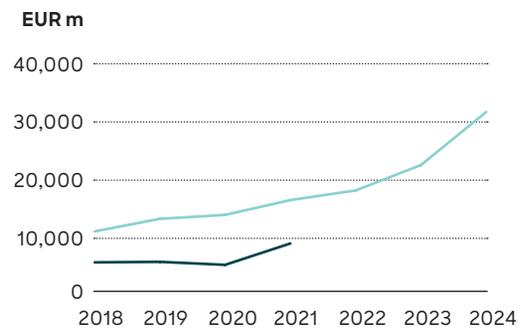
Target 1:
20 % of total defense spending on equipment procurement (including R&D/R&T)
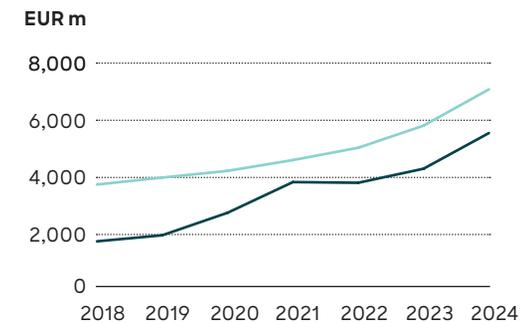
EUR m

Target 2:
35 % of total equipment spending on European collaborative equipment procurement
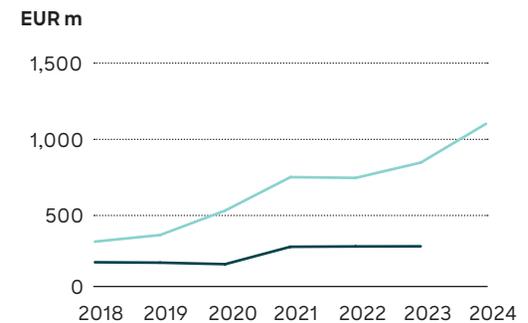
EUR m

Target 3:
2 % of total defense spending on defense R&T

EUR m

Target 4:
20 % of total defense R&T spending on European collaborative defense R&T

EUR m

■ Actual ■ Target

Source: EDA, European Commission, Roland Berger

Stefan Hess
Head of Group Sales and Account
Management, Hensoldt

●● "European defense still operates
sometimes according to a craft-based
logic; not enough reliable volumes, no
clear priorities, scaling is missing often."

Dr. Johanna Möhring
Political Scientist and Chercheuse
associée, CIENS and ENS, Paris

●● "Europe has no shortage of
innovations or creative startups;
what is missing is diffusion and
scaling into the armed forces."

Eric Autellet
Major général des armées (2021–
2023), Senior Advisor, Roland Berger

●● "Despite numerous initiatives,
defense innovation in Europe is still
treated as an experimental activity
rather than a strategic capability to be
scaled, sustained and industrialized."

Clément Galic
CEO and Co-Founder,
Unseenlabs

●● "Europe supports defense innovation, and
there's a clear opportunity to strengthen its
impact by prioritizing scale – building on
successful pilots with sustained continuity and
tighter alignment between legacy systems and
new players."

Line Rindvig
CEO,
Defence Builder Kyiv Ukraine

●● "Europe's new normal in defense
innovation has to be speed and scale:
prototypes to deployment in weeks,
not years."

Florian Hohenwarter
CEO,
KNDS Deutschland

●● "Automation matters: fewer crews,
more autonomy – first and foremost to
protect human lives."

François Lombard
Head of Connected Intelligence,
Airbus Defence and Space

●● "Our markets are too scattered and
small; without a European marketplace
for sensitive defense technologies,
innovation cannot scale."

Prof. Dr. Rafaela Kraus
University of the
Bundeswehr Munich

●● "Mass and rapid iteration
outperforms high-end systems
alone; our planning processes are
not yet designed for this reality."

Defense innovation models

What Europe can learn from
Israel and Ukraine

3.1/ Israel

A model for using defense as an innovation engine

KEY MESSAGE

Europe can draw valuable lessons from proven models of defense innovation. Israel demonstrates the power of inside-out innovation, leveraging close integration between military, industry and academia to drive continuous capability development. In contrast, Ukraine exemplifies outside-in innovation, rapidly adapting commercial and off-the-shelf technologies under extreme operational pressure to counter emerging threats. Together, these models highlight how agility, experimentation and collaboration are essential for effective defense innovation.

The rapidly evolving conflicts and the defense innovation environments in Ukraine and Israel show that modern defense innovation relies on agility, experimentation and organizational design as much as resources or legacy capabilities. The countries demonstrate how urgency, simplified processes and tight integration between defense stakeholders can generate rapid, scalable battlefield breakthroughs. While the countries of the established European liberal order are not engaged in a conventional conflict like Ukraine or Israel, many experts interviewed for this study described Europe as already being exposed to elements of hybrid warfare. Although the intensity and immediacy of the threat are not comparable, Europe is increasingly confronted with actions that test its willingness and ability to defend its values, political system and, ultimately, its security. The experiences of the Ukrainian and Israeli defense sectors therefore provide valuable insights for European stakeholders.

Since its founding, Israel has existed in a permanently hostile security environment. This pressure has forged a unique defense innovation ecosystem: compact, improvisational, deeply integrated and relentlessly mission-driven. Unlike larger nations that can rely on scale or political pressure, Israel's survival has always depended on technological superiority, rapid adaptation and the ability to turn ideas into battlefield-ready capabilities within extremely short cycles. It is a structural reality that has shaped not only its military, but its entire innovation culture.

KEY STRENGTHS OF ISRAEL'S DEFENSE INNOVATION ECOSYSTEM

Israel's success in defense innovation has been built around several key pillars that reflect an inside-out innovation model.
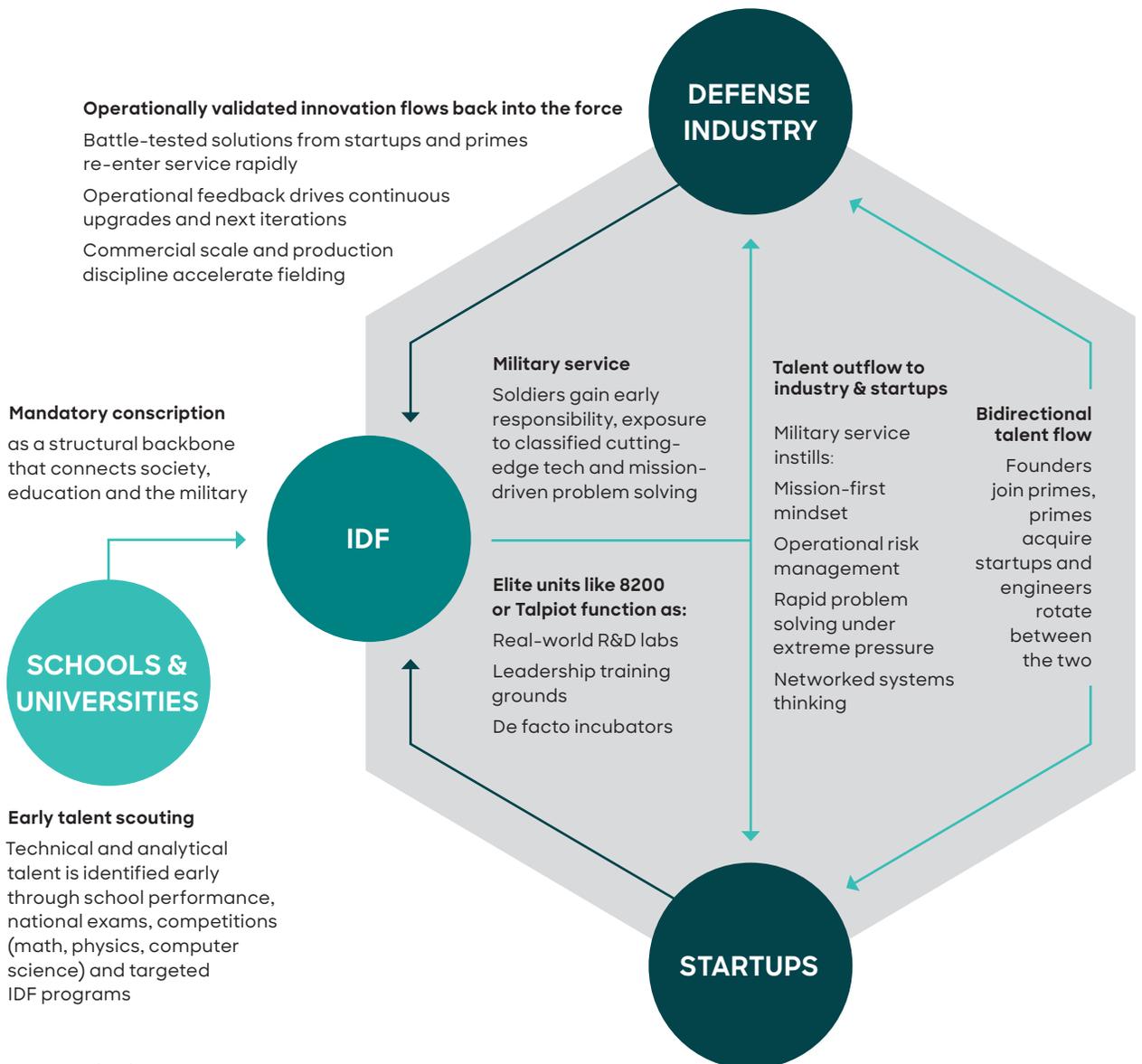
A tight-knit military–industrial complex

Israel's defense innovation system is built on unusually strong integration between the armed forces, universities, defense companies and venture capital. ▶ **E**

The Israel Defense Forces (IDF) function as a national innovation pipeline: Mandatory service after school or university ensures a constant inflow of young technical talent who are exposed early to real-world security challenges. Working in small, interdisciplinary teams, soldiers often prototype solutions, test them in operational conditions and refine them in tight feedback loops. Meanwhile, veterans leave the military with operational experience, a mission-driven mindset, technical skills and fertile professional networks. These are assets they can translate directly into startups and private industry, making veterans the backbone of Israel's thriving deep-tech and cybersecurity sectors.

Meanwhile, the tight link between academia, the IDF and the private sector allows ideas to move quickly from

E Talent and innovation flow between Israeli academia, military and industry

DEFENSE INDUSTRY

IDF

SCHOOLS & UNIVERSITIES

STARTUPS

Operationally validated innovation flows back into the force

Battle-tested solutions from startups and primes re-enter service rapidly

Operational feedback drives continuous upgrades and next iterations

Commercial scale and production discipline accelerate fielding

Mandatory conscription

as a structural backbone that connects society, education and the military

Early talent scouting

Technical and analytical talent is identified early through school performance, national exams, competitions (math, physics, computer science) and targeted IDF programs

Military service

Soldiers gain early responsibility, exposure to classified cutting-edge tech and mission-driven problem solving

Elite units like 8200 or Talpiot function as:

Real-world R&D labs

Leadership training grounds

De facto incubators

Talent outflow to industry & startups

Military service instills:

Mission-first mindset

Operational risk management

Rapid problem solving under extreme pressure

Networked systems thinking

Bidirectional talent flow

Founders join primes, primes acquire startups and engineers rotate between the two

Source: Roland Berger

operational need, to prototype, to commercial product. Innovations developed and validated in startups and defense companies are systematically re-introduced into the armed forces through procurement, upgrades and joint testing. This feedback loop ensures that operational experience informs development, while commercial solutions are delivered to the military as field-ready capabilities. The IDF is therefore both the starting point and a beneficiary of the defense innovation cycle.

In addition, universities and defense companies frequently collaborate on applied R&D funded by the Ministry of Defense's Directorate of Defense Research & Development (MAFAT). This allows national defense needs to serve as a springboard for breakthroughs in AI, cybersecurity, sensors and semiconductors, for example. These collaborations – frequently co-funded – bridge the traditionally slow transition from military requirements to deployable systems.

Israel's strong national commitment to research underpins the country's entire military–industrial complex. For decades, it has invested more in R&D relative to GDP than any other advanced economy – 6.3 % in 2023, compared with 3.4 % in the United States and 2.1 % in the European Union. This sustained investment is the key driver of defense innovation.

A strong support structure for iterative development

In practical terms, Israeli innovation is characterized by short, iterative development cycles, small agile teams and continuous operational testing. Prototypes are often deployed on the battlefield early, generating real-time data that directly shapes subsequent iterations. This "build fast, adapt faster" approach stands in contrast to the lengthy specification and certification processes typical in Europe.

Israel's unified command structure is a major enabler of the approach. Unlike in the US or Europe, where land, air and sea forces often compete for funds and priorities, the IDF operates as a single organization. This eliminates inter-service rivalry and creates shared priorities. For example, while pilots in some air forces may be critical of large-scale investments in unmanned systems that could reshape traditional roles, Israel's integrated governance minimizes such cultural resistance. It is therefore easier for innovations such as drones or AI-enabled targeting tools to be scaled rapidly across military branches.

Government policy supports the approach by identifying strategic technology priorities – such as missile defense or AI-based command systems – and aligning policy behind them. The result has been some of the world's most advanced defense technologies, including the Iron Dome and David's Sling missile defense systems, Trophy active protection systems, world-leading unmanned aerial vehicles (UAVs), such as the Heron and Hermes families, and a globally influential cyber and intelligence sector.

A successful export-driven defense sector

Because the domestic market is small, Israel's defense companies must compete globally from day one. But this also has advantages. The country's export-driven model maintains cost discipline, accelerates R&D cycles and reinforces global competitiveness. Revenues from exports are reinvested into R&D, sustaining the innovation loop. Light-touch regulation for dual-use tech supports the model, enabling many cyber, AI and sensor companies to scale globally, largely free of the regulatory burden found, for example, in Europe. This combination has allowed Israel to become the world's seventh-largest arms exporter, despite being only the 26th-largest economy. It accounts for roughly 4 % of global arms exports, while representing just 0.5 % of global GDP. ▶ F

A defense-focused mindset

Cultural and institutional factors amplify Israel's structural strengths. At the core is a national mindset forged under

permanent external threat, in which improvisation, experimentation and controlled risk taking are not cultural preferences but operational necessities. Hierarchies in military R&D environments are relatively flat, decisions are made quickly and failure is treated as an essential part of the learning process rather than something to be punished, encouraging bottom-up innovation.[3] This culture permeates elite military technology units, such as Unit 8200, Talpiot and Mamram, which serve as talent incubators for the broader tech ecosystem.[4]

In addition, movement of talent within the armed forces–academia–industry triangle is fluid, creating shared norms and dense informal networks. More broadly, a strong national narrative around resilience and technological ingenuity – reinforced by success stories such as Iron Dome – ensures wide public support for investment in defense-related R&D. Mandatory national service, meanwhile, is considered part of the national ethos and keeps veterans connected to the military long after active duty.

What Europe can learn from the Israeli experience

In summary, Israel's defense innovation ecosystem is the product of continuous threat exposure, institutional alignment, cultural openness and a deeply interconnected technology network. It combines the speed and creativity of startups with the strategic discipline and operational testing environment of a unified military, helping to drive innovation. The lessons for Europe are clear, with the Israeli case demonstrating the importance of:

- Integrating armed forces more closely with startups and academia
- Shifting procurement from specification-driven processes to outcome-based experimentation
- Using dual-use innovation to strengthen both defense capabilities and commercial competitiveness.
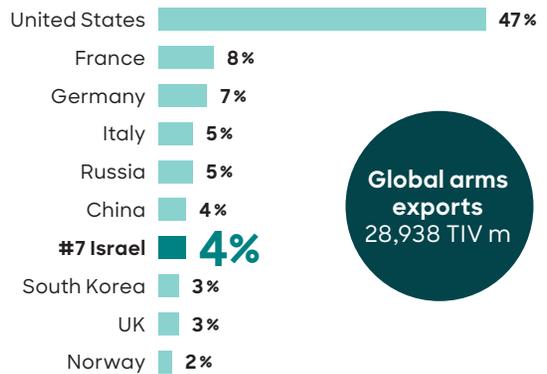
3 Samuel Neaman Institute: Israel's Innovation Ecosystem
4 Suss, Gavin: The Role of IDF and the Israeli Military Industry in the Technological and Economic Development of Israel

F Israel's global ranking as an arms exporter and economy
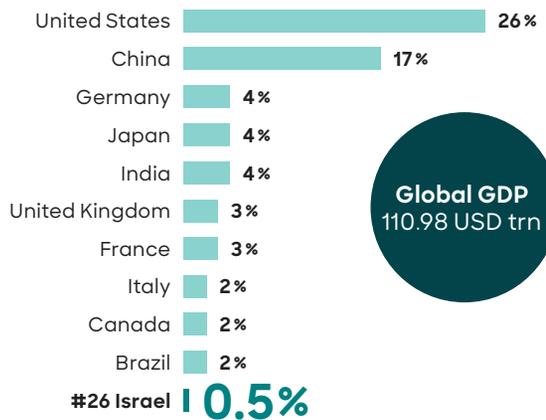
Top arms exporters, 2024
[% of total arms exports measured in TIV[1])]

United States	47%
France	8%
Germany	7%
Italy	5%
Russia	5%
China	4%
#7 Israel	4%
South Korea	3%
UK	3%
Norway	2%

Global arms exports
28,938 TIV m

Largest economies, 2024
[% of global GDP, based on current USD]

United States	26%
China	17%
Germany	4%
Japan	4%
India	4%
United Kingdom	3%
France	3%
Italy	2%
Canada	2%
Brazil	2%
#26 Israel	0.5%

Global GDP
110.98 USD trn

1 TIV refers to "Trend-Indicator Value", a unique unit of measurement used to calculate the volume of international transfers of major conventional weapons

Source: SIPRI, Oxford Economics, Roland Berger

3.2/ Ukraine

Harnessing urgency to drive defense innovation

S ince the full-scale Russian invasion in 2022, Ukraine has found itself in a position of existential urgency. Unlike Israel, whose innovation culture was forged over decades of persistent threat, Ukraine's transformation has been compressed into a period of acute crisis. Facing a technologically advanced adversary with overwhelming advantages in manpower, firepower and resources, Ukraine's survival has depended not on incremental improvement but on the ability to radically accelerate the development cycle from idea to battlefield deployment.

KEY STRENGTHS OF UKRAINE'S DEFENSE INNOVATION ECOSYSTEM

Ukraine's innovation success lies not in one overarching effort but in a combination of transformational shifts, initiative and clever use of tech to build a formidable outside-in innovation model.

A rapid defense transformation

Ukraine's traditional procurement cycles and legacy defense industrial structures, inherited from the Soviet era, have proved inadequate for the speed and unpredictability of modern high-intensity warfare. The Russian military's scale, massive stockpiles and capacity for sustained attrition have instead forced Ukraine to seek asymmetric advantages wherever possible. The result has been a wholesale reimagining of the defense innovation environment, driven by the need to outpace Russian adaptation and to compensate for material shortfalls with ingenuity, speed and societal mobilization.

Ukraine's defense innovation system is now defined by its openness, agility and the blurring of boundaries between military, industry and civil society. The war has catalyzed a shift from a closed, state-centric defense sector to a dynamic, networked ecosystem that draws on the full spectrum of national capabilities. This transformation is visible in two key dimensions:

Stakeholder integration

The involvement of outside players in defense is unprecedented. The Ukrainian government, recognizing the limitations of its traditional defense industry, has actively sought to bring together the armed forces, state-owned and private defense companies, non-defense industrial players, the IT sector and a burgeoning community of startups. This "whole nation" approach is not merely rhetorical; it operationalizes outside-in innovations through new institutional mechanisms designed to break down silos and accelerate collaboration.

Culture of improvisation and rapid iteration

This is deeply embedded in Ukraine's defense innovation system. Engineers, entrepreneurs and soldiers operate in short development cycles, with prototypes often tested in combat within days of conception. Failure is accepted as a necessary step in the learning process, and the feedback loop between the front lines and the lab is direct and continuous. This environment rewards speed, adaptability and a willingness to experiment – qualities that have become strategic assets in the face of Russian mass and rigidity.

Brave1: An open platform to accelerate battlefield innovations

At the heart of Ukraine's defense innovation surge is Brave1, a government-backed platform that serves as the connective tissue of the ecosystem. Brave1 was established as a joint initiative of the Ministry of Digital Transformation, the Ministry of Defense and other key agencies, to accelerate the development and deployment of defense technologies.

The platform functions as a national accelerator, bringing together military end users (soldiers), defense contractors, civilian tech firms and startups in a single,

mission-driven environment. Its operating model is built around three core principles: openness to non-traditional actors; rapid prototyping and field testing; and a relentless focus on operational outcomes.

The platform acts as a clearinghouse for battlefield needs, collecting urgent requests and feedback directly from soldiers via digital channels, field liaisons and regular hackathons. These needs are then broadcast to the innovation community, which is invited to propose solutions, form ad hoc teams and access funding and support provided by Brave1. The result is a highly responsive system in which the time from frontline problem identification to prototype delivery can be measured in weeks.

In one instance, Ukrainian infantry units reported a critical vulnerability to Russian FPV (first-person view) drone attacks. Within days, Brave1 coordinated a challenge among local startups and university teams to develop low-cost electronic countermeasures. The winning prototype was delivered to the front, tested under combat conditions and iterated based on soldier feedback – all within a month.

Brave1's success lies in its ability to convene diverse stakeholders – military officers, defense engineers, software developers and even hobbyists – around shared operational goals. The platform's open architecture and light-touch regulation have lowered barriers to entry, enabling small teams and non-traditional suppliers to contribute meaningfully to the war effort. At the same time, Brave1 has worked to streamline certification and procurement processes, ensuring that promising solutions are not trapped in bureaucratic limbo.

A rapid, iterative approach to drone development
Nowhere is Ukraine's innovation success more visible than in the field of unmanned aerial systems. Confronted with Russian air superiority and the need for persistent surveillance, precision strike and EW capabilities, Ukraine has become a global leader in the development and operational use of military drones. Its drone ecosystem is highly decentralized, with production taking place in a network of small workshops, startups and even private homes. Designs are often open source, and knowledge is shared freely across informal networks. Civil society organizations and diaspora groups have played a critical role in funding and scaling production, blurring the line between military and civilian innovation.

The impact on the battlefield has been profound. Ukrainian forces now deploy a diverse array of drones – reconnaissance, kamikaze, cargo and EW platforms – many of which are tailored to specific operational needs and iterated rapidly based on frontline feedback. This technological edge is reflected in operational outcomes: Despite Russia launching tens of thousands of Shahed-derivative kamikaze drones against Ukraine, a significant share have been intercepted and destroyed by Ukrainian air defenses. By continuously innovating and adapting counter-drone tactics and technologies, Ukraine has managed to offset much of the potential damage from these mass drone strikes, maintaining resilience even under sustained aerial assault. ▶ **G**

This distributed, iterative approach to drone innovation stands in stark contrast to the centralized, hierarchical model of traditional defense procurement. It has enabled Ukraine to maximize the value of limited resources, harness the creativity of its tech sector, and maintain a tempo of innovation that has often outpaced its adversary.

A willingness to mobilize all the nation's capabilities against the enemy
The defining feature of Ukraine's defense innovation environment is its outside-in orientation. Rather than relying solely on legacy defense firms or state-owned enterprises, Ukraine has mobilized the full spectrum of its industrial and technological base. The IT sector, previously focused on global outsourcing, has pivoted to defense

G **Number of Russian Shahed-type kamikaze drones launched on Ukraine and Ukrainian interception rates**

■ Shahed-type drones launched   — Share of destroyed drones
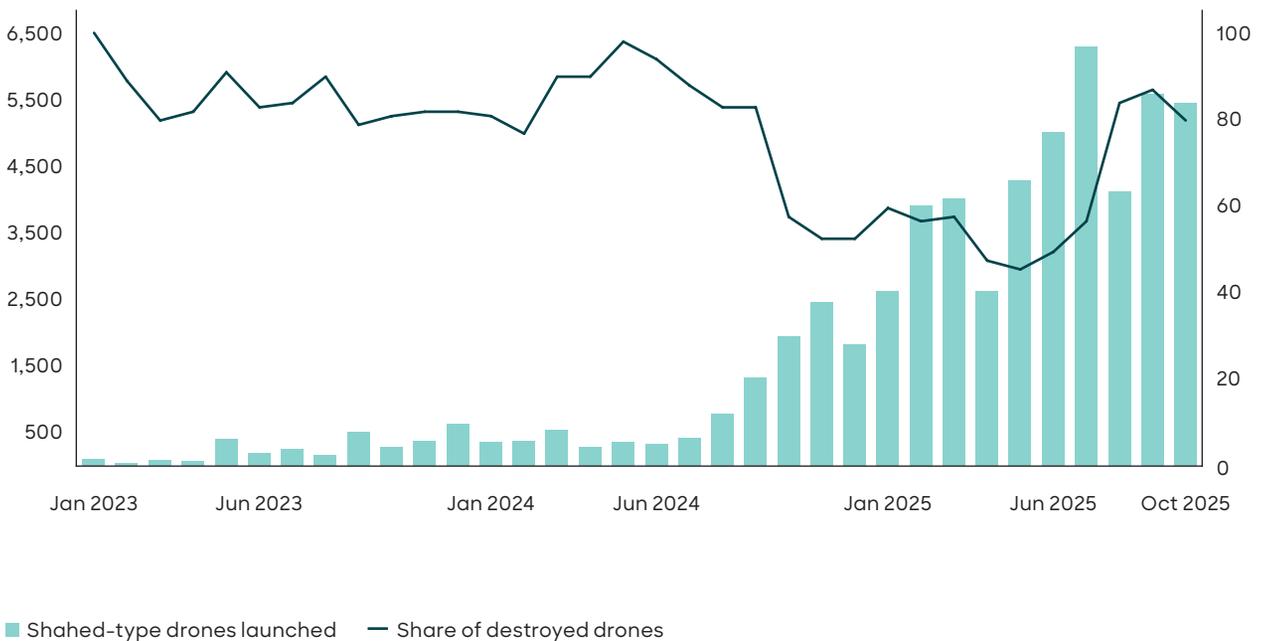
Source: Petro Invaniuk via Kaggle

applications, contributing expertise in artificial intelligence, cybersecurity and communications. Meanwhile, civilian factories have been repurposed to produce military hardware, from body armor to drone components, and university research teams and volunteer engineers have become integral to the rapid prototyping and deployment of new systems.

What Europe can learn from the Ukrainian experience
While urgency and existential threat have been the main drivers of Ukraine's defense innovation experience, there are still important lessons for its peacetime neighbors:

• The country's approach has been enabled by a culture of openness, flat hierarchies and a willingness to accept risk and failure as part of the innovation process.
• The war effort is a whole-of-society endeavor, with widespread public support for defense innovation and a shared understanding that survival depends on the ability to adapt faster than the adversary.

3.3/ Inside-out vs. outside-in innovation
The two models compared

——————

The analysis of Israel and Ukraine reveals two distinct but highly effective models of rapid defense innovation. Israel's system is fundamentally inside-out: innovation is generated from within the military and then diffused into the civilian technology sector. Elite initiatives such as Unit 8200, Talpiot and Mamram act as engines of talent creation, instilling technical excellence, mission-driven culture and a willingness to experiment. Veterans carry this mindset into startups and defense firms, creating a reinforcement loop. Defense challenges become commercial opportunities, and commercial capabilities, in turn, strengthen national security.

Ukraine, by contrast, has pioneered a strong outside-in model. Under the pressure of full-scale war, the country built an innovation pipeline that takes the best of its civilian tech sector and channels it directly into military use cases. Civilian innovators and the armed forces collaborate in real time, often skipping traditional procurement and bureaucratic bottlenecks. Startups iterate rapidly on frontline feedback, enabling an unprecedented pace of battlefield adaptation. This model has proven capable of turning grassroots ingenuity into scalable military capability in record time.

Together, these two models demonstrate that there is no single path to defense innovation at speed and scale. While Israel shows the power of institutionalized, military-anchored talent pipelines, Ukraine illustrates the potential of open, demand-driven collaboration between civil society and the military.

For Europe, the key lesson for deterrence is to master both logics: strengthen military-driven innovation structures while simultaneously opening the ecosystem to civilian tech talent, startups and non-traditional players. ▶ H

H The outside-in and inside-out innovation models
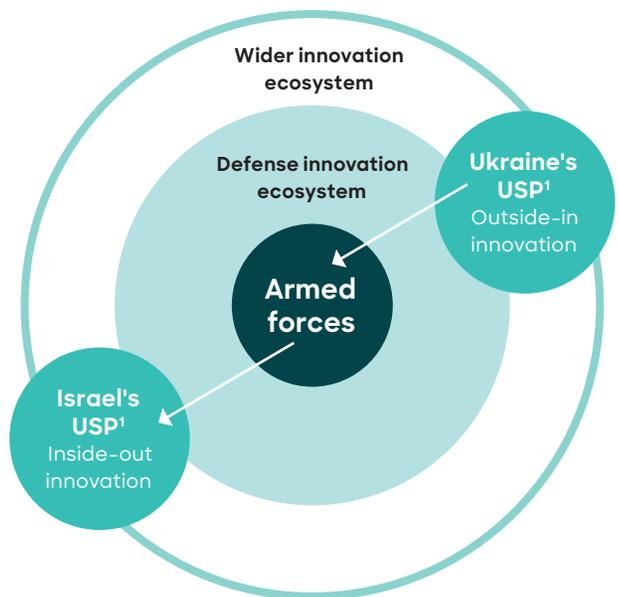
1 USP: Unique selling point

Source: Expert interviews, Roland Berger

Thomas Gottschild
Executive Vice President Strategy
& Future Growth, MBDA

⬤⬤ "Europe must do more than the
United States as the technology gap is
widening – otherwise we'll fall behind."

Line Rindvig
CEO,
Defence Builder Kyiv Ukraine

⬤⬤ "If Europe cannot defend itself, Ukraine
has a problem. If Ukraine cannot defend
itself, Europe has a problem. That is why
collaboration is so important."

Dr. Linus Terhorst
Research Analyst, Royal United
Services Institute

⬤⬤ "Innovation requires a tolerance for
failure: If politics penalizes every field test
that encounters problems, we will suffocate
new capabilities before they deliver impact."

Matthias Wachter
Co-Director Innovation,
Security and Technology, BDI

⬤⬤ "Israel has perfected the flow
of talent between the military, the
defense industry and startups."

Olha Sytnychenko
Chief Operating Officer,
Axendra

⬤⬤ "Modern defense innovation
depends on continuous battlefield
feedback, rapid iteration and the ability to
return improved capabilities to operators
in real time."

Tom McSorley
General Counsel,
NATO DIANA

⬤⬤ "The lesson from the wars in Ukraine
and Israel is not to protect yesterday's tool,
but to invent tomorrow's."

Dr. Johanna Möhring
Political Scientist and Chercheuse
associée, CIENS and ENS, Paris

⬤⬤ "Ukraine operates a wartime innovation
engine at exceptional speed; Europe, despite
the 'Zeitenwende', still thinks too much in
peacetime terms."

Sven Weizenegger
Director, Cyber Innovation
Hub of the Bundeswehr

⬤⬤ "Western Europe is neither at
peace nor at war; we can't test like
Ukraine – but we can adapt their
feedback mechanisms and speed."

Our vision

How to achieve a resilient European
defense innovation system

KEY MESSAGE

Europe's ability to deter relies on a resilient, innovation-driven defense ecosystem built around three pillars: an agile regulatory and procurement framework that tolerates managed risk and accelerates capability delivery; closer collaboration between armed forces, industry, startups and research; and predictable and strategically aligned financing. In concert, these drivers will ensure Europe can systematically harness innovation, scale emerging technologies and respond rapidly to evolving threats.

E urope faces tough decisions about how to best organize defense innovation. While its armed forces, industries and research institutions possess world-class capabilities, the way they interact remains poorly aligned with the demands of modern deterrence. Fragmentation across national and pan-European stakeholders, risk-averse regulation, slow procurement cycles and limited pathways to scale innovations have left the continent structurally less adaptive than the security environment now requires. Remaining a deterrent will require change.

The challenge is not one of technological potential but of ecosystem design. Effective deterrence increasingly depends on tight feedback loops between users and innovators, the ability to tolerate and manage risk, and financing mechanisms that allow promising technologies to be rapidly deployed at scale. In its current form, Europe's defense innovation system struggles to deliver these outcomes consistently, despite significant increases in defense spending and political focus since 2022.

In this chapter, we set out a vision for a resilient European defense innovation ecosystem that addresses these structural challenges without discarding Europe's existing strengths. It describes how three key innovation drivers can jointly restore adaptability as a core feature of European deterrence: a more agile regulatory and procurement framework; closer integration of stakeholders; and European-level pooling of financing. ▶❙

❙ The three drivers of Roland Berger's vision for European deterrence through innovation
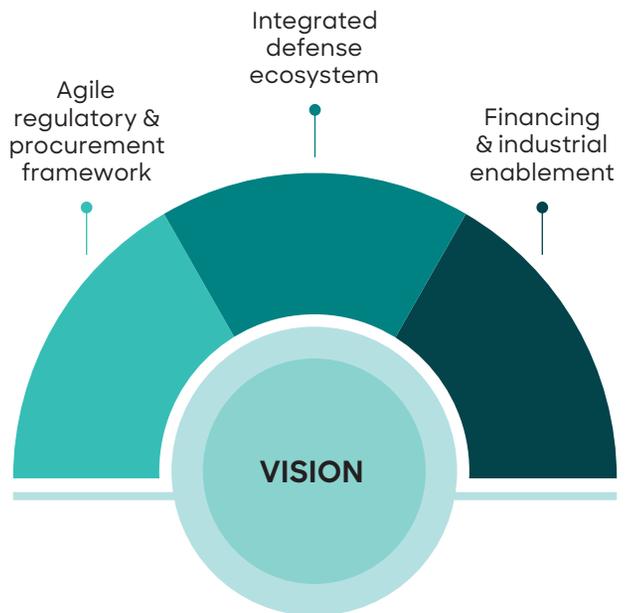
Source: Roland Berger

4.1/ Agile regulatory and procurement framework
Reform procurement and bureaucracy for modern warfare

Modern warfare confronts Europe with a dual requirement. On the one hand, European armed forces continue to rely on large, high-end platforms (combat aircraft, ships, armored vehicles) that demand long planning horizons, extensive safety and security certification, and industrial stability. These systems remain essential and will continue to require rigorous, risk-averse procurement processes. On the other hand, the same operational environment increasingly depends on fast-evolving technologies (software, sensors, autonomy, EW, data and AI) that develop on civilian timescales and lose relevance if acquisition cycles stretch over many years. A future-ready European defense innovation ecosystem must therefore be able to accommodate both: preserve robust procurement for strategic platforms, while enabling rapid acquisition and iteration for fast-developing technologies.

Today, procurement in many European countries is still optimized almost exclusively for the first category. It is built around over-specification, process rigidity and risk aversion, focusing on avoiding mistakes at all costs rather than achieving rapid operational advantage. Layers of requirements and multi-year qualification cycles create a system in which projects move slowly, emerging technologies are outdated by the time they are fielded and startups or SMEs struggle to even enter the process. This dynamic delays capability delivery and structurally disadvantages fast-cycle innovation relative to established prime contractors.

Develop an enhanced procurement model
To address this gap, a second, complementary procurement logic is required – one designed explicitly for speed, experimentation and learning. A modern procurement system must embrace a "spiral development" approach: rather than specifying thousands of pages of requirements up front, armed forces should articulate operational problems, invite industry to demonstrate possible solutions quickly and conduct pilot deployments in real or realistic environments.

This "spiral approach" ensures iterative testing and soldier/operator feedback become built-in checkpoints that refine the system through short, software-driven sprints. This mirrors the processes that allowed Ukraine to integrate commercial drones, EW tools and battlefield software within weeks of needs emerging.

For the pathway to work at scale, there must be a corresponding shift in defense procurement architecture. In particular, Europe's large platforms must be designed from the outset to accommodate rapid technological change. Open, modular and software-defined architectures need to become the technical foundation of European defense procurement. Closed, monolithic systems lock innovation into long upgrade cycles, restrict third-party integration and reinforce vendor dependency. By contrast, modular architectures with standardized interfaces allow new sensors, effectors, software modules or algorithms to be integrated incrementally, without redesigning entire platforms or reopening full certification processes. This enables large platforms to evolve continuously over time, while allowing fast-developing technologies to be fielded, updated and replaced at their natural pace.

The use of software-defined systems further decouples functionality from hardware, enabling faster updates, mission-specific reconfiguration and rapid adaptation to new threats. From command-and-control to EW and ISR (intelligence, surveillance and reconnaissance), this shift allows procurement to focus less on fixed end states and more on adaptable capability frameworks. Importantly, open architectures also lower entry barriers for startups and non-traditional suppliers.

Take a more agile approach to risk
Making this dual-procurement model viable requires a different tolerance for risk. Innovation inherently involves uncertainty, yet European procurement frameworks are largely structured to eliminate uncertainty altogether. A

4.2/ An integrated defense ecosystem

Closer collaboration between all stakeholders

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more agile model accepts that some pilots will fail, that rapid prototyping may produce imperfect early versions and that qualification processes must reflect operational urgency rather than administrative completeness.

"Fast lanes" or lightweight acquisition pathways alongside traditional procurement – a speedboat next to the tanker – can enable rapid contracting of prototypes, temporary authorizations for field evaluation and faster transitions into serial production. The tanker remains essential for large, strategic programs demanding rigor and stability. But alongside it, procurement agencies need a speedboat capability: small, empowered teams with simplified contracting, delegated authority and flexible budgets. These can onboard startups and test commercial technologies, or run short development sprints without being slowed by the inertia of the main system.

● ● "Effective deterrence in the 21st century depends on the ability to scale innovation faster than adversaries. Our vision brings users, innovators and industry together under agile governance and European-scale financing to translate innovation into enduring military advantage."

Manfred Hader
Senior Partner

I n our vision, Europe's defense innovation ecosystem becomes a tightly connected network. Collaboration must improve not only between armed forces but across all stakeholders, from industry primes and startups to research bodies, civil suppliers and procurement agencies.

Understand users and need, the frontline drivers of innovation

A mission-driven defense innovation ecosystem needs continuous interaction between those who define operational needs (users) and those who develop solutions. To ensure a sustained deterrence, armed forces must be active participants in innovation, providing early demand signals, rapid feedback from training and operations and clear prioritization. Personnel should be empowered to test early versions, provide structured KPI-based evaluations and continuously shape refinement requirements. Unclassified demand signaling (similar to what NATO's DIANA organization attempts to provide) helps industry understand military needs, reducing wasted effort and aligning R&D with real demand.

Ukraine's experience shows how external pressure can force such "outside-in" urgency, with frontline needs directly shaping technological development. For Europe, the lesson is to deliberately engineer these feedback loops rather than rely on crisis-driven adaptation. As well as lowering institutional barriers between stakeholders, this requires a cultural shift to enable regular, unfiltered exchange. It also means aligning incentives around shared missions rather than isolated projects. Germany's armed forces "Innovationszentrum" (Innovation Hub) provides a practical example. It facilitates regular exchanges, joint experiments and rapid prototyping under one roof, demonstrating how structured collaboration between stakeholders can accelerate innovation.

J **The heart chamber of the new European defense industry must consist of the powerful primes and agile startups and new primes**

Primes –
The powerful engine

- Deliver high-power, long-range, technologically complex systems
- Build for scale, robustness and strategic deterrence
- Operate on long development cycles with deep engineering depth
- Provide industrial stability, certification and integration capability

Startups & new primes –
The agile pulse

- Fast iteration, short development cycles, rapid prototyping
- Smart, affordable mass; high adaptability in contested environments
- Bring disruptive technologies and dual-use innovation
- Plug into emerging tech ecosystems and digital talent pools

A synchronized heartbeat for European defense

- Deterrence requires both strategic power and tactical agility
- Innovation thrives when speed (startups) meets scale (primes). Standards, procurement rules and open architectures act as the valves that keep innovation flowing
- Europe needs a synchronized rhythm: fast experimentation + scalable industrialization

Source: Roland Berger

Synchronize industry, the beating heart of defense innovation

On the industrial side, defense primes and startups must together form the heart of the defense innovation ecosystem, making up two distinct but interdependent chambers. In one, established primes delivering complex, high-end systems; in the other, agile startups and smaller firms providing software-driven capabilities, smart and affordable mass, and rapid adaptation. ▶ **J**

Surrounding this dual core, other actors – procurement authorities, civil industry, research bodies, the armed forces – function as vital supporting organs, enabling circulation, coordination and continuous learning. When these two chambers beat in sync, innovation will flow efficiently from idea to operational capability. By tightly coupling the heartbeat to military demand and research, innovation can be turned into sustained and scalable deterrence.

Yet today, Europe's two chambers often beat out of rhythm. Procurement patterns remain heavily skewed toward high-end strategic platforms, with most national budgets allocating the bulk of investment to a handful of big-ticket programs. Meanwhile, the budgets for fast-cycle systems – UAS, C-UAS, EW, tactical software, battlefield networking – remain fragmented, underfunded or trapped in pilot phases. In some major European countries, the share of procurement dedicated to agile, software-driven, short-cycle systems remains in the single-digit percentage range, for example. And while dozens of European defense tech startups have emerged since 2022, only a small fraction have received multi-year contracts or meaningful scaling orders.

The effect on the heart chambers resembles a physiological imbalance: an overdeveloped left side trying to compensate for an underpowered right one. Europe builds world-class platforms but struggles to produce them in sufficient numbers, integrate them with agile

subsystems or pair them with the autonomous mass now reshaping modern warfare. The effect? Ukraine's battlefield experience has shown that large platforms without sufficient sensors, drones, EW assets and software-defined tools are increasingly exposed. Conversely, agile systems without strategic enablers cannot deliver deterrence.

An effective national-level model
The United Kingdom shows that it can be done better. Its emerging 40–40–20 force-mix logic, unveiled in 2025 and based on Ukraine's experience, provides a concrete illustration of how to synchronize the two heart chambers of modern defense.[5]

Under this approach, roughly 40 % of future capability is expected to come from autonomous or uncrewed systems – the agile chamber that delivers mass, speed and expendability. A further 40 % is allocated to hybrid or optionally crewed platforms, bridging high-end effect with rapid adaptability. The remaining 20 % focuses on big-ticket, high-end systems such as advanced fighter aircraft or naval assets. ▶ K

This type of target mix forces decision makers to make mass visible in planning and procurement while preserving the high-end backbone. It is not a perfect blueprint for Europe, but it captures the core principle: a resilient force requires both heart chambers beating in sync, rather than overinvesting in a single class of capability. In our vision, European procurement sets clear innovation targets and allocates budgets accordingly, ensuring that both high-end and agile capabilities are developed in a coordinated, mission-driven way.

The target picture for a unified European ecosystem
Beyond national boundaries, pan-European coordination is equally essential to ensure that knowledge, capabilities and resources flow seamlessly to create a resilient and scalable ecosystem. Stakeholders should be connected through shared platforms for information exchange, joint experimentation and co-development programs. Funding and demand signals could also be aggregated at the European level. This would help to prioritize capabilities with continent-wide relevance, reduce duplication and ensure that both agile startups and large primes can contribute where they are most effective.

The sequence is clear: first, build future-proof national defense innovation ecosystems by federating all stakeholders effectively. Second, scale up by interlinking and integrating these national ecosystems across Europe, ensuring stakeholders are no longer isolated. The goal is not to erase national priorities but to align them within a cohesive European framework that maximizes collective speed, efficiency and deterrence. ▶ L

K UK model for distribution of future combat capability

Expendable, largely autonomous systems
E.g., loitering munitions and kamikaze drones

Reusable, AI-enabled assets
AI-enabled assets including surveillance drones that can operate with or without human input

**Traditional platforms**
Tanks, artillery and attack helicopters

High autonomy

40 %

40 %

20 %

Low autonomy

Source: Roland Berger

5 UK MoD Strategic Review 2025

TARGET STATE

A unified European defense innovation ecosystem

Integrated stakeholders, coordinated demand, scalable impact while preserving national sovereignty and decision making

France

Germany

Italy

United Kingdom

France

Germany

Italy
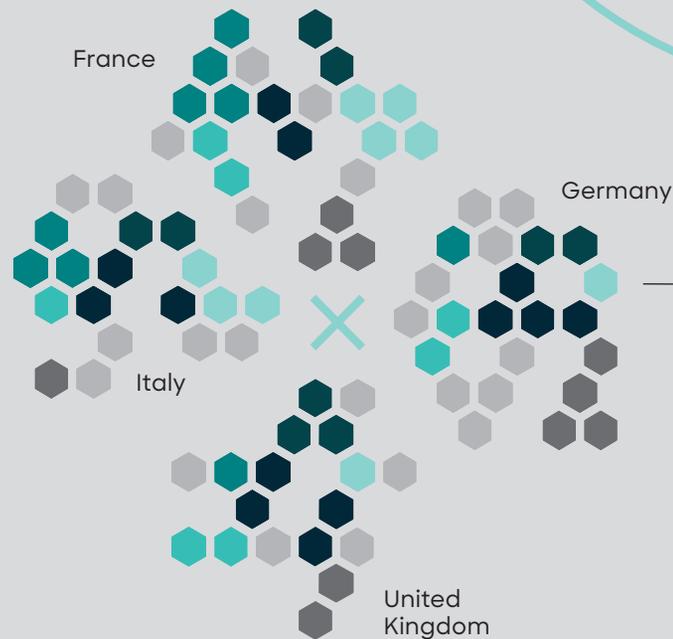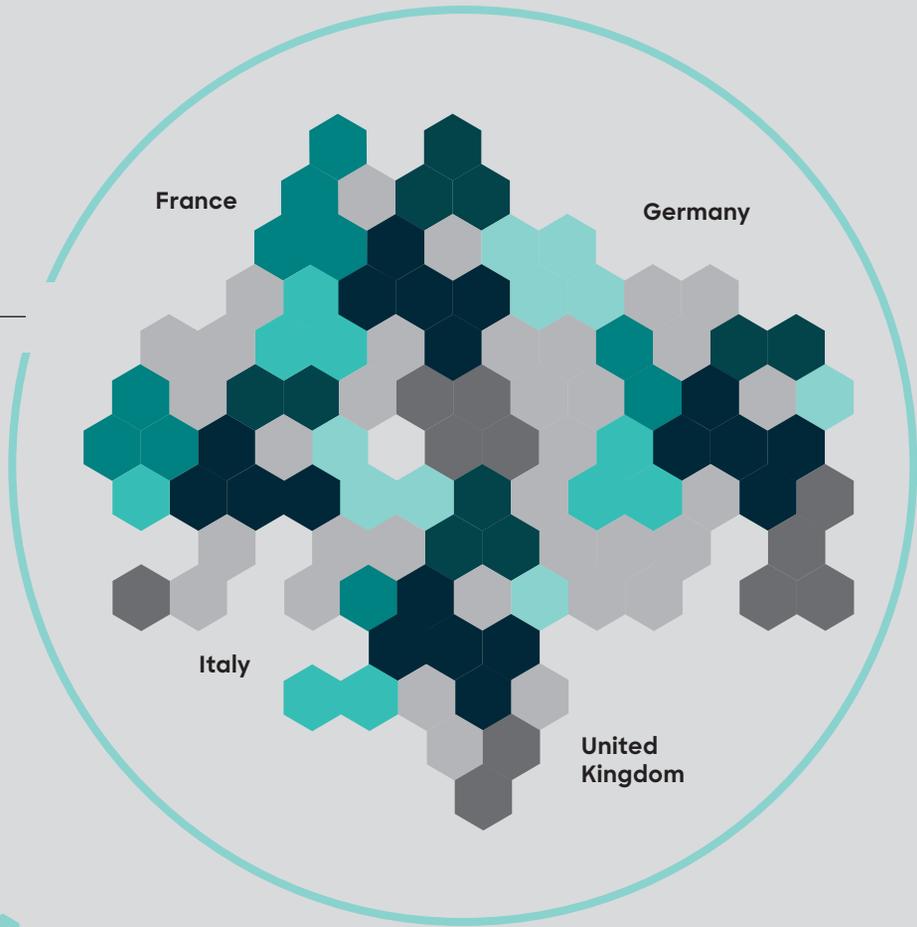
STATUS QUO

Fragmented national defense innovation systems

Limited cross-border coordination and weak stakeholder integration

United Kingdom

- Military
- Defense primes
- Non-defense industry
- Startups
- Procurement
- Research institutions
- Other

Source: Roland Berger

4.3/ Strategically defined financing
Rethink funding and pool demand to support scale

E urope's defense innovation challenge is not only about generating new ideas – it is about scaling them. Today, a lack of coordinated financing often hinders the scaling of promising defense technologies. In a resilient innovation ecosystem, financing becomes a strategic enabler rather than a bottleneck. Public and private capital are deliberately aligned along a pan-European stage-gate financing pathway. Such a pathway – moving ideas from R&D to prototyping, low-rate initial production and eventually full-scale manufacturing – provides continuity, predictability and risk-sharing across the innovation lifecycle.

Close the financing gap
Today, breakthrough concepts frequently stall in the so-called Valley of Death, the gap between early-stage technology readiness levels (TRL 1–4: basic research and prototypes) and the point where militaries commit to large-scale procurement (TRL 7–9: validated, deployable systems). ▶M

This gap exists because startups lack long-term funding certainty, procurement cycles are too slow and governments are hesitant to commit before technologies reach maturity. The result is a system geared toward bespoke, expensive platforms that are slow to develop – a setup that is poorly suited to the new world of agile innovation.

Closing the gap requires a deliberate shift from episodic funding and fragmented procurement toward an integrated scale-up pathway. Governments must commit earlier through milestone-based financing that bridges R&D, prototyping and initial production, sharing risk with industry rather than avoiding it.

Pool demand to achieve scale
Financing alone, however, is not sufficient to unlock scale. For defense innovators to invest confidently in production capacity, supply chains and workforce, they must also see

M The Valley of Death for emerging technologies

Investment
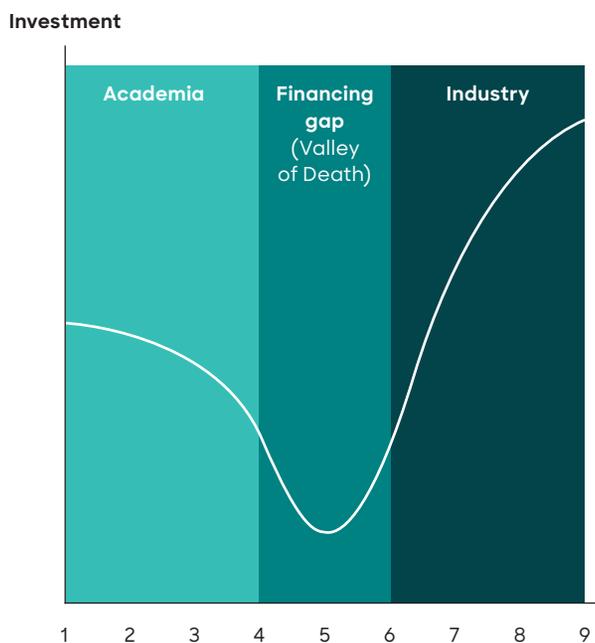
Technology readiness levels

1 Basic principles
2 Technology concept
3 Proof of concept
4 Technology validated in lab
5 Technology validated in relevant environment
6 Technology demonstrated
7 System prototype
8 System complete & qualified
9 System deployed

Source: University of South Alabama, Kirmse, S., Roland Berger

predictable demand. This requires a shift from fragmented national purchasing toward systematic demand pooling at European level wherever operationally feasible. Aggregated, multi-year framework contracts – spanning capabilities such as ammunition, drones, sensors, EW modules and secure communications – would transform uncertain project pipelines into bankable order books. By creating volume visibility and harmonizing requirements early, European-scale demand pooling enables industry to move from artisanal production to scalable manufacturing and reinforces supply chain resilience. It also ensures that innovative solutions can be fielded rapidly and in meaningful quantities across multiple armed forces.

Defense companies and investors both gain from this approach. Pooling demand and capital at European level – through coordinated procurement commitments, anchor customers and blended finance instruments – allows defense companies to secure the visibility and balance-sheet strength required to scale. Investors, meanwhile, achieve clearer downside protection and credible paths to exit. This shift would see defense venture capital in Europe move from small, fragmented bets toward fewer, larger and mission-aligned investments, ensuring that promising technologies do not stall after demonstration.

Reshore to secure supply chains

Securing production also means securing the supply chains behind it – and doing so in a way that enables rapid innovation. Europe remains heavily dependent on non-EU suppliers – especially China – for critical raw materials and components, such as semiconductors, batteries, specialty metals, UAV motors and optical sensors. These dependencies do not only create strategic vulnerabilities; they directly constrain innovation by forcing early design freezes, extending lead times for modified components, and making reliable scaling uncertain even when technologies perform well in testing. As a result, experimentation slows, learning cycles lengthen and promising systems struggle to move beyond pilot scale.

A future-proof defense ecosystem must diversify and, where strategically necessary, reshore key inputs to ensure that new technologies can be prototyped, iterated and scaled at operational speed. That includes building trusted suppliers of chips and RF components, expanding certification and security-clearance capacity and mobilizing Europe's high-tech SMEs as a flexible, distributed manufacturing backbone that can surge production quickly. Integrating non-defense industrial champions – from robotics to additive manufacturing – into defense supply chains as full innovation partners enables faster iteration, modular upgrades and resilient scaling. In this sense, supply chain security is not merely a defensive measure; it is a prerequisite for sustained innovation and credible deterrence.

In summary, Europe cannot innovate at speed without scaling at scale. Building a resilient defense innovation ecosystem requires coordinated EU-level demand, long-term financing, a broader industrial pool and secure supply chains.

Christoph Siegelin
Vice President,
Thales Digital Factory

●● "In digital defense, no player can succeed alone. Value is created through ecosystems – where platforms, data, software and operations are integrated through partnerships rather than built in isolation."

Tom McSorley
General Counsel,
NATO DIANA

●● "We still think too much in terms of classification and closed architectures; true interoperability and software-defined integration have yet to become the norm."

Stefan Hess
Head of Group Sales and Account Management, Hensoldt

●● "Open, modular architectures are key to enabling innovation without compromising the security of core systems."

Prof. Dr. Rafaela Kraus
University of the
Bundeswehr Munich

●● "Without raw materials and components, technology is meaningless – supply chains must be considered from the outset."

François Lombard
Head of Connected Intelligence,
Airbus Defence and Space

●● "Europe needs a balanced mix of high-end and low-end innovation; credible deterrence will depend on both."

Florian Hohenwarter
CEO,
KNDS Deutschland

●● "Deterrence must be technological; mass alone is no longer sufficient."

Dr. Gundbert Scherf
Co-Founder and Co-CEO,
Helsing

●● "Europe needs a sovereign end-to-end operational technology stack, covering command, control, data processing and effects."

Clément Galic
CEO and Co-Founder,
Unseenlabs

●● "The role of new players is not to replace legacy actors but to co-build value with them, strengthening the European defense industrial base through complementary capabilities."

Recommendations

How European stakeholders can build a
sustainable deterrent

COMMON GOAL

Agile, interoperable and resilient European defense capabilities enabling sustainable deterrence through innovation

KEY MESSAGE

Stakeholders in Europe's defense innovation ecosystem must act in concert to close existing gaps. National and pan-European collaboration, clearer operational needs, faster procurement and aligned financing are essential to enable rapid innovation and scalable deployment. Only through coordinated action and continuous adaptation can Europe out-innovate its adversaries.

Within the three pillars of our vision for a future European defense innovation ecosystem (an agile regulatory and procurement framework; closer collaboration between stakeholders; and predictable and strategically aligned financing), numerous initiatives are already underway. But there is still room for improvement. In this chapter, we break down by defense industry player how this potential can be realized.

Armed forces, procurement authorities, primes, startups, civil industry and research bodies each face distinct but interdependent areas of action. During our research, interviewees repeatedly and strongly emphasized the need for organizational transformation. They stressed that isolated reforms will not be sufficient – progress depends on aligning incentives, responsibilities and interfaces across the entire military–industrial complex. The following sections outline the key actions identified for each stakeholder, translating fragmented initiatives into a coherent, system-level vision for European defense innovation. ▶ N

AREAS OF ACTION

Armed forces
Clearer re-quirements and direct engagement with innovators

Procurement
Flexible, fast and innovation-friendly procurement

Defense primes
Act as innovation integrators

Startups
Access to funding, testing and operational feedback

Civil industries
Dual-use collaboration and knowledge transfer

Research bodies
Focused, mission-oriented defense R&D

FOUNDATION

Regulatory framework enabling accelerated innovation and coordinated priority setting

Source: Roland Berger

ARMED FORCES

A European defense innovation ecosystem that functions as a sustainable deterrent starts with operators adopting user-in-the-loop development as a norm. Small co-development and test units embedded in brigades should run rapid sprints and feed KPI-based frontline feedback directly into procurement and design.

Commanders need regular, unfiltered interaction with innovators to avoid "command center only" blind spots. Also, forces should focus on software-defined integration and Joint Automated Command and Control (C2) to close the sensor-to-shooter loop in quasi real time across land, air, sea, space and cyber, with secure communications and resilient data handling.

Ukraine's Brave1 platform or Germany's armed forces Innovation Hub provide a compelling practical example of how structured, direct military–innovator interaction can rapidly translate operational needs into deployable capabilities under combat conditions. The armed forces should also articulate their operational needs more clearly and be empowered to engage systematically with innovators, startups and research organizations.

DEFENSE PROCUREMENT ENTITIES

Procurement entities must move from overspecification to spiral development pipelines supported by stage gates, rapid testing and risk-based qualification. The US experience offers a useful reference point: The Department of Defense's Middle Tier of Acquisition (MTA) pathway demonstrates how spiral development, iterative testing and risk-based qualification can be embedded into procurement, accelerating timelines and enabling broader engagement with innovative suppliers.[6]

There are several other goals. For example, capacity for certifications and security clearances needs to scale, and peacetime testing frameworks require delegated approvals and mutual recognition of allied certifications. In addition, demand should be aggregated at a European level through lived standards, multi-year frameworks and purchase guarantees to bridge the Valley of Death and scale promising pilots.

6 https://www.army.mil/article/285669/army_acquisition_moves_fast_with_mta_pathways

DEFENSE PRIMES

Defense primes should evolve from platform to innovation integrators, enforcing open, modular interfaces while safeguarding critical systems with security by design. This means: building competence to qualify and certify external AI, software and quantum technologies; mastering integration risk through reverse engineering, hardening and partner rotation; and accelerating upgrade cycles with faster partner onboarding.

One of Germany's leading defense primes exemplifies this evolution through its strategic co-development partnership with a leading US defense tech startup. Together, they jointly develop and produce modular, software-defined autonomous drones that fit into the European digital framework and modular ecosystem.[7]

Primes should lead the building of a sovereign European C2/ISR stack across sensor–data–decision–shooter, and shift production toward flexible, distributed manufacturing islands that are automation-enabled and resilient. This means working proactively with accelerators, aggregators, corporate VC, SMEs and startups to pull dual-use innovation into defense at speed. An open innovation program from a European defense prime serves as a good example. It is structured to actively identify, engage and sustain collaborations with SMEs, research organizations, startups and academic partners. The program explicitly aims to integrate external disruptive technologies into future weapon systems and foster a community of innovators, rather than relying solely on internal R&D or closed supply chains.

STARTUPS

Startups need to get close to end users and field test early. A French defense tech company provides a practical example, having deployed and continuously refined its software in close collaboration with Ukrainian soldiers directly at the front line.[8]

It doesn't end there. Designing components for modular interfaces and security by design enables qualification within open architectures. Meanwhile, dual-use business models, readiness for TRL/stage gates and compliance preparedness – security screening, export controls, IT and data hygiene – are essential.

Startups should also note that national innovation centers like Germany's Innovation Hub and matchmaking platforms that help to secure trials and first contracts sooner, focus on software-defined capabilities, ISR, counter UAS/EW, autonomy and robust communications. They also design to EU standards with full documentation and test evidence to scale across borders.

7 https://www.ft.com/
content/32c61658-cf03-4209-8341-07456ea7b6ff

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CIVIL INDUSTRIES

Civil industries can contribute automation, flexible production systems, telecoms, electronics, sensors, optics, batteries, engines and critical materials. These build capacity for distributed, resilient manufacturing that can ramp up fast and withstand disruptions.

Quality and traceability should meet defense standards without sacrificing civilian efficiency. Engagement through structured matchmaking and EU standards will reduce customization and raise volumes, while localizing critical inputs cuts dependency on choke points and enables faster EU ramp-ups.

RESEARCH BODIES

Research bodies should break silos and form multidisciplinary soldier–developer teams, shifting from "Agile Labs" in name to lived fast iteration. They should establish a standardized startup review framework that combines due diligence and security screening with staged, readiness-based support – from mentoring and prototyping to field testing and early procurement pathways.

AI-enabled horizon scanning – own language models and community engagement – should maintain a current technology picture and feed national tech roadmaps that align with the EU Defense Technology Roadmap. Priorities include AI, connectivity, robotics (including humanoid), space data exploitation, laser/EW and quantum, all of which should be linked to operational problems, shared test data and interface specifications that enable open architectures and real interoperability.

HOW TO REMAIN A DETERRENT

All six stakeholders are currently confronted with challenges of organizational transformation. While the target picture described in chapter four sets the goal, the concrete actions described in this chapter show the path to reach this goal through specific actions that solve the transformational challenges in each field.

If all six stakeholders act accordingly and in a coordinated manner, Europe can unlock a genuinely vibrant defense innovation ecosystem. Clear military demand signals, innovation-integrating primes, agile procurement, empowered startups, active civil-industry participation and mission-oriented research would reinforce each other, creating fast feedback loops between operational needs and technological solutions. Innovation would move more rapidly from concept to deployment, scale more effectively across national borders and continuously adapt to evolving threats. The result would be a defense ecosystem that not only delivers technological excellence but also sustains credible, long-term deterrence, all anchored in resilience, interoperability and the ability to innovate faster than potential adversaries.

Credits

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FURTHER READING
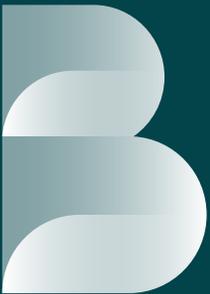

The defense imperative

**Embrace the future of defense:
A call for transformation**

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