McKinsey & Company

The future of European defense and security

February 2024

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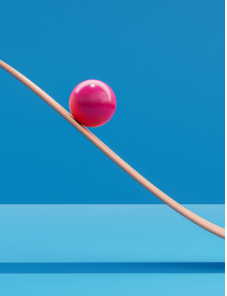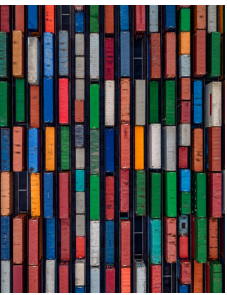
Foreword

Enhancing European security

Ensuring the economic development of Europe and the well-being of its citizens is the primary objective for European leaders. At the same time, two years into the war in Ukraine and 75 years since the creation of NATO, Europe is adapting to a new reality when it comes to defense and security. Doing so with efficiency and effectiveness is essential to protect the lives and livelihoods of European citizens, while still allowing for investments into other priorities such as education, technology, healthcare, and the net-zero transition.

Government stakeholders of European countries, the European Union, and NATO could be faced with difficult trade-offs in the coming years on how to allocate funding effectively between competing defense priorities: replenishing critical supplies quickly; investing in recapitalizing fleets of equipment for newer models; increasing availability of equipment while incentivizing innovation in the defense supply base; and integrating new technologies into the armed forces.

For the defense industry, where many players are already ramping up production, it is only the beginning of a journey that will require greater manufacturing efficiency, velocity, and capacity. It is also a balancing act between their local and sovereign responsibilities and remaining globally competitive. European countries have already committed to increasing their defense postures and have started to appropriate the corresponding funding. According to McKinsey estimates—based on announced spending plans—defense budgets are expected to increase by a cumulative €700 billion to €800 billion between 2022 and 2028.[1]

In a globally intertwined world, security goes beyond armed defense. It can encompass industrial and supply chain resilience; the long-term physical and cyber integrity of critical infrastructure; strengthening digital sovereignty; securing global trade routes and food supply; and mitigating the effects of climate change on national security.

In this compendium, we will share some of our recent research as well as put a spotlight on approaches to the underlying enablers of European security and defense. Within this analysis, three themes emerge that merit concurrent consideration by decision makers.

- **How to attract and retain talent**: The European defense industry is inherently linked to the commercial aerospace industry, with many players—especially in the supply chain—present in both sectors. In both of these, the challenges are similar: the demographics of their people pyramids and their ability to attract and retain talent. Across the industry, 30 to 35 percent of the manufacturing and engineering workforce are 50 years of age or older.[2] Approaches that worked in the past, which were based on experience and tenure, may no longer be effective to attract and retain the number of employees who possess the right skills and passion for the industry.

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[1]   McKinsey analysis.

[2]   "Europe's gray-to-green workforce transition in aerospace and defense," McKinsey, October 12, 2023.

- **How to achieve scale and pace:** The European defense industry is characterized by a substantial fragmentation of both supply and demand, as well as an insufficient capacity and velocity for defense equipment production. For example, the armed forces of European countries operate a complex portfolio of defense equipment. This can hinder interoperability, a greater potential for pooling, sharing scarce training and support resources, as well as achieving greater economies of scale through larger programs. On the supply side, European defense companies will likely need to drive comprehensive operational change programs and adopt modern and integrating manufacturing methods widely in place in other industries.

- **How to innovate:** Venture capital investment in defense technologies more than doubled between 2019 ($4.2 billion) and 2022 ($11.0 billion).[3] Three areas require new technological capabilities and attract most of the investment: disaggregated platforms, fast and resilient networks, and cutting-edge technologies. While start-ups are well placed to attract the right type of innovative talent and harness the disruptive power required, they often suffer from the mismatch between the private capital funding cycle and defense budgets. Creating incentives for defense innovation is as important a priority for the future of European security as rebuilding defense capabilities and responding to new challenges, such as the nexus of security and climate change.

This compendium marks the starting point of a series of publications on the new defense and security environment with which Europe faces. We will explore these three critical themes through our own latest independent insights, enriched by viewpoints from key leaders in the sector.

David Chinn
Senior Partner
Tel Aviv

Hugues Lavandier
Senior Partner
Paris

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[3] McKinsey analysis.

Innovation and efficiency: Increasing Europe's defense capabilities

European countries are increasing defense spending in response to regional geopolitical shifts. Critical considerations could help them address constraints, long-term resilience, and collaboration.

This article is a collaborative effort by David Chinn, Nadine Grießmann, Hugues Lavandier, Rafael Ocejo, Tobias Otto, and Katherina Wagner, representing views from McKinsey's Aerospace & Defense Practice.
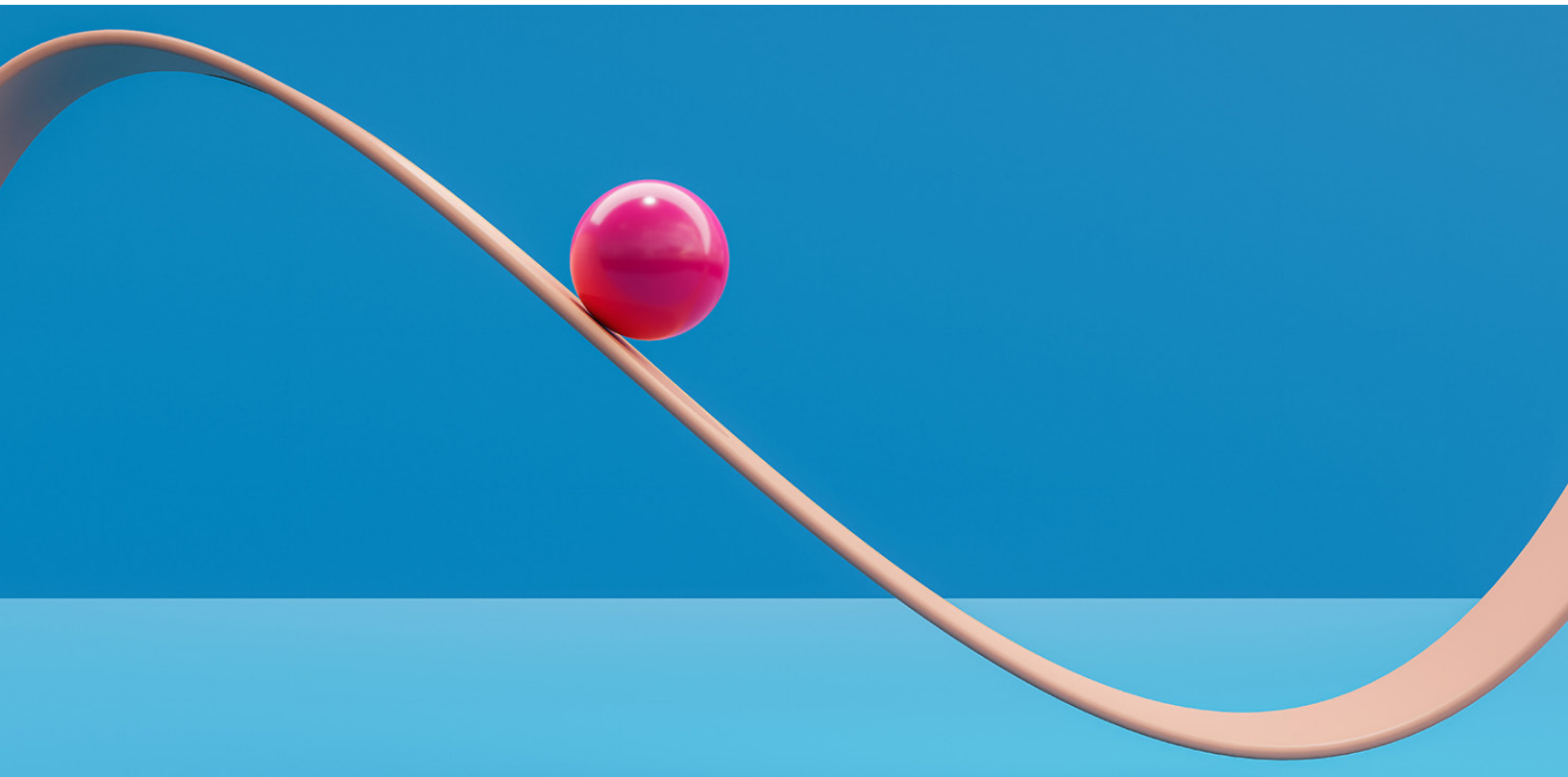
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As global geopolitical tensions reemerge after many decades, the security environment in Europe is changing. European countries are once again rebuilding their defense capabilities to ensure their security after three decades of reduced defense spending. While long-term peace and the well-being of their citizens are countries' primary objectives, security has reemerged as a prerequisite. This needs to be addressed with efficiency and effectiveness so that Europe can deploy significant investments into other priorities—such as education, innovation, healthcare, and infrastructure.[1]

Many NATO countries have made commitments to increase their defense spending.[2] European countries have also committed significant support to Ukraine by sending equipment and consumables, or supporting Ukraine in continuing its public services. For example, at the start of February 2024, the European Union (EU) agreed a further €50 billion package of support to Ukraine.[3] While most countries in 2023 have not yet met the stated two percent goal for defense spending set by NATO members,[4] McKinsey analysis suggests that over half the European NATO countries will hit that goal in 2025. In addition, NATO is expanding, with Finland joining in April 2023 and Sweden in the process of doing so.[5]

New initiatives continue to progress to increase cooperation on developing military capabilities in Europe, such as the Future Combat Air System and the Main Ground Combat System, while more than 15 European countries have joined forces as part of the European Sky Shield Initiative to develop a multilayer air and missile defense system.[6] And, in May 2023, joint procurement of ammunition for Ukraine marked a first for member states collectively acquiring defense supplies.[7]

In this article, we look at the impact that the period of reduced defense spending by European NATO countries has had on countries' capabilities, and how increased defense spending plans could affect the European defense supply base. We identify various factors these countries can consider to ensure that their new spending commitments contribute effectively and efficiently to strengthening Europe's defense and security—while guaranteeing the safety of the lives and livelihoods of their citizens.

The 'peace dividend' era has ended—what's next?

Europe's defense spending since 1992 was lower than previous periods in the past—a cumulative difference of about $8.6 trillion (Exhibit 1). Our analysis also shows that, over the past three decades, European NATO countries have spent $1.6 trillion less than they would have had they met the 2 percent of GDP target stipulated by the Alliance. Ten European NATO members (Estonia, Finland, Greece, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia, and the United Kingdom) were expected to meet or exceed the 2 percent target in 2023, based on official NATO estimates as of July 2023.[8]

1   "Accelerating Europe: Competitiveness for a new era," McKinsey Global Institute, January 16, 2024.

2   Camille Grand, "Defence spending: Sustaining the effort in the long run," NATO Review, July 3, 2023. For specific examples, see "Bundestag approves the special fund for the Bundeswehr," Deutscher Bundestag, June 3, 2022; *National strategic review 2022*; General Secretariat of Defense and National Security, Government of France, 2022; *Autumn statement*, HM Treasury, November 2022.

3   "EU leaders agree on €50 billion of reliable financial support for Ukraine until 2027," European Commission, February 2, 2024.

4   *Defense expenditure of NATO countries* (2014–2023), NATO Public Diplomacy Division, July 7, 2023.

5   "An update: Sweden's journey to NATO membership," Allied Command Transformation, January 17, 2023; "Finland joins NATO as 31st ally," North Atlantic Treaty Organization, April 4, 2023.

6   "Europe's future air combat system: On the way to the first flight," Airbus, December 16, 2022; "KMW and Nexter join forces on main ground combat system," KNDS, June 18, 2020; "European Sky Shield Initiative gains two more participants," North Atlantic Treaty Organization, February 15, 2023.

7   "EU joint procurement of ammunition and missiles for Ukraine: Council agrees on €1 billion support under European Peace Facility," Council of European Union, May 5, 2023.

8   *Defense expenditure of NATO countries* (2014–2023), NATO Public Diplomacy Division, July 7, 2023.
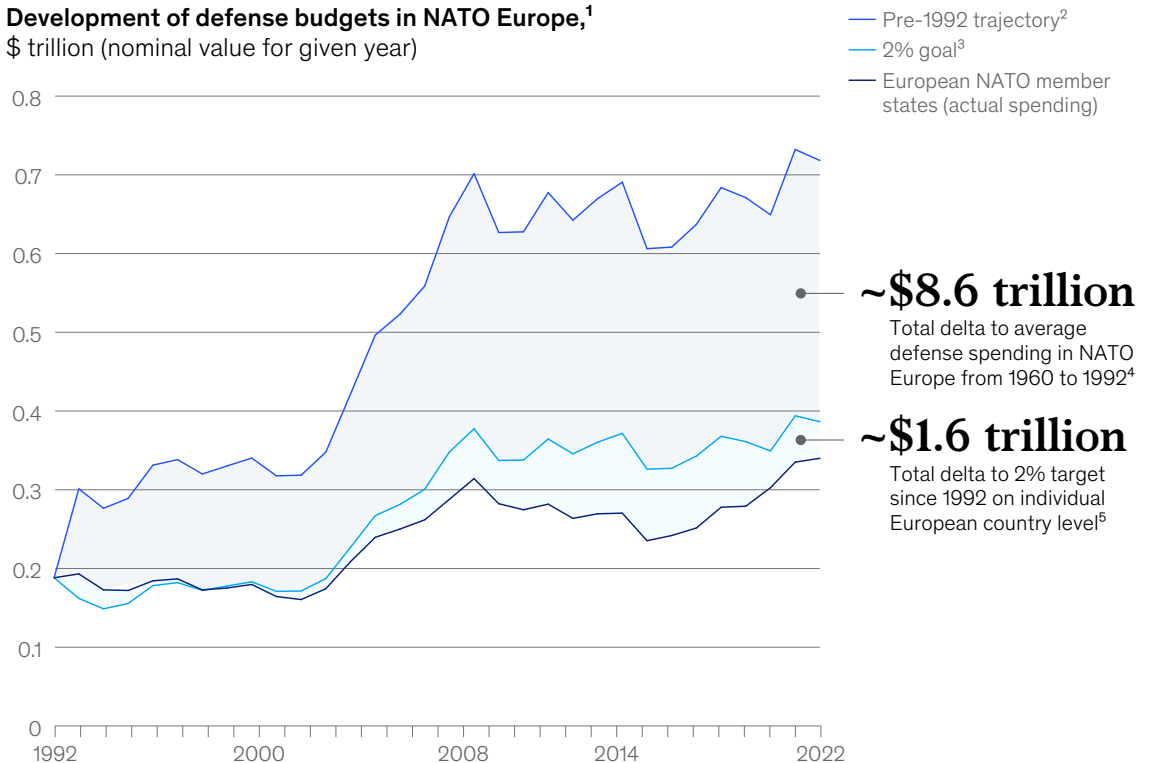
This reduction in spending has come to be known as the "peace dividend." While the exact magnitude of the effects of the peace dividend has been a subject of public and academic debate, reduced military spending has seen European governments invest more in domestic economic development and health and education priorities.[9] Governments will continue to have to make tradeoffs around economic and security priorities—for example, recent years have revealed new fragilities in European economies and continued investment in a "European agenda for competitiveness" will be required to address them.[10] At the same time, investment in European defense and security capabilities will be necessary as the sector is challenged by new security scenarios.

Exhibit 1

European NATO member states have spent up to approximately $8.6 trillion less on defense since 1992.

Development of defense budgets in NATO Europe,[1]
$ trillion (nominal value for given year)

Legend:
— Pre-1992 trajectory[2]
— 2% goal[3]
— European NATO member states (actual spending)

~**$8.6 trillion**
Total delta to average defense spending in NATO Europe from 1960 to 1992[4]

~**$1.6 trillion**
Total delta to 2% target since 1992 on individual European country level[5]

[1]Values for 2022 NATO estimates; the number of European NATO member states also increased over time and therefore many more countries contribute to the combined budget in 2021 than did in 1992 (examples are Bulgaria, Croatia, Czech Republic, Estonia, Latvia, Lithuania, Poland, Romania, or the Slovak Republic).
[2]Calculated using average of Cold War (1960 to 1992, due to data availability) spend share of ~3.7%.
[3]2% Goal line shown also before 2014—the year of the NATO Wales agreement—for illustrating past spending levels; some countries are meeting the 2% goal but, collectively, it is not met.
[4]As share of GDP.
[5]~$1.2 Trillion for NATO Europe as a whole due to some countries exceeding the 2% target.
Source: NATO statistics; World Bank

9   Wuyi Omitoogun and Elisabeth Sköns, "Military expenditure data: A 40-year overview," 2006 Yearbook, Stockholm International Peace Research Institute, 2006.

10   "Accelerating Europe: Competitiveness for a new era," McKinsey Global Institute, January 16, 2024.

The previous period of a lower level of spending has had various impacts on European military capabilities, as our analysis shows:

1. Since 1992, inventories of in-service military equipment have been reduced, in some categories falling by more than half, while modern platforms are substantially more capable and typically more costly than their 1992 equivalents.[11] A direct comparison is hard, but the size of military force that can potentially be fielded or used as a factor of deterrence remains important, even with modern equipment.[12]

2. The availability of major military platforms is lower than the specified target levels, meaning that the number of actual forces that can be fielded is lower than the headline inventory level suggests.[13]

3. In-service systems have a large share of equipment belonging to a generation first introduced about 30, or even more, years ago. For example, in the case of land systems, around 50 percent of total systems in Europe started entering service before 1990; for land-based air systems, this figure is up to 80 percent. In the naval domain, around 40 percent of mine warfare and amphibious vessels, and approximately 50 percent of submarines, stem from equipment generations brought into service before 1990. In the air domain, this accounts for about 35 percent of air systems.[14]

4. A fragmented procurement environment adds complexity to the underlying spending challenge. Further, acquisition decisions are made by individual nations sourcing from a mix of domestic, regional, and global suppliers, with additional specifications to meet local requirements. This increases the risk of inefficiencies and has led to increased diversity in weapons systems across Europe, which may pose challenges to interoperability, joint operations, training, and maintenance (Exhibit 2).

[11] "Invasion of Ukraine: Implications for European defense spending," McKinsey, December 19, 2022.

[12] "Joint communication to the European Parliament, the European Council, the Council, the European Economic and Social Committee, and the committee of the regions on the defense investment gaps analysis and the way forward," European Commission, May 18, 2023.

[13] "Invasion of Ukraine: Implications for European defense spending," McKinsey, December 19, 2022.
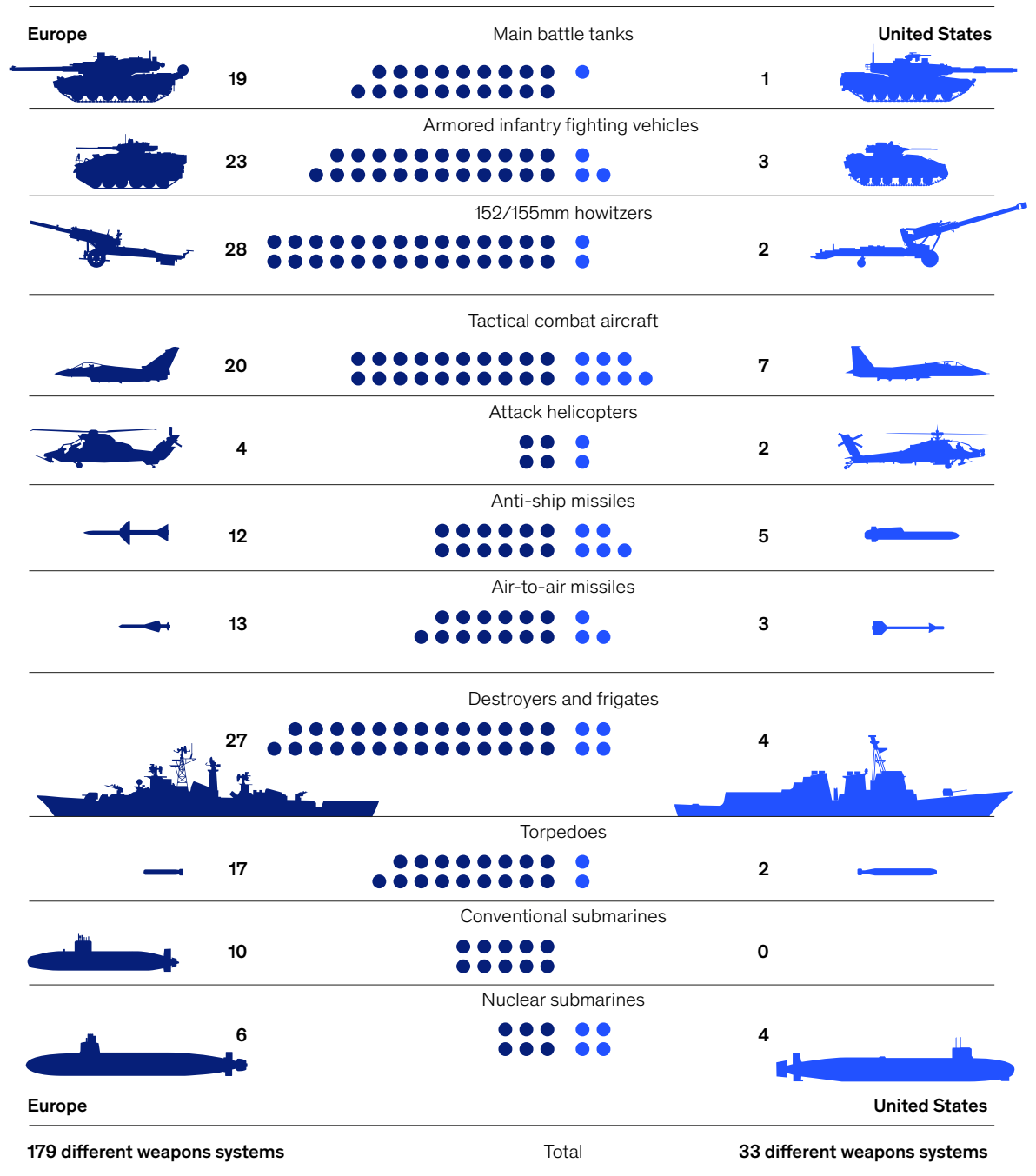
[14] McKinsey analysis, leveraging data from Cirium Fleets Analyzer and *The Military Balance 2023* published by The International Institute for Strategic Studies, among others.

Exhibit 2

Europe has a fragmented landscape of in-service weapons systems.

Different weapons systems in service, 2023,[1] number

Europe			United States
Main battle tanks			
19			1
Armored infantry fighting vehicles			
23			3
152/155mm howitzers			
28			2
Tactical combat aircraft			
20			7
Attack helicopters			
4			2
Anti-ship missiles			
12			5
Air-to-air missiles			
13			3
Destroyers and frigates			
27			4
Torpedoes			
17			2
Conventional submarines			
10			0
Nuclear submarines			
6			4

Europe   **United States**

179 different weapons systems   Total   **33 different weapons systems**

[1]Weapon system categories and grouping partially differ from *The Military Balance 2023* for simplification and comparability with prior versions of the analysis.
Source: McKinsey analysis based on data taken from *The Military Balance 2023* published by The International Institute for Strategic Studies (reproduced with permission)

The fragmented approach has resulted in two to three times as many European suppliers competing at the platform level—aircraft, tanks, and ships—compared to the United States.[15] On average in 2021, before the recent turn in defense posture, Europe's leading defense companies had 30 percent of the revenues of the average US defense company and operating margins were lower by around two to three percentage points.[16] We have found similar analysis on other sectors across the European corporate landscape.[17] Investment into future technologies, measured as a percentage of defense spending allocated to defense R&D, was declining through 2016 before it peaked at slightly above 4 percent in 2021.

At subsystem and component levels, significant fragmentation also shows, for example in areas such as electro-optics, electronic warfare, and aerostructures. With less cooperation and collaborative procurement, there are small program sizes implied, duplication of R&D efforts, and limited economies of scale, which in turn contribute to the comparatively high cost of the European defense industrial ecosystem and might limit also the defense industry's international competitiveness.[18]

Exhibit 3

European nations have announced spend increases that could add between €700 billion and €800 billion over seven years.

Spending of European NATO countries or member states, 2022–28,[1] € billion
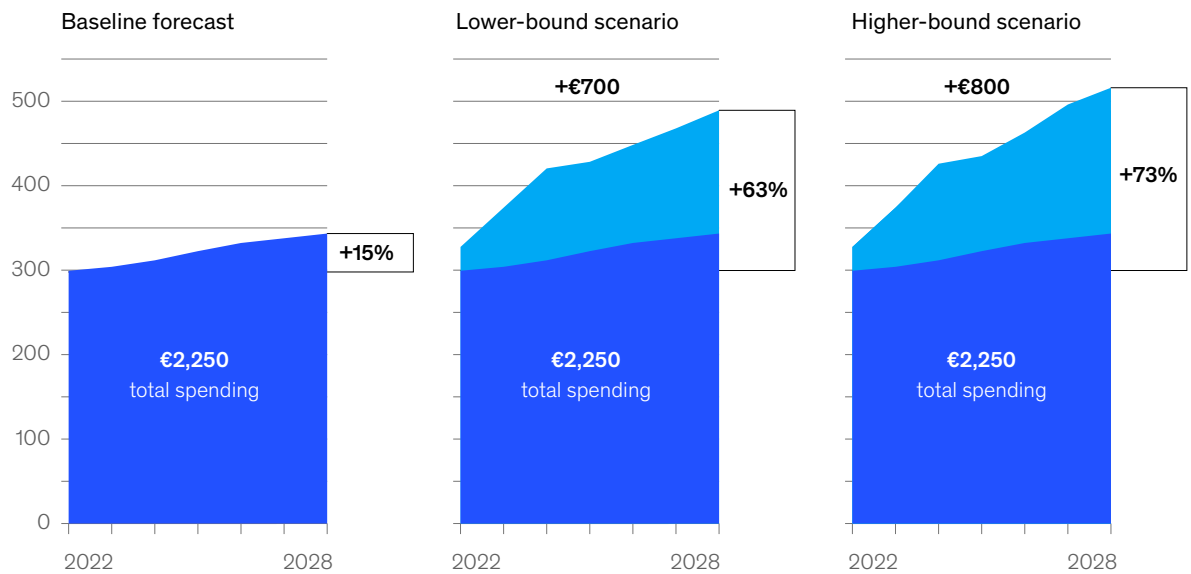
¹Our scenarios and modeling cover all European NATO nations, including Türkiye. They also include Austria, Sweden, and Switzerland.
Source: Government plans and announcements; NATO; McKinsey analysis

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15 McKinsey analysis.

16 McKinsey analysis.

17 "Accelerating Europe: Competitiveness for a new era," McKinsey Global Institute, January 14, 2024.

18 "European Defence Fund: Questions and answers," European Commission, June 7, 2017; "The future of European defence", McKinsey, May 13, 2013.

Defense spending is to increase

Following the invasion of Ukraine, European NATO member states announced plans to spend significantly more on defense in the coming years.[19] If actual spending stays in line with the latest announcements made by European governments, our analysis estimates that cumulative defense spending could increase by €700 billion to €800 billion between 2022 and 2028; total European spending could reach as much as €500 billion per year in 2028 (Exhibit 3).

While this is a marked increase over previous spending levels, it may not balance out the backlog of three decades of lower volumes of investment. In allocating this additional budget, European NATO partners might have to balance short-term goals—for example, increasing readiness and restoring depleted equipment and supply inventory levels—with longer-term goals, such as investing in future defense capabilities and improving the resilience of supply chains and their industrial base.

Planned investment in future capabilities will likely include a substantial investment in developing disruptive technologies, to be carried out at pace, as well as their integration with the existing inventory.

Procurement procedures and production capabilities that have been used over the past 20 years may not be equipped to meet these rapidly paced priorities.

Implications for the European defense industry

The invasion of Ukraine may well contribute to defining the future of warfare and how to prepare for it. A conflict of this nature with the scale of consumption of ammunition and advanced weapons has strained global supply capacity. Further, it has reinforced the need to utilize older technologies, such as artillery, and brought to the fore the importance of newer technologies, for example, unmanned aerial vehicles (drones) of all sizes and types[20]; the importance of the cyber[21] and space domains[22]; the power of high-velocity intelligence fusion and dissemination;[23] and the role of electronic warfare and associated countermeasures.[24] Air and missile defense in general remains a critical way to protect military capabilities, civilian populations, and infrastructure.[25]

[19] For example, France has announced in its LPM 2024-2030 to spend €118 billion more than in the previous LPM 2019 ("The LMP 2024–2030 definitively adopted by parliament," Ministry of Armed Forces, July 14, 2023); Sweden has significantly increased defense spending from 2024 to 2026 and believes it will meet the NATO target of two percent of GDP in 2024 ("Military budget initiatives for 2024," Government offices of Sweden, September 22, 2023); Estonia, after four years of fulfilling the NATO 2-percent goal, decided in 2023 to guarantee a level of at least 3 percent of GDP for the coming four years ("Defense budget," Ministry of Defense, Republic of Estonia, 2024).

[20] "Strategic compass of the European Union," Council of the European Union, March 21, 2022.

[21] "EU policy on cyber defense," European Commission, November 11, 2022.

[22] "EU space strategy for security and defense," European Parliament, November 2023;

[23] "Enhancing EU military capabilities beyond 2040," European Defence Agency, September 2023.

[24] Josep Borrell, "Lessons from the war in Ukraine for the future of EU defence," European Union External Action, May 29, 2023.

[25] "Air defense remains a top priority at meeting on Ukraine defense," US Department of Defense, September 19, 2023.

In addition, the pace and breadth of technology innovation—military and commercial—has increased since the invasion of Ukraine, leading to the development of dual-use technology that can be used for both defense and civilian purposes, as well as leading to the repurposing of civilian technologies for the military.[26]

Following decades where the European defense industrial base evolved to maintain limited levels of production, we now see examples of companies considering to rapidly expand capacity. Given the share of equipment that has been in service for many decades (including before 1990), defense customers are reportedly looking at industry to increase total capacity, which would enable them to grow stockpiles and allow for the replacement of rapidly ageing equipment.[27]

Beyond this, there is an emerging recognition of the historical strength of the engineering and manufacturing supply chains (both defense and nondefense) across Europe that can be brought to bear, including for imported off-the-shelf equipment. However, Europe will need to find the right balance between rapidly importing off-the-shelf equipment that could be required in the short term to satisfy immediate security needs, and building out domestic capabilities to strengthen the local workforce and ensure the sustainability of its security on the long run.

With this in mind, some governments have been starting to ask for tighter requirements for international companies to directly invest in the domestic industrial base, as well as seeking to apportion a greater share of new spending locally. However, Europe still faces the challenge of how to achieve the required industrial scale to enable lower costs, higher production rates, and resilient industrial organizations.[28]

Critical considerations shaping Europe's future defense industrial capabilities

Considering the scale of the European defense transformation currently underway and the existing constraints, both European governments and the European defense industry alike will need to find ways to address the following questions:

Collaboration among players

- How can defense capacity and capabilities be increased while making the European supply base more resilient, effective, and efficient?

- Which mechanisms for collaboration between countries can most effectively support a ramp-up in capacity in the industry and incentivize collaborative agreements that foster supply chain resilience in all partnering countries?

Europe still faces the challenge of how to achieve the required industrial scale to enable lower costs, higher production rates, and resilient industrial organizations.

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[26] Seth J. Frantzman, "How Israel's military is prioritizing dual-use start-ups to accelerate defense tech," Breaking Defense, 2023; Duggan Flanakin, "Making dual-use tech an economic priority," Global Trade, December 6, 2023; "President von der Leyen makes call for powering up European defence," European Commission, December 1, 2023.

[27] Sebastian Clapp, *Reinforcing the European defence industry*, European Parliament, June 2023.

[28] "For critical considerations for Europe overall, see "Accelerating Europe: Competitiveness for a new era," McKinsey Global Institute, January 14, 2024.

- Can M&A and alternative collaboration and financing models help achieve scale and resilience in European defense industry supply chains?

Skills and capabilities

- How can the development of leading-edge, military cloud capabilities and infrastructure be enabled, while ensuring interoperability at the European and NATO level?

- How can talent be attracted immediately to the industry or retrained in response to increased demand, and how can they be retained in the long term? How, too, can talent with the skills needed to design, manufacture, and operate future capabilities be nurtured?

- How can long-term investment in defense innovation be enabled?

Business model of defense industrials

- How can new operating models be developed that will be globally competitive on both capability and cost?

- How can low-volume, highly functionalized industrial setups be transformed into high capacity, integrated ones?

Recent geopolitical shifts have led European countries to reassess their defense spending. By focusing on strengthening capabilities at pace, investing wisely, and adopting new technologies to complement existing ones, Europe can enhance the stability of its future defense and security, while ensuring that peace for its citizens remains the most essential prerequisite.

About the author(s): David Chinn is senior partner in McKinsey's Tel Aviv office; **Nadine Grießmann** is a client activation senior manager in the Berlin office, where **Katherina Wagner** is an associate partner; **Hugues Lavandier** is a senior partner in the Paris office; **Rafael Ocejo** is a partner in the Madrid office; and **Tobias Otto** is a capabilities and insights expert in the Munich office.

Strengthening national security through a more resilient supply chain

Recent disruptions in global supply chains have exposed national vulnerabilities—adopting an end-to-end approach to reinforce supply chain resilience can be vital to national security.

By Tomás Calleja Mediano, Alejandro García-Salmones, Javier Gil Gomez, and Paul Rutten
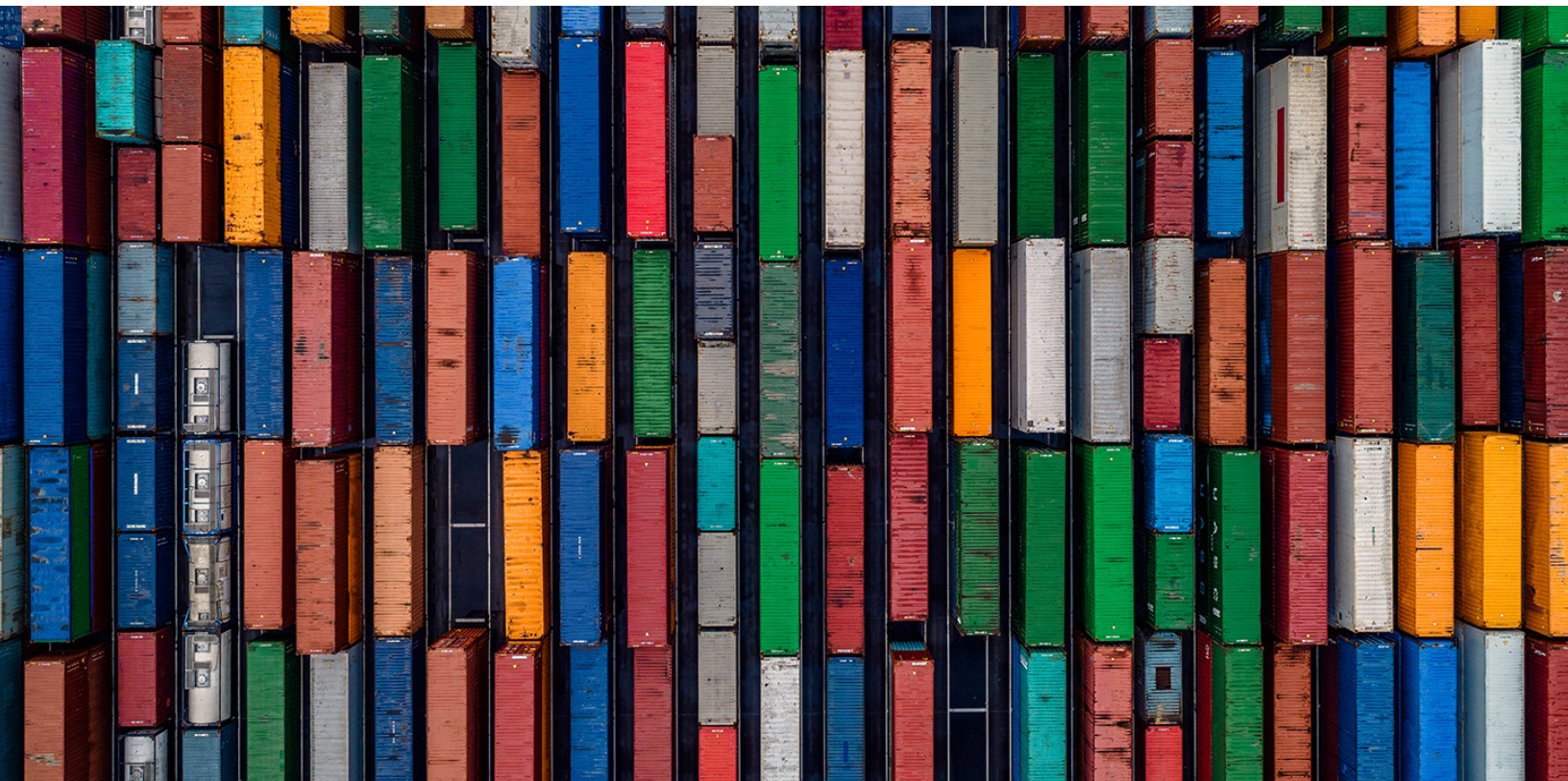
Over the course of decades, the world has been committed to achieving rapid and comprehensive economic integration: global value chains have enabled greater specialization and economies of scale, leading to increased efficiency, lower prices, and a wider range and higher quality of goods and services becoming available. Research conducted by the McKinsey Global Institute on global trade flows illustrates the extent of global economic integration—all regions are mutually interdependent, relying on trade with others for more than 25 percent of at least one important product.[1]

Yet, the COVID-19 pandemic, Russia's invasion of Ukraine, and other geopolitical conflicts have brought globalization and its interdependencies to the fore. They have shown how global interconnectedness can cause regional disruptions that can have far-reaching consequences. Various countries around the world have already experienced disruptions to strategic or essential industrial supply chains due to delays or shortages—for example, the reduction in semiconductor chip production in Asia due to the COVID-19 pandemic and supply chain disruptions had a ripple effect on automakers in Europe and the United States.[2]

Moreover, in coming decades, vulnerabilities in connected supply chains could be aggravated due to intensified rivalry between regions to achieve global influence and could result in more significant challenges to every country's economic and national security.[3] Countries now may need to find a balance between meeting these challenges and becoming more resilient, while not, however, jeopardizing economic development.

Against this backdrop, EU heads of state and governments convened in 2022 to focus on the strategic autonomy of the European Union, where they agreed to take more responsibility for EU security and reduce dependencies, while preserving an open economy.[4] EU member states are striving to reinforce the integrity of the single market through regulatory initiatives, such as the Critical Raw Materials Act and the Chips Act, and to strengthen the resilience of critical supply chains beyond the pandemic response.[5]

As an illustration, the European Union initially established the Health Emergency Preparedness and Response Authority (HERA) in response to the pandemic. Now, in alignment with its efforts to enhance its resilience and strategic autonomy in light of geopolitical and unexpected challenges, the European Union is undertaking measures such as the development of a critical medicines list to proactively mitigate further disruptions.[6]

Nevertheless, there is not yet an EU-wide, overarching mechanism with an end-to-end approach and a single governance specifically designed to address the risk of disruptions in international supply chains across strategic industrial sectors. Such a mechanism, if implemented at a European scale (in coordination with national bodies), could effectively contribute to national and regional security and economic sovereignty through an improved European industrial capacity in critical sectors such as health, defense, technology, and agriculture. The responsible organization will not face an easy task, however, as it will need to demonstrate an ability to remain relevant and targeted enough to manage the high complexity of the supply chains in the sectors addressed.

1   *Global flows: The ties that bind in an interconnected world,* McKinsey Global Institute, November 2022.

2   "Coping with the auto-semiconductor shortage: Strategies for success" in *McKinsey on semiconductors,* McKinsey Global Institute, November 2021.

3   *Global Trends 2040*, Office of the Director of National Intelligence (US), March 2021.

4   "Council adopts conclusion on strategic autonomy of European economic and financial sector," European Council, April 5, 2022.

5   "Critical raw materials: Ensuring secure and sustainable supply chains for EU's green and digital future," European Commission, March 16, 2023; "Digital sovereignty: European Chips Act enters into force today," European Commission, September 21, 2023.

6   The European Commission, the Heads of Medicines Agencies (HMA), and the European Medicines Agency (EMA) have published the first European Union list of critical medicines: "Commission publishes first Union Critical Medicines list to tackle shortages," European Commission, December 12, 2023.

A resilience mechanism for uncertain times

A national, integrated approach developed in one country to address critical supply chain disruptions could be replicated in other countries or become an overarching approach to ensure supply chain resilience at regional scale.[7] The overall 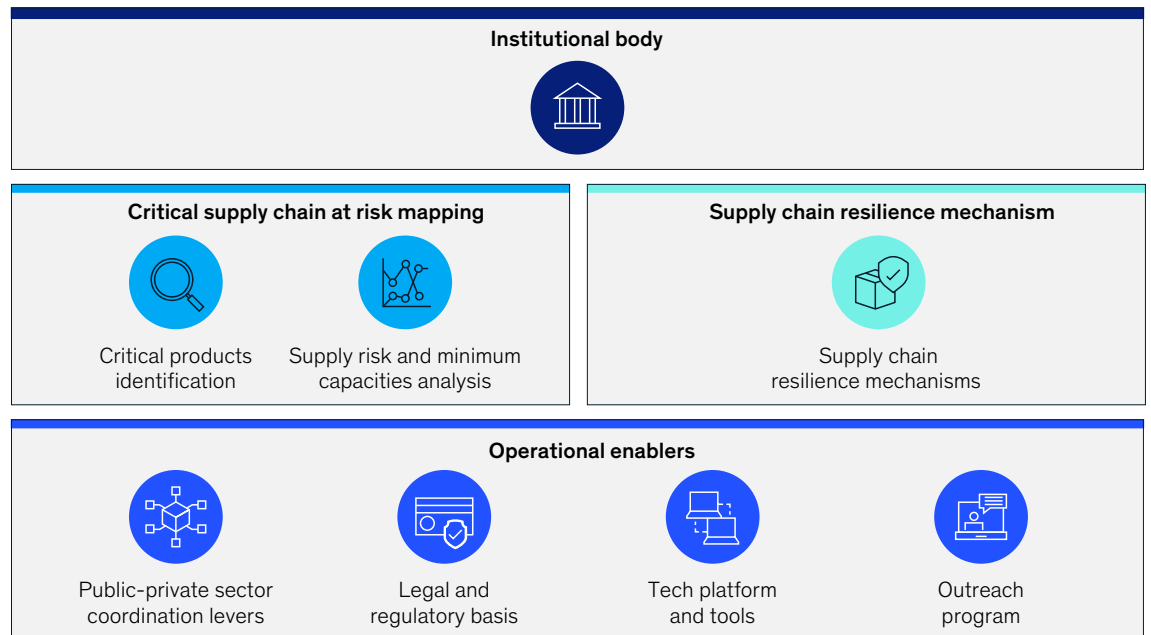goal would be to reinforce resilience to supply chain crises, especially in those sectors that are critical for national security—defense, for example. A true end-to-end integrated approach would need to include four key elements (Exhibit 1).

Institutional body: An overarching institutional body responsible for managing the strategic reserve and coordinating efforts across ministries and directorates through a single governance structure.

Exhibit 1

An end-to-end integrated approach could potentially address risks of disruptions in international supply chains.

Key components

Institutional body

Critical supply chain at risk mapping
- Critical products identification
- Supply risk and minimum capacities analysis

Supply chain resilience mechanism
- Supply chain resilience mechanisms

Operational enablers
- Public-private sector coordination levers
- Legal and regulatory basis
- Tech platform and tools
- Outreach program

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7   An example of such a blueprint is the one being developed by the Spanish Ministry of Industry and Tourism, sponsored by the European Commission (DG REFORM), a first-of-its-kind initiative in Europe ("Spain—technical support instrument: Country factsheet," European Commission, January 2023). There are a few other noteworthy instances of nationally focused initiatives, including the National Emergency Supply Agency established by the Finnish government, which places Finland among the leading countries in the development of supply chain resilience mechanisms ("National emergency supply agency," Finnish Government, 2024). The United States recently announced a similar effort on the creation of the US Council on supply chain resilience ("President Biden announces new actions to strengthen America's supply chains, lower costs for families, and secure key sectors," The White House, November 27, 2023).

Critical supply chain at risk mapping: A tech-enabled methodology to understand national industrial supply chain vulnerabilities by identifying critical products—necessary for individual and national survival—and assessing the associated supply risk to estimate the minimum industrial capacities required for effective risk mitigation.[8]

Supply chain resilience framework: A ranked list of mechanisms that could be used to mitigate the risk to critical products with an associated high risk of supply (Exhibit 2).

Contingency planning: Levers to be implemented before a crisis occurs to increase critical supply chain resilience. An example of a contingency lever could be an early warning system to monitor key indicators of the supply chain to anticipate disruption. It could also include smart strategies like ensuring a multiskilled workforce, approaches to recalling retirees, or even putting out a credible, holistic demand signal for relevant sectors (for example, by showing anticipated demand across certain technologies or highlighting investable bottlenecks).

Diversification: Before implementing more complex (or costly) mechanisms, diversification—where possible—could reduce the national risk associated with critical products by already starting to import, or promoting further imports, from lower-risk sources.
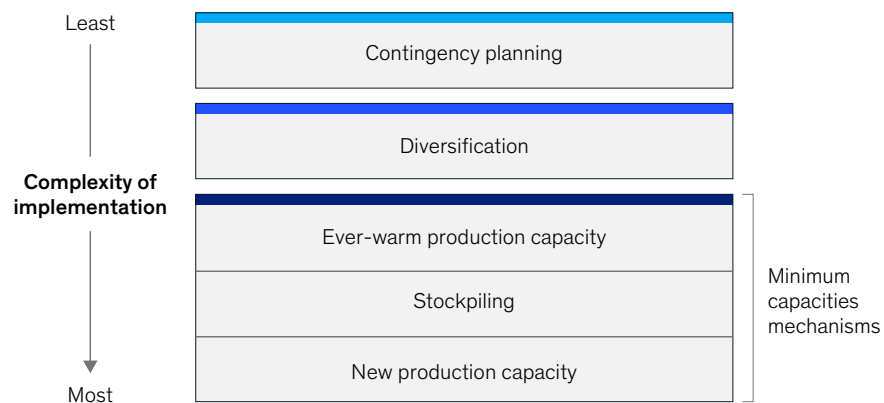
Minimum capacities mechanisms: To be put in place for those products where diversification is not enough or feasible to reduce high or medium risk. This includes three options (from the least to the most difficult to implement):

- cost-effective and efficient storage of products

- capacities that allow a rapid increase of production in times of possible crisis situation—that is, ever-warm production lines

- last-resource actions to build national capacities, such as developing new domestic production of critical products of high or medium risk

Exhibit 2

Capacity mechanisms can be used to mitigate risks to critical products in the supply chain.

Supply chain resilience mechanism by complexity of implementation

Least

Complexity of implementation

Most

Contingency planning

Diversification

Ever-warm production capacity

Stockpiling

New production capacity

Minimum capacities mechanisms

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8 Critical products may differ from one country to another, encompassing essential items such as antibiotics, basic healthcare provisions including personal protective equipment (PPE), as well as a variety of minerals and fuel-related products such as fertilizers or ammunition.

In-depth assessment of these mechanisms for each sector considered is essential, including careful prioritization and recurring reexamination, given the potentially high costs involved.

Operational enablers: A set of elements that could facilitate the functioning of the strategic reserve and its future operations. This could include public-private sector levers (leveraging tax policies, public procurement, or public subsidies); the necessary legal and regulatory basis; a technology platform and tools (dedicated to analyzing vast volumes of trade flow data); and an outreach program (defining the relationships with other entities such as industry, academia, and other public institutions).[9]

An ever-warm production capacity: A potential approach to mitigate critical supply chain risk

A potential resilience mechanism to consider is the development of ever-warm industrial capacity in critical sectors, due to its innovative nature, potentially lower complexity, and flexibility in its implementation. Ever-warm capacity could be a suitable mechanism for urgently needed products and temporary crises such as supply shortages (for up to 12 months).

Developing ever-warm capacity involves partnering with industrial organizations to ensure access to the production capacity of strategic products in a crisis. An ever-warm industrial partner commits to deliver a certain quantity of a product in a specific timeframe and is compensated for the costs and loss of profits associated with the capacity reserved. This compensation is reflected in a "reservation fee," which considers precrisis costs such as inventory holding and equipment maintenance, and postcrisis costs—for example, switching costs and possible penalties for breaching other client contracts.

From a technical feasibility point of view, developing ever-warm capacity depends on the ability to meet at least one of the following criteria: that enough companies are already manufacturing the strategic product; existing companies are capable of adapting their manufacturing lines to produce the strategic products; or there are companies that can expand their manufacturing capacities. Moreover, developing ever-warm production capacity needs to be assessed against the expected cost, which could be high and requires a clear commitment to be sustained during noncrisis times.

We have identified three main operating models for ever-warm production capacity; their suitability depends on how urgently the critical product is needed (Exhibit 3).

A potential resilience mechanism to consider is the development of ever-warm industrial capacity in critical sectors, due to its innovative nature, potentially lower complexity, and flexibility in its implementation.
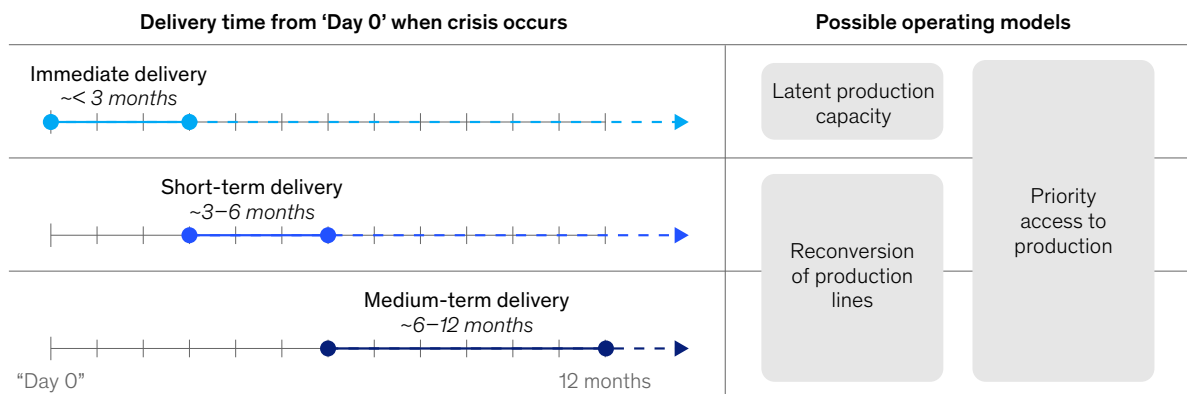
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[9] The technology aspect is especially relevant due to the need for analyzing vast volumes of trade flow data and the security requirements and specifications needed based on the sensitivity of the data handled.

Exhibit 3

The ever-warm production capacity chosen needs to be able to meet the production lead time requirements.

Possible operating models by delivery time

| Delivery time from 'Day 0' when crisis occurs | Possible operating models |

Immediate delivery
~< 3 months

Short-term delivery
~3–6 months

Medium-term delivery
~6–12 months

"Day 0"   12 months

Latent production capacity

Reconversion of production lines

Priority access to production

Latent production capacity is a model in which the industrial partner guarantees access to additional capacity to be used only during crisis events. This is appropriate for the immediate delivery of additional capacity within less than three months.

Reconversion of production lines is a model in which the industrial partner commits to repurpose production for alternative uses. This is suitable for the short- to medium-term delivery of additional capacity—around three to 12 months.[10]

Priority access to production is a model in which the industrial partner commits to redirect existing capacity if need be. This is the most flexible operating model as it enables access to additional capacity at any delivery speed.

Regardless of the ever-warm operating model used, building ever-warm production capacity requires

maintaining a continual partnership approach between the institutional body and the industrial organizations. The process of selecting the most suitable partners can be crucial as well as continually monitoring their preparedness to react against a potential crisis event—for example, ensuring that the industrial organization has sufficient stock or access to critical inputs to ramp up capacity.

Ever-warm learnings

There are relatively few instances of ever-warm production capacity arrangements used to improve resilience in national or regional critical industrial supply chains. Yet, there are various notable examples, which include the EU FAB network in Europe and the Biomedical Advanced Research and Development Authority in the United States, both of which offer insights to apply in subsequent endeavors.[11]

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[10] A specific application of this type of ever-warm capacity could come from repurposing existing assets that are normally doing something else. For example, the Civil Reserve Air Fleet (CRAF) in the US allows the US Department of Defense (DoD) to require airlines to support national security operations when the necessary airlift capacity exceeds the military aircraft available. The DoD incentivizes airlines to participate in the CRAF by bidding out part of its airlift work in peacetime—only airlines that pledge aircraft to the CRAF can bid on this peacetime work.

[11] "Biomedical Advanced Research and Development Authority," Administration for Strategic Preparedness & Response, 2016; "Factsheet—EU FAB," European Commission, April 2022.

In particular, the EU FAB was developed by HERA to create reserve manufacturing capacities and to obtain a priority right for vaccine manufacturing in case of a future public health emergency. This reserve—which amounts to 700 million doses annually—is built through partnerships with pharmaceutical companies and contract manufacturing organizations (CMOs) in the pharmaceutical industry that have committed capacity and stocks of raw materials to produce the committed doses if a public health emergency were to occur.

The study of ongoing ever-warm examples can offer lessons for effectively implementing robust ever-warm industrial production in the future. Considerations include:

Be clear from the start: Be exhaustive and clear when developing the contracts in relation to the crisis declaration process, commitments of quantities and timeframes, specific price structure pre- and postcrisis, and protection against international takeovers or similar geopolitical scenarios.

Keep communication lines open: Traditional contracting approaches may not work. Use instead an open dialogue to engage with the industrial companies involved, both before and during the contractual relationship. Include risk-sharing provisions in the contract to define responsibilities during crises and develop an effective conditions package.

Embrace diversification: Diversify among participating companies and explore potential candidates with vertical integration or consortium structures. Assess diversification not solely based on the number of companies but also considering their footprint and geographical presence.

A more resilient supply chain to strengthen national security

A truly integrated approach toward more resilient critical industrial supply chains could help the European Union better manage the risks and downsides of trade dependencies, improve the entire industrial supply chain, and further develop its industrial capacity in critical sectors. The approach could also harness the benefits of interconnection, thereby leveraging collective strengths and creating a coordinated approach to future disruptions.

The use of smart resilience approaches—for example, developing well-designed, ever-warm industrial capacity—could be helpful in sectors critical for national security, such as defense, as well as for critical products related to basic needs such as antibiotics or fertilizers. Seamless collaboration between industrial and public entities, a partnership approach for enduring and mutually beneficial relationships, and the meticulous design of the key contractual arrangements could be crucial for the successful implementation of mechanisms to enhance national security.

Climate change adaptation and security: Two sides of the same coin

Tom Middendorp, chair of the International Military Council on Climate and Security, discusses the link between climate change and security and the important role that the defense sector can play.

By Hugues Lavandier and Tom Middendorp

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With increasing populations and decreasing resources creating tensions around the world, climate change could have a detrimental impact on national security. In turn, greater insecurity could limit governments and organizations' abilities to address climate change and the associated security risks. In this interview, Tom Middendorp speaks to Hugues Lavandier, a senior partner in McKinsey's Aerospace & Defense Practice, about the role the defense industry can play, in collaboration with the public and private sectors, in mitigating the impact of a changing climate on security. Prior to his current role, Middendorp was the chief of defense of the Royal Netherlands Armed Forces and is the author of the book, *The Climate General.*

McKinsey: A little over a year ago, we interviewed you about the link between climate and national security. What has changed since then?

Tom Middendorp: I think we are increasingly facing a new reality, one that we can't deny: climate change is something we must deal with. Last year, one record after another was broken when it came to high temperatures, droughts, floods, and severe weather events. In the United States alone last year, there were more than 28 separate climate disasters—the highest number on record—causing $92.9 billion in damages.[1] And that's just the direct impact of climate change, let alone the indirect.

However, the disruptive effects of climate change are increasingly being recognized and regarded as a matter of national security. For example, NATO regards climate change as a defining challenge and aims to be a global leader on climate and security. NATO in 2023 decided to establish a Centre of Excellence on Climate and Security in Montreal to deal with the issue.[2] In addition, various NATO member countries are designing mitigation and adaptation strategies for their security sectors; however, not all at the same pace.

McKinsey: You have previously made the point that "climate change is not a stand-alone issue." Could you elaborate on that?

Tom Middendorp: This needs to be seen in the context of four main trends—separate from the technology revolution that continues in the background: population growth, scare resources, climate change, and the geopolitical landscape. The first of these is the increase of the world's population, which currently stands at eight billion. At the start of this century, it was 6.1 billion and the United Nations expects an increase to about 11 billion by the end of this century.[3]

The growth of the world's population will result in growth in the global demand for water, food, natural resources, and livable, arable land. This will result in a growing gap developing between demand and supply, leading to competition and tensions on a global scale. Climate change reduces the livable, arable land on our planet, meaning the current rate of production and consumption of resources is not sustainable in the longer term.

The changing geopolitical landscape is the last trend. We are moving away from a globalizing world toward a more fragmented one with competing coalitions and power blocs. This directly impacts the effectiveness of multilateral mechanisms and our ability to find global solutions, because these mechanisms require consensus.

McKinsey: What could be the potential outcome if the nexus between climate change and security is not properly addressed?

1. Adam B. Smith, *2023: A historic year of US billion-dollar weather and climate disasters,* Climate.gov, January 8, 2024.

2. "Environment, climate change and security," North Atlantic Treaty Organization, January 12, 2024.

3. "World population projected to reach 9.8 billion in 2050, and 11.2 billion in 2100," United Nations Department of Economic and Social Affairs, 2017.

Tom Middendorp: I think we will see impacts on a global, regional, and national level. On a global level, it will lead to more competition between power blocs, which could potentially lead to conflicts. Historically, most conflicts globally have been about access to scarce resources. Therefore, as resources become even scarcer due to the impact of climate change, we can expect more disruptions in global supply chains. This effect on supply chains needs to be integrated into our risk management.

On regional and national levels, climate change directly impacts water and food security, which could lead to internal tensions around access to arable lands and job opportunities. These tensions could easily escalate into internal and regional conflicts. Indirectly, supply chains are disrupted, which could lead to further security issues.

Developing countries in the Middle East, northern Africa, and South Asia, especially, are most affected by a changing climate and its disruptive effects. Countries in these regions are extremely vulnerable to floods and heat waves and are reliant on freshwater supplies from sources outside their own borders.

On a local level, climate change is causing an increase in the occurrence of extreme weather incidents, such as hurricanes, wildfires, flooding, and heat waves. This is already having severe consequences for communities and livelihoods. These incidents represent a "new normal" to which countries and vital infrastructure will need to adapt, bringing new challenges for local and regional crisis response mechanisms.

McKinsey: How can security and defense potentially provide an early warning to alleviate some of the challenges associated with climate change?

Tom Middendorp: I'm not a pessimist, despite having painted a very bleak picture. We need to face the situation, adapt to the changing climate reality, and innovate solutions. We have unprecedented foresight on the impact of this new reality, which gives us a responsibility to adapt and be prepared. The security sector needs to be part of the solution.

On the area of forecasting, it can help to assess the security effects of different climate scenarios by the tools at its disposal such as big data, military expertise, and intelligence services. The sector can identify areas where climate change could lead to migration flows or instability, adding a security lens to help create a more comprehensive picture. Building this comprehensive understanding can help institutions be better prepared. These insights can be translated into early warning mechanisms to increase our reaction times and prevent governments from being taken by surprise.

The disruptive effects of climate change are increasingly being recognized and regarded as a matter of national security.

On the adaptation side, there are internal and external dimensions to what the security sector—the military—can contribute. Internally, it is important to climate-proof organizations to enable them to operate under any climate circumstance and to protect their vital infrastructure (such as naval ports) against the disruptive effects of climate change. Externally, the security sector can help affected countries adapt. As explained earlier, many of these countries are vulnerable to the effects of climate change, so helping them to adapt and become more climate resilient could be regarded as a tool for conflict prevention. The security sector thereby has a vested interest in improving adaptation programs for fragile regions. These are programs that can—and should—be used also to reinforce stability in a country as a means for conflict prevention. There is no adaptation without security, as there is no security without adaptation. These are two sides of the same coin.

The third area of attention is mitigation. On a global scale, we need to find new ways to bridge the gap between growing demand and declining availability of resources. It is not sustainable to meet that growing demand by producing more in the way we are producing now, because that will only lead to a more rapid depletion of scarce resources and to more global competition. It is becoming crucial that we look for ways to become more autonomous and reduce our dependency on scarce resources. This requires us to innovate on circularity and on extending life cycles, reusing materials and components, and using alternative materials that are less scarce. The more self-sufficient countries can become, the less vulnerable they are.

It is important that the security sector recognizes the enormous potential of new green technologies. These technologies can enable the sector to operate more autonomously and become more self-sufficient. New technologies can help security organizations to become energy independent, to produce their own water (by extracting water from desert air with a small solar-powered device), and to print their own spare parts—with 3D printing—without needing to resupply. The defense sector has always been a front-runner on new innovations and can act as a platform for innovation for industries, private companies, and research centers.

McKinsey: You've emphasized that different sectors and various actors in the ecosystem need to come together. What could public-private sector collaboration look like to address some of these challenges?

Tom Middendorp: Collaboration between security experts and scientific research institutes is important. Scientists can use experts' input to build further knowledge on the topic, and this can be used in the diplomatic arena to inform players as they shape new policies based on research. An example of such an interactive network is the International Military Council on Climate and Security—which I chair—where security leaders and research institutes join forces.[4]

There is no adaptation without security, as there is no security without adaptation.

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4   For further information, see the International Military Council on Climate and Security's website, imccs.org.

From a future capabilities perspective, we need to innovate on self-sufficiency, which requires a new kind of cooperation between the public and private sectors, merging old and new technologies into new concepts. It is crucial that defense industries and defense organizations open their gates for innovators, start-ups, and research centers that together can come up with out-of-the-box solutions. This requires companies and organizations to accept risks and be willing to invest in innovation. Nine out of ten innovation attempts will not succeed, yet one successful innovation can help guarantee future security.

An interesting example of this is an initiative called FieldLab SmartBase in the Netherlands, a free space where military users, tech companies, and research centers can meet to look at what they can contribute to achieving one common goal: building a completely self-sustaining military compound.[5] This pulls together many different players who all bring new pieces of the puzzle to the table and create an environment for innovation.

McKinsey: At COP28, the NATO Secretary General again stressed the Alliance's goals to reduce emissions to become net zero by 2050. What can member states do to achieve these objectives?

Tom Middendorp: It starts with member states being made more aware of the need to change the defense sector in relation to a changing climate, for example, by common standards to be incorporated into their climate mitigation and adaptation programs. It's also important to look for the right narrative. There is a perception that climate mitigation and adaptation will cost additional money that will affect operational readiness. It is crucial that these efforts be presented more as an opportunity than a cost. In many ways, if you innovate on circularity and self-sufficiency, you can create military units that are more autonomous and need less logistical supply.

McKinsey: What do you view as the most important message in the context of climate and security?

Tom Middendorp: Climate change is much more than just an environmental problem. I have just returned from Iraq where I saw how the Mosul Dam only contains 20 percent of its capacity, threatening the water supply to large parts of the population. Throughout the country, I met with farmers who have had to leave their lands because of increasing droughts and were struggling to sustain their families.

The geopolitical landscape is becoming more complex, and we are standing at the forefront of a challenge that requires innovation. Because the military can help predict where conflicts could occur due to a changing climate, we can provide unprecedented foresight into the impact that climate change could have.

About the author(s): Tom Middendorp is the chair of the International Military Council on Climate and Security. **Hugues Lavandier** is a senior partner in McKinsey's Paris office.

Comments and opinions expressed by the interviewee are his own and do not represent or reflect the opinions, policies, or positions of McKinsey & Company or have its endorsement.

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5   Evert Brouwer, "Field lab with small and medium-sized businesses," Defense Magazine, February 12, 2016.

Europe's gray-to-green workforce transition in aerospace and defense

The global aerospace and defense sector is facing a talent crisis as its workforce ages, particularly in Europe. Attracting and retaining younger employees will require a radical new approach.

This article is a collaborative effort by Hugues Lavandier, Dana Maor, Giulietta Poltronieri, Andy Voelker, and Brooke Weddle, representing views from McKinsey's Aerospace & Defense Practice.

The race for talent is intense across industries, and aerospace and defense (A&D) is no exception. The best employees, including skilled tradespeople and those with software development and engineering skills, are in high demand globally and know their value. In this environment, A&D companies around the world, despite their strong reputations, may find themselves at a disadvantage when attempting to recruit the best talent; they must compete with big tech companies and start-ups that have created strong value propositions that emphasize the importance of innovation and the creation of leading-edge technologies that change the world. Adding to the burden, A&D companies are dealing with the talent challenge at a time when the sector is growing rapidly, digitalizing many processes, and navigating other pressing challenges, including supply chain disruptions.

While we have previously written about the challenges from a US perspective, Europe faces its own share of pressing workforce issues that represent a significant call to action. The latest European Commission reporting found that 75 percent of companies report difficulties in finding workers with the necessary skills, and 40 percent of adults lack basic digital skills—all
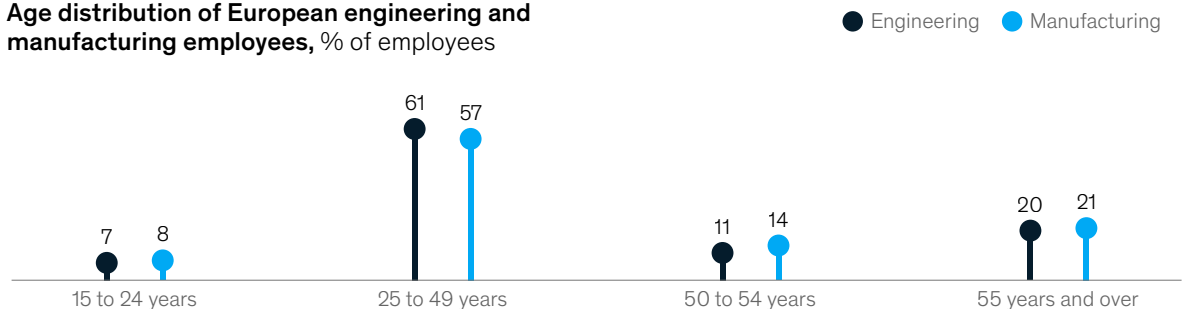
of which has been the impetus for the Commission to kick-start the "European Year of Skills."[1] In response, partly because of the war in Ukraine, a shift in the perception of the European A&D industry and its purpose (specifically the defense side of the sector) has taken place, including at the unexpected intersections of defense and start-ups and tech. For younger talent, for whom purpose matters significantly, this presents an opportunity.

Globally, the A&D sector faces multiple challenges as it attempts to attract younger or "green" employees to companies in which the workplace often skews "gray" and in which many of the most valued staff members are approaching their retirement years. While the United States leads on this trend with about one-third of industry employees aged 55 or older,[2] in Europe, it's closer to about one-fifth of the industry. A significant proportion of the A&D workforce is aged 50 to 54, however—approaching the retirement window. This trend is present among both highly skilled manufacturing trades and advanced technical engineering professions. In the context of broader labor challenges across Europe, this presents a significant risk to the ability to deliver on future, growing industry demand (Exhibit 1).

Exhibit 1

The transition from 'gray' to 'green' employees in Europe creates significant headwinds.

Age distribution of European engineering and manufacturing employees, % of employees

● Engineering   ● Manufacturing

	15 to 24 years	25 to 49 years	50 to 54 years	55 years and over
Engineering	7	61	11	20
Manufacturing	8	57	14	21

Note: Figures may not sum to 100%, because of rounding.
Source: Eurostat

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1   "Commission kick-starts work on the European Year of Skills," European Commission, October 12, 2022.

2   Varun Marya, Michael Park, Andy Voelker, and Brooke Weddle, "Navigating the gray-to-green transition in aerospace and defense," McKinsey, March 16, 2023.

In another major postpandemic shift, workers are now more open to pursuing new opportunities, even if it means moving to a different employer. In Europe, as many as one-third of employees are thinking about changing jobs in the next three to six months.[3] This number is lower compared to the United States, where 46 percent of employees are thinking about changing jobs in this time frame; however, this statistic is still notable in a region with a traditionally less dynamic job market.[4] Younger workers with less job experience are the most likely to make a shift, with research showing they are twice as likely to change employers compared to long-tenured employees.[5]

The demographic shifts, as well as the new attitudes about switching jobs, have decreased talent replacement rates at A&D companies.[6] If companies cannot replace long-tenured employees who retire, and if the turnover rate for young employees is high, A&D companies may find that their workforce lacks some of the most essential skills. In Europe, the situation is even more acute, with employers struggling to keep pace with their American counterparts on this front. This is evidenced by a lower hiring rate and higher attrition rate, especially in areas critical to the future of the industry, such as digital and advanced-analytics profiles.[7] This trend in Europe will likely continue to worsen: as shown in McKinsey's earlier research on female technical talent in Europe, women's graduation rate in higher education from STEM disciplines is declining. At current rates, the share of women in tech roles in Europe is set to decline to 21 percent by 2027.[8] For A&D players in Europe, this is a sobering reality that will require extraordinary measures to change.

New generation, new expectations

Younger workers—the green contingent—tend to have a different conception of the employee–employer relationship than do older employees in the gray group.[9] Younger workers grew up in a world where the internet made goods and services readily available—often instantly or with same-day delivery—and allowed them to conduct much of their social lives online. Not surprisingly, these experiences have shaped what many younger employees now expect in the workplace, and our global research shows that six factors are particularly important to them:

— an easy application process with clear communication and a quick time to hire

— rapid career progression and clear performance feedback (for example, information on how an employee compares to others in similar roles)

— the ability to work in a hybrid workplace (at least in nonmanufacturing roles), with face- to-face interactions primarily reserved for situations where they clearly add value[10]

— the option to explore multiple employers or even multiple careers[11]

— a strong focus on diversity, inclusion, and sustainability, including a workplace that allows for self-expression and sanctions noninclusive behavior[12]

3   Vincent Bérubé, Dana Maor, Marino Mugayar-Baldocchi, and Angelika Reich, "European talent is ready to walk out the door. How should companies respond?," *McKinsey Quarterly*, December 12, 2022.

4   McKinsey Great Attrition/Great Attraction Survey, 2022.

5   Varun Marya, Michael Park, Andy Voelker, and Brooke Weddle, "Navigating the gray-to-green transition in aerospace and defense," McKinsey, March 16, 2023.

6   McKinsey analysis of data from Eurostat, 2023, and the Bureau of Labor Statistics, 2023.

7   McKinsey Org Data Platform.

8   Sven Blumberg, Melanie Krawina, Elina Mäkelä, and Henning Soller, "Women in tech: The best bet to solve Europe's talent shortage," McKinsey, January 24, 2023.

9   Kari Alldredge, Jeff Jacobs, and Warren Teichner, "Great expectations: Navigating challenging stakeholder expectations of brands," McKinsey, December 9, 2021.

10   "Hybrid work is just work. Are we doing it wrong?," Microsoft, September 22, 2022.

11   "How does Gen Z see its place in the working world? With trepidation," McKinsey, October 19, 2022.

12   McKinsey Inclusion Assessment, global benchmark, 2022.

— compelling and engaging communications throughout the hiring process and during the entire workplace tenure, in keeping with younger employees' significant preference for consuming news and information via social media[13]

In this environment, the employee value proposition (EVP) that A&D employers offer has never mattered more. On a global level, the industry lags its highly competitive tech and auto peers on many of the touchstone perceptions of the EVP, including pay and differentiated benefits.[14] That said, when it comes to the A&D industry, Eur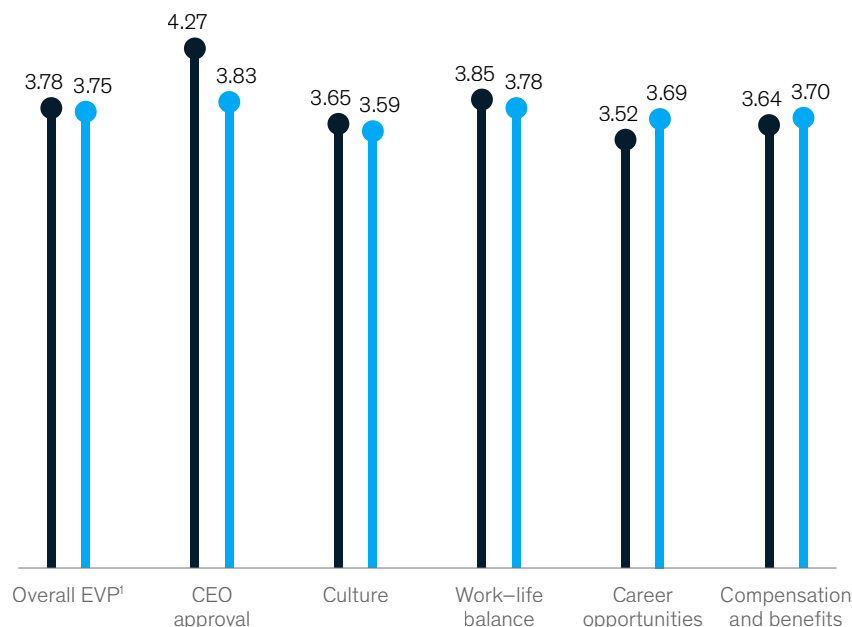ope leads the United States on most elements of the EVP, especially as it relates to perceptions of senior leadership, corporate culture, and work–life balance. This is evidenced at a macro level by data from employee sentiment analyses, as well as at a more granular level by a recent ranking of the best employers in France (in which two A&D players are in the top ten[15]) or by Universum's yearly pulse survey of French engineers, which highlights that six out of the top 15 most attractive players are in A&D.[16] However, beyond what employers offer their employees, Europeans are less in tune with the values, mission, and collective purpose of the aerospace industry than their American colleagues (Exhibit 2).[17]

Exhibit 2

While aerospace and defense employers in Europe offer a stronger employee value proposition, employees are less connected to the industry overall.

Average employee sentiment score, scale of 1 to 5

● Europe ● US

Perceived connection to overall industry, scale of 1 to 5

	Europe	US
Overall EVP[1]	3.78	3.75
CEO approval	4.27	3.83
Culture	3.65	3.59
Work–life balance	3.85	3.78
Career opportunities	3.52	3.69
Compensation and benefits	3.64	3.70
Collective identity	2.68	2.81

[1]Employee value proposition.
Source: McKinsey analysis of publicly available employee reviews, 2020–23

[13] "The news consumption habits of 16- to 40-year-olds," American Press Institute, August 31, 2022.

[14] Eric Chewning, Matt Schrimper, Andy Voelker, Brooke Weddle, "Debugging the software talent gap in aerospace and defense," McKinsey, July 18, 2022.

[15] Bruno Declairieux, "The 500 best employers in France: The 2023 ranking," *Capital Avec Management*, March 9, 2023.

[16] "The most attractive employers in France," Universum, 2023.
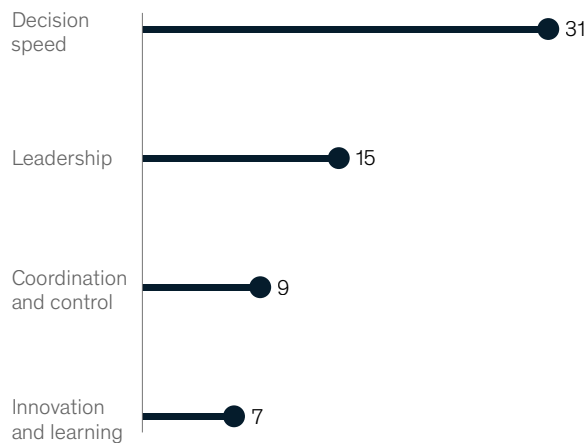
[17] McKinsey Org Data Platform.

Despite geographic variation, the global trend is clear: the prize is high for creating a healthy organization with a strong EVP. For industrial manufacturing companies, including those in A&D, those who get it right are perceived by employees as making faster decisions and having strong leaders, tighter control, and better innovation. Additionally, such companies are better able to hire critical, highly competitive technical talent (Exhibit 3).

Exhibit 3

The prize is high for creating a healthy organization with a strong employee value proposition.

Advantages for top performers with a 'culture premium,'[1] % premium benefit compared to lower performers

Decision speed	31
Leadership	15
Coordination and control	9
Innovation and learning	7

Hiring of technical talent for top performers, % difference in hiring over the past 5 years compared to lower performers

Software engineering	Data and analytics
129	83
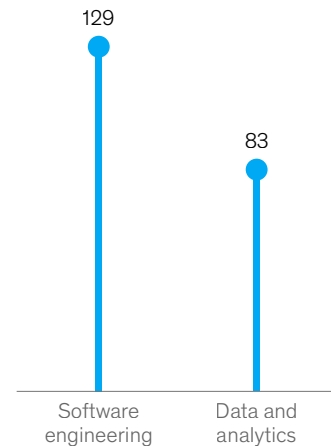
[1]Organizations with a culture premium are those that outperform others on perceptions of culture.
Source: McKinsey analysis of publicly available employee reviews, 2020–23

Despite geographic variation, the global trend is clear: the prize is high for creating a healthy organization with a strong EVP.

Taking a new approach to recruitment

A&D companies that fail to understand the needs of younger employees will find it difficult to recruit them in this competitive market. This is especially true in Europe, where the EVP of the A&D employer is stronger than the tie to the actual industry.[18] With demand for workers becoming even more intense, a lack of talent will increasingly limit an A&D company's growth and performance.[19]

Navigating the gray-to-green transition will require entirely new processes and mindsets. For instance, A&D companies must go on offensive when attempting to recruit the best employees, rather than relying on their traditional channels or hoping that their reputation alone will be a draw. Human resources leaders may want to create new knowledge management solutions and retention strategies. As A&D companies rethink their talent approaches, they may benefit from focusing on three key dimensions (Exhibit 4):

— *The quest for meaning.* This relates to elevating the collective sense of meaning in the sector, especially among the younger generations, to create stronger attractiveness (for example,

in the fields of national security, innovation decarbonization, and new space frontiers) and retention. Middle managers (for instance, forepersons and supervisors) play a critical role in establishing this sense of meaning, and investing in them pays off: new research shows that having more top-performing middle managers leads to much better financial outcomes.[20] This suggests that upskilling and shifting the responsibilities of middle managers is a significant lever to instill meaning at scale.

— *Expanded talent pools.* This includes widening the aperture for talent sources to consider nontraditional talent, strengthening partnerships with external parties, and rethinking cooperation with educational systems. Often, A&D players limit their views of expanded talent-pool levers and primarily develop their own academies, but that tactic has proved not to be enough. In the United States, early traction has already been made by including nontraditional sources in the scope of hiring. A&D players in Europe could look to the many European workers that are skilled through alternative routes but not formally educated. This workforce often has the skills for higher-wage jobs but is overlooked.

Exhibit 4

Effective action will focus on three key dimensions.

Dimensions	The quest for meaning	Expanded talent pools	New career paths and recognition measures
Levers	Employee value proposition	Workforce development	Nonpromotion-based advancement
	Talent attraction	Skills-based hiring	Recognition and rewards
	Middle management	Schedule flexibility	

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[18] McKinsey Org Data Platform.

[19] Doug Cameron and Alistair MacDonald, "Weapons makers can't hire enough workers as Ukraine war drives demand," *Wall Street Journal*, April 24, 2023.

[20] Emily Field, Bryan Hancock, Stephanie Smallets, and Brooke Weddle, "Investing in middle managers pays off—literally," McKinsey, June 26, 2023.

According to LinkedIn,[21] adopting a skills-first approach for hiring could increase the size of the talent pool for European countries by six times. Another global theme picking up steam but not yet fully embraced in Europe is the desire of older adults to continue to work in their old age. Many feel this way (as much as 20 to 25 percent) but are not currently acting on it.[22] This represents another talent pool for Europeans to consider.

— *New career paths and recognition measures.* A&D companies could begin offering more nonlinear career paths or could allow employees to assume new roles and responsibilities before they receive a formal promotion. Recognition could also take new forms. For instance, employees could receive badges if they acquire new skills or receive mentoring from senior employees if they demonstrate strong potential. In some cases, they could even be given responsibility for high-priority projects normally given to those with more experience. Such changes may help companies satisfy employee needs for rapid career progression, visible performance acknowledgment, and the opportunity to try out different roles. Given A&D's commitment to both security and reliability, the talent management of tomorrow will have to focus on expertise and performance, both technical and managerial.

Leading A&D companies understand how critical these changes are and how they are essential to driving future value creation. They also understand the degree of change management that is required to shift an industry that has long benefited from a stable approach to talent management. Those that are making moves are doing so quickly and boldly.

While all A&D companies are struggling to navigate the ongoing gray-to-green transition, European players face the most intense challenges. If they do not adopt a new approach to talent recruitment and retention, they may find that their workforce has multiple capability gaps that hinder both productivity and performance. But it is within their power to reverse the situation if HR and top executives across the C-suite are willing to go on the offense and create new strategies for recruiting younger employees, all backed by sufficient investment and resources. A&D companies can potentially enhance such efforts by working with educational institutions and members of the public sector to develop training programs that provide their students with critical skills. It's a winning proposition for all involved—including the young employees who will find challenging and rewarding work in the vitally important A&D sector.

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[21] "A 'skills-first' strategy for a resilient European labor market," Politico, July 5, 2023; *Skills-first: Reimagining the labor market and breaking down barriers*, LinkedIn Economic Graph, 2023.

[22] "Age is just a number: How older adults view healthy aging," McKinsey, May 22, 2023.

A rising wave of tech disruptors: The future of defense innovation?

Nontraditional sources of innovation are transforming the defense sector with powerful capabilities—but they must overcome obstacles on the path to scalable success.

By Jesse Klempner, Christian Rodriguez, and Dale Swartz.
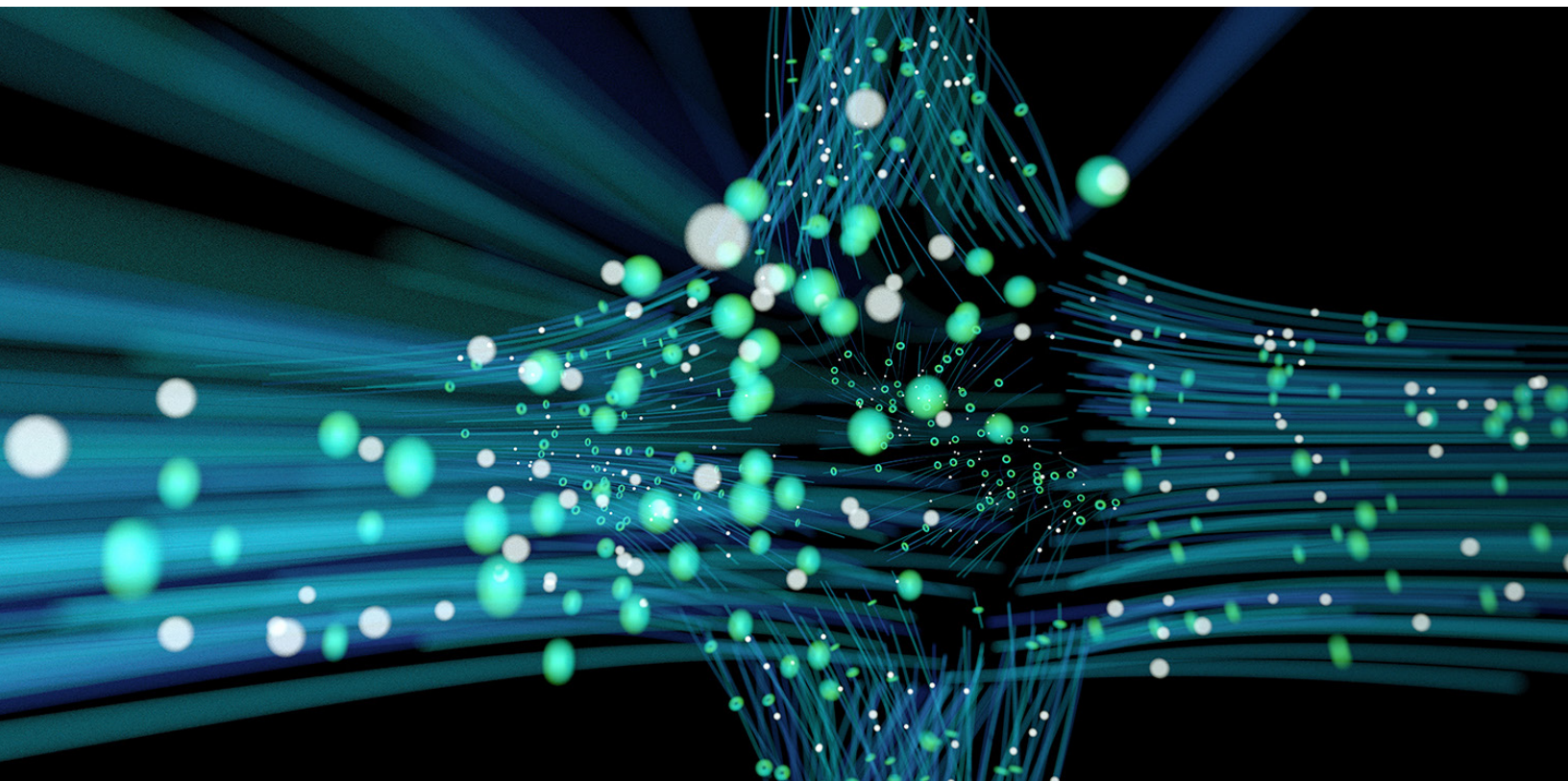
In response to a new era of geopolitical uncertainty and a rapidly shifting national security environment, countries across the world are transforming their military capabilities. And, as new mission needs in this transformation take shape across multidomain operations, different tools are in demand—increasingly supplied by a range of new entrants to the defense industry.

National security customers are showing demand for technologies sourced by firms outside the traditional defense industrial base. This dynamic is not new but has materialized in three distinct waves of defense tech start-ups over the past 20 years (exhibit 1).

For example, in the United States, SpaceX and Palantir were notable companies in the first wave in the early 2000s; both designed technology for government channels other than the Department of Defense.[1] A second wave began in the mid-to-late 2010s, represented by new entrants like Anduril and ShieldAI—both now unicorns—that leveraged commercially derived technology tailored to defense applications (such as sensor fusion at the edge and AI pilots).[2] A third wave of disruption is now on the rise—a much larger ecosystem of start-ups and nontraditional companies that are driving innovation, attracting significant venture capital (VC) funding, and looking for the means to scale.

Exhibit 1

Tech disruptors are increasing in numbers, focusing on a range of defense tech.

US defense tech start-up proliferation,
number of seed funding rounds, 2002–23
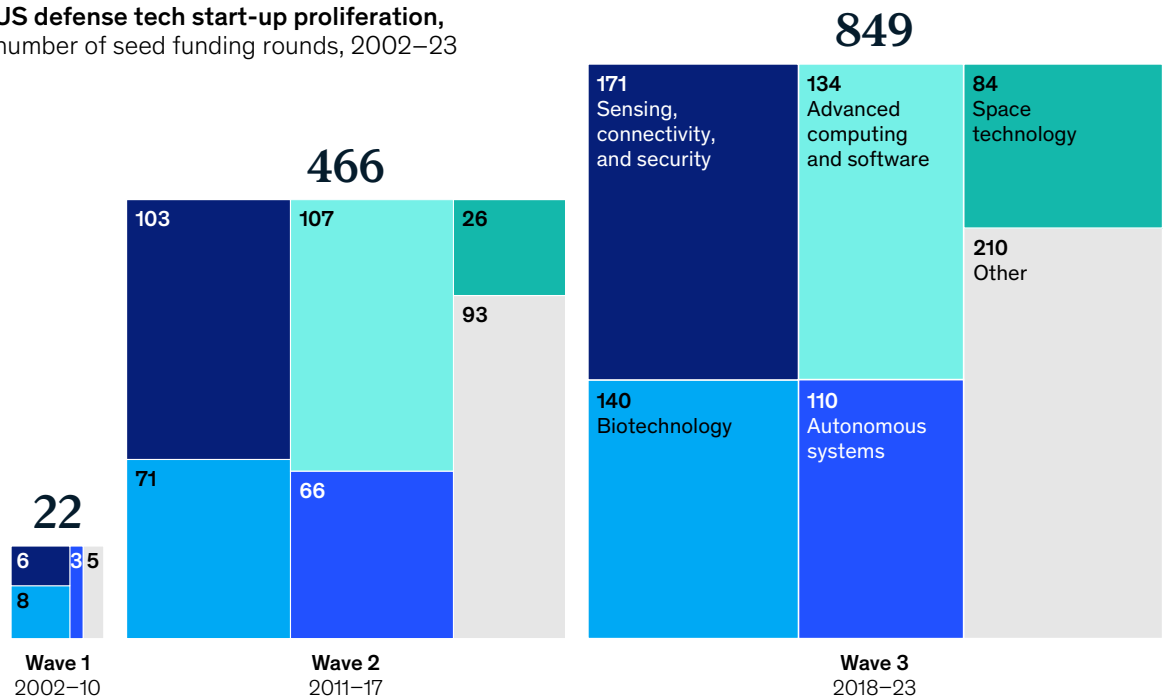
[1]Other includes advanced materials, human machine interfaces, quantum, energy generation or storage, and semiconductors.
Source: Pitchbook; McKinsey analysis

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[1] For further information, see company websites: spacex.com; palantir.com.

[2] For further information, see company websites: anduril.com; shield.ai.

In many cases in Europe and the United States, these start-ups (along with their commercial hyperscaler counterparts) are well positioned to fulfill critical national security needs, complementing the traditional industrial base that might not have enough capabilities to respond to evolving demands on its own.[3] Before large-scale solutions can be reliably supplied for national security users, however, challenges need to be overcome. Effective strategies tailored to fit defense customers could ease the journey, and leveraging dual-use technology (suitable for both military and nonmilitary applications) could be critical to accelerated growth for successful organizations in this environment.

New defense priorities spur new technology needs

For several decades, national security agendas focused primarily on asymmetric and transnational threats such as terrorism and cybercrime. However, sometimes the uncertain global geopolitical environment can cause peer and near-peer competition, as evidenced in the national security strategies published since 2022 in Germany, Japan, the United Kingdom, and the United States.[4] These strategies can lead to demand for new technologies to increase resilience and efficacy—in particular, technologies that will support new disaggregated and "joint all-domain" concepts. We have noticed that there is a call for three overlapping sets of capabilities:

1. **Disaggregating capabilities:** By disaggregating capabilities into networks of smaller nodes, force planners can reduce points of failure and increase the likelihood of successful missions connecting air, land, sea, and space assets. This could improve operational coverage while boosting resilience. Instead of one high-value satellite, for example, the preference might be for an array of smaller, linked satellites; instead of one manned submarine, a coordinated fleet of unmanned underwater vehicles.

2. **Effective communication networks:** For such disaggregated assets to function collectively, real-time intelligence sharing—enabled by resilient and effective communication networks—is important. Resilient networks can ensure instant communication between assets (meshing sensors to effectors) and allow for smooth, responsive operations. Resilient network-enabling technologies such as 5G, phased-array antennas, artificial intelligence (AI), and high-density computing can enable the movement of responsive decision making to the tactical edge where they can have the greatest mission impact.

3. **New technologies**: Engineering high bandwidth, resilient networks would likely involve retrofitting existing platforms—or developing entirely new architectures (such as AI-powered command-and-control systems that connect users across services and collation partners in air, land, sea, and space). The density of technology-enabled mission systems is likely to continue to increase for the foreseeable future. Either way, new technologies—including decentralized cloud computing, data management, edge analytics, autonomy-enabling systems, and a plethora of hardware solutions and novel materials—are frequently cited capability needs.

Start-ups (along with their commercial hyperscaler counterparts) are well positioned to fulfill critical national security needs, complementing the traditional industrial base.

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3   McKinsey analysis.

4   *Integrated security for Germany: National security strategy,* German Federal Government, June 2023; Japan security policy, Minister of Foreign Affairs of Japan, April 2023; "Integrated review refresh 2023: Responding to a more contested and volatile world," Gov.UK, May 16, 2023; *National security strategy*, The White House, October 2022.

In addressing these needs, the traditional defense industrial base can bring various strengths to national security customers: for example, an understanding of specific missions; deep technical expertise in designing for those missions; long-established security protocols and infrastructure to host classified data; business development, customer relationships, and acquisition; program management excellence; and integration opportunities within existing, installed platforms.[5]

These capabilities alone, however, may no longer be enough. In response to evolving needs, a new generation of security tech companies has materialized. This new cohort features both start-ups and commercial technology hyperscalers and can offer different but complementary benefits:

- greater spend on high-risk R&D, relative to size, than the average defense contractor

- top-tier software and a new generation of STEM talent with fluency in digital technologies such as AI, quantum computing, and advanced microelectronics

- product-oriented business models that tend to be faster, cheaper, and more innovative

- a focus on commercially priced, scalable products and services

The European Union and the United States have signaled interest in these novel capabilities. The US Department of Defense has taken steps to access commercial technology through new acquisition and budgeting authorities—for example, increasing the prominence of the Defense Innovation Unit and establishing the Replicator initiative in 2023 to rapidly field autonomous, attritable systems.[6] NATO has formed an innovation accelerator (DIANA) to foster collaboration with start-ups and other tech companies, and has announced the €1 billion NATO Innovation Fund focused on dual-use technologies.[7]

Private capital has also indicated an intent to pursue defense tech opportunities, and we have observed that VC investment in such technologies outpaced the overall growth in venture spending between 2019 and 2023. Meanwhile, traditional defense firms have increased their corporate venture funds to be able to access the emerging tech.

New defense tech companies face obstacles

Despite this momentum, many next-generation defense tech firms have struggled to do business at scale with national security organizations.[8] This is likely due to three main challenges:

Reconciling program-centric versus product-centric operating models. National security customers often seek bespoke solutions to very specific problems versus an "out of the box" commercial offering. With limited access to classified information and other sources of insight, tech firms can struggle to understand the precise nature of these problems. The effort to tailor an existing solution to the "last mile" in defense may also not be compatible with the commercial scale business models favored by tech companies.

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5   *National Defense Industrial Strategy 2023,* US Department of Defense, January 2024.

6   "Memorandum for senior Pentagon leadership, commanders of the combatant commands, defense agency and DOD field activity directors," Secretary of Defense, US Department of Defense, April 4, 2023; Joseph Clark, "Defense officials report progress on replicator initiative," DOD News, US Department of Defense, December 1, 2023.

7   "NATO Innovation Fund closes on €1 billion flagship fund," North Atlantic Treaty Organization, August 1, 2023.

8   Heather Somerville, "Investors are betting on defense startups. The Pentagon isn't," *Wall Street Journal*, January 25, 2023.

Building a go-to-market muscle for defense markets. New defense tech companies can be constrained by unfamiliarity with the government sales and contracting landscape. Scaling a solution in defense markets requires a robust government affairs operation and an understanding of unique government procurement processes. Start-ups, in particular, often lack a track record of performing on programs of record at defense agencies, which can be an important requirement for winning new contracts.

Aligning revenue timelines with investor expectations. Government contracting often offers an atypical return profile to private capital (such as VCs and growth equity) that has become the primary backer of defense tech start-ups. Private investors tend to look at three- to five-year horizons for returns—which can be out of sync with the slower (traditionally seven- to ten-year) pace of defense programs of record. A start-up may run short on funding before consistent revenue from government contracts begins to materialize. This mismatch is likely to deter private investment.

Public markets are unlikely to fill this gap entirely, given their emphasis on short-term results and an aerospace and defense investor base that often emphasizes stable cash flows versus at-risk investments in novel technologies. Meanwhile, governmental entities in Europe and the United States generally invest less in innovation than their private sector counterparts: for example, the US national security community has recently been spending less than 5 percent of its total budget on developing innovative technologies, whereas a typical commercial technology firm spends three to four times that share of revenue annually.[9]

Successful defense tech disruptors use five strategies

How to tackle these challenges? Lessons learned from successful defense tech companies include five strategies that they effectively employ.

Lay the infrastructure for scaling from the outset. Most defense tech companies ultimately become hardware companies, and many are now facing the same scaling challenges as their more at-scale peers and competitors—such as maintaining manufacturing speed and quality, resilient supply chains, and machining or technical talent. Building scaling infrastructure into the initial plan, from prototyping resources onwards, can make the difference on time to market.

Lower barriers by leveraging more established partners. Once a product's validity has been demonstrated, partnership with an established industrial defense company could facilitate its entry to market. Established suppliers can bring installed bases, mission expertise, and customer familiarity that complements tech companies' capabilities. Established suppliers often shape access to the aircraft, land systems, and ships that new mission systems will be integrated into by providing the "socket" into which a disruptor's "lightbulbs" can plug. The list of recent partnership announcements between defense tech disruptors and traditional defense organizations span hardware and software across a range of technology focus areas, including 5G, hypersonic aircraft, autonomy for next-generation tactical aircraft, AI, and edge networks.[10]

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9   Eric Chewning, Will Gangware, Jess Harrington, and Dale Swartz, "How will US funding for defense technology innovation evolve?," McKinsey, November 4, 2022.

10   "Northrop Grumman, AT&T, and Fujitsu demonstrate new 5-G powered open capabilities to support joint force," Northrop Grumman, January 18, 2023; "Strategic relationship 5G.MIL solutions," Lockheed Martin, February 22, 2023; Jaspreet Gill, "ShieldAI, Boeing ink agreement to push AI, autonomous development," Breaking Defense, March 8, 2023; "GM Defence and Anduril announce teaming agreement," Anduril Industries, October 10, 2023.

Take, for example, defense disruptor, Helsing, which was able to get to a program of record in fewer than three years by partnering with an existing defense prime (Saab). Helsing's AI and signal processing expertise complemented Saab's hardware-based sensors and self-protection systems. As a result of the two companies growing closer, Saab in September 2023 made a sizeable investment of €75 million in Helsing's most recent venture round, at an overall valuation of €1.5 billion.[11]

Go dual use. Purely defense focused start-ups can struggle to achieve scale before investors become frustrated with delays. But, companies that find nonmilitary applications for their technologies can build scale in commercial markets, while buying the time needed to secure a long-term defense contract. However, pursuing dual-use innovations may also mean designing a two-speed business model to accommodate disparate timelines and unique international security requirements.

Strong demand and healthy capital inflows have allowed certain dual-use tech organizations to thrive. Private investors, who have a higher tolerance for risk than public markets or government R&D appropriators, in many cases are looking to back dual-use technology, given its large potential returns and broad applicability.[12]

Vertically integrate to provide software and hardware in one solution. Defense customers generally are comfortable with purchasing integrated hardware and software products, rather than stand-alone software capabilities that can be applied to a range of hardware. For tech disruptors, opting to sell a piece of differentiated software packaged within hardware can be beneficial (for example, a fleet of ready-to-deploy drones rather than a drone operating system).

Tailor sales capabilities to the customer. Selling to defense customers can be a challenge if a company hasn't set up a government affairs unit with proper clearances and extensive experience. Tech companies can look beyond a defense organization's broad requests for proposals and focus on communicating with potential customers about granular needs.

Defense oriented technology is a vital and enduring component of national security. Start-ups, scaled commercial organizations, traditional defense contractors, and investors all have roles to play in integrating innovative new technologies into the defense ecosystem.

About the author(s): Jesse Klempner is a partner in McKinsey's Washington, DC, office and a leader in McKinsey's Aerospace & Defense Practice; **Christian Rodriguez** is an associate partner in the Washington, DC, office; **Dale Swartz** is a partner in the Bay Area–Silicon Valley office and a leader in the Aerospace & Defense and Tech Practices.

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11 "Saab signs strategic cooperation agreement and makes investment in Helsing," Saab, September 14, 2023.

12 McKinsey analysis.