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Building and managing  
supply chain resilience  
in aerospace and defense

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# The imperative for aerospace and defense companies to build and manage resilient supply chains

Aerospace and defense (A&D) companies are part of a highly complex network, comprising hundreds or even thousands of suppliers in a multi-tiered, webbed relationship. The A&D supply chain includes a complex ecosystem of original equipment manufacturers (OEMs); multiple tiers of suppliers; maintenance, repair, and overhaul (MRO) providers; and customers, including commercial airline carriers and militaries. This makes transparency across the entire supply chain extremely difficult. Moreover, as the supply chain has been globalized over the years and cuts across geographies, A&D companies are often vulnerable to disruptions.

The COVID-19 pandemic caused widespread disruption across the A&D industry. Commercial aerospace companies experienced a decline in demand and production as passengers stopped traveling, workers went home, and customers deferred delivery of new aircraft. Demand for spare parts also declined since less maintenance was required. Lower aircraft demand and restrictions on the movement of people and goods led to a breakdown of many essential supply networks and missed customer deliveries. As most A&D suppliers are highly specialized with unique expertise and complex equipment, they struggle to make quick changes to production in response to varying demands. The challenge is accentuated as many suppliers serve both commercial aerospace and defense. Any spillover risk from commercial aerospace could leave defense OEMs vulnerable to sourcing critical parts for their programs and platforms.

Even as the industry was gradually recovering from the disruption caused by the COVID-19 pandemic, Russia's invasion of Ukraine (the invasion) has further disrupted A&D supply chains and trade flows.

The invasion is causing additional stress on an already weakened global aerospace supply chain, limiting the industry's ability to meet demand. The invasion has also raised fundamental questions about whether the industry is too dependent on particular countries or regions and if diversification should be considered. The invasion could accelerate the shift from global to regional sourcing, including the exchange of raw materials, parts, and finished A&D goods between the West, Asia, and Russia. It could lead major OEMs to reduce dependency on Russia for raw materials and on Asia for components and finished goods.

This article analyzes the impact of the invasion on the A&D supply chain and provides approaches that A&D companies could consider to build resilience and navigate current and future supply chain disruptions.





## Russia's invasion of Ukraine exposed the industry's dependence on a few regions for critical metals and minerals

A commodity supercycle was already emerging, underpinned by COVID-19 and macroeconomic uncertainties, but the invasion has pushed price volatility and commodity exposure to record levels. As Russia is the 14th largest economy by goods exports (\$337 billion), the invasion has had ripple effects across the A&D industry due to Russia's strong and competitive advantage in supplying several crucial commodities.<sup>1</sup> Russia is a significant exporter of some of the world's most essential commodities.<sup>2</sup>

Leading global aerospace OEMs rely on Russian titanium, primarily for wide-body aircraft—as Russia supplies an estimated 50% of the titanium grade required for aerospace manufacturing,<sup>3</sup> signaling a much greater exposure and risk in this commodity specifically. Globally, titanium is the fourth rarest element, and a significant share of the titanium supply chain for the aerospace industry passes through Russia.<sup>4</sup>

Ukraine supplies about 50% of the global neon gas demand,<sup>5</sup> essential for semiconductor chip production. As a result, semiconductor supply chain constraints may hold back

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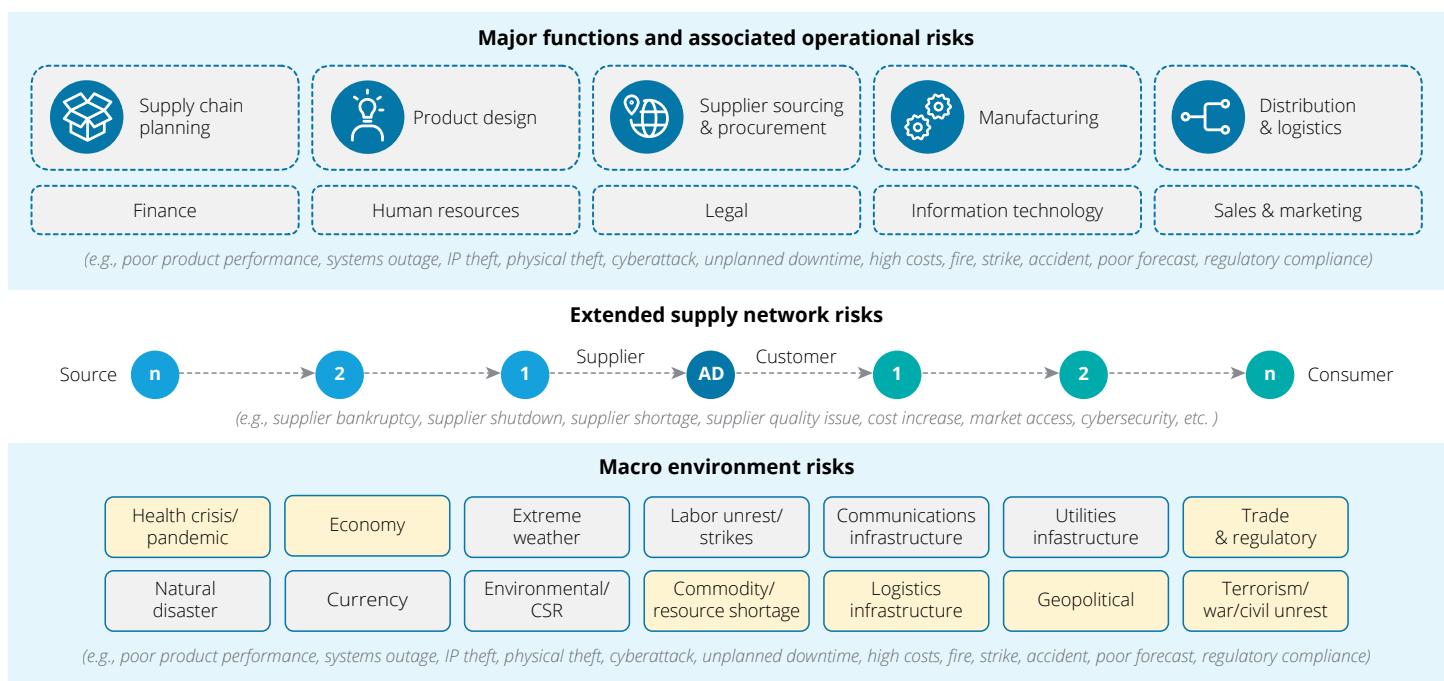
production as nearly 90% of neon (used for etching circuits on silicon wafers) consumed by US companies to produce semiconductors is sourced from Ukraine and/or Russia.<sup>6</sup> Russia also supplies other materials such as aluminum, nickel, cobalt, and vanadium.<sup>7</sup>

# The invasion is shifting focus from traditional “operational” supply chain risks to a much broader set of risks

Even before the pandemic and the invasion, supply chain risks were rising, as was their potential impact on business performance and shareholder value. Events that may have once been considered “outliers”—high impact but low probability events—now seem to be an almost regular occurrence. This is because, in a globally interconnected business environment, challenges that used to remain isolated in the industry

now have far-reaching impacts. The interconnected nature of supply networks in today's globalized world means that disruptions in one region could have global impacts as A&D companies today rely on much more heavily interconnected global networks built for efficiency. As a result, A&D companies are now exposed to a much broader set of risks than in the past (figure 1).

**Figure 1. Growing supply chain risks for the A&D industry**



**Note:** Yellow shaded boxes denote the most pertinent current macro risks.

Source: Deloitte analysis.

Building for efficiency has often come at the cost of redundancy and resilience. Disruption to any nodes across these global supply networks can lead to impacts across the entire network. These disruptions can often come from suppliers beyond tier 1 and several tiers

deep in the network. Therefore, in the wake of COVID-19 and the invasion, A&D companies worldwide are again reminded of the importance of supply chain resiliency in an increasingly volatile world.

# Three ways in which the invasion could impact A&D supply chains

Russia's invasion of Ukraine will likely impact A&D supply chains in three significant ways: (1) forced decoupling and the resultant impact of critical minerals on A&D companies, (2) uncertainty around the demand for commercial aircraft, and (3) increased defense spending and localization. Let's examine each of these in a more detailed manner.

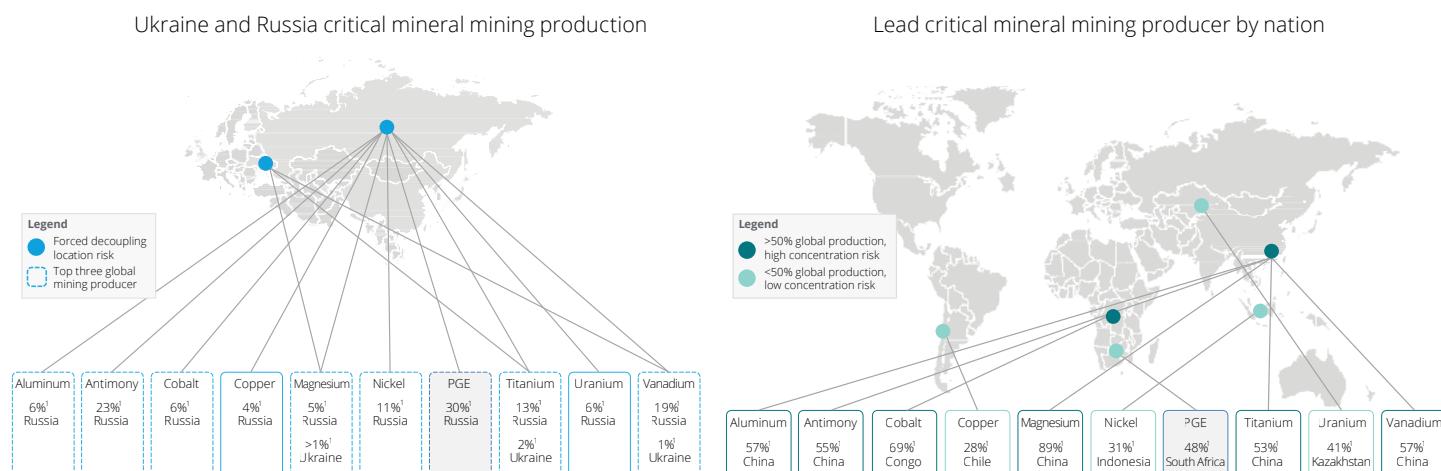
## 1. Forced decoupling and the resultant impact of critical minerals on A&D companies

The invasion has forced a global decoupling from the Russian supply of critical minerals, which increases industry reliance on other concentrated hubs. Ten critical minerals pose a significant supply security concentration risk due to the forced decoupling from

Russia, with eight of these in the top three global productions: aluminum, antimony, cobalt, magnesium, nickel, PGE (platinum-group elements that include platinum, palladium, rhodium, ruthenium, iridium, and osmium), titanium, and vanadium.<sup>8</sup>

The forced decoupling reduces the supply of these minerals and increases industry reliance on other concentrated hubs such as China for titanium and Africa for PGE, as they are the lead global producers of six of the eight prioritized Russian source-critical minerals, producing over 50% of the worldwide production.<sup>9</sup> This could create additional concentration risks, impacting metals and mining's global multi-tier supply network (figure 2).

**Figure 2. Forced decoupling to result in further geographic concentration risks**



**Note:** USGS. All numbers are of approximate value. This information is collected using the Illuminate capability from a range of open sources. Consequently, further contextualization of this information with relevant stakeholders may be required before any decisions are made. The Deloitte member firm network provides services to thousands of companies around the globe, some of which may be included in this report. The analysis conducted is independent from services provided to other entities included in this report. This analysis is designed to be illustrative and should not be relied upon in any way.

Source: United States Geological Survey (USGS)

As a result, A&D companies could face significant issues, including production delays due to raw materials shortages and international shipping bottlenecks. And longer delivery times could delay A&D manufacturing activity dependent on imported goods. Furthermore, soaring prices for energy, transportation, and critical materials increase operating costs, potentially impacting margins.

## **2. Uncertainty around the demand for commercial aircraft**

As of May 31, 2022, about 40 countries, including EU countries, the United Kingdom, and the United States, have closed their airspace to Russian airlines. Russia has, in turn, banned airlines from most of those countries from entering or flying over Russia. International traffic between Russia and the rest of the world accounted for 5.2% of global international traffic but only 1.3% of total global traffic in 2021.<sup>10</sup> International air traffic to and from Russia accounted for 5.7% of total European traffic in 2021.<sup>11</sup> Moreover, Ukrainian airspace is closed, putting a halt to the movements by air of roughly 3.3% of total air passenger traffic in Europe, and 0.8% of total traffic globally, as of 2021.<sup>12</sup> With Russian airspace closed to carriers from 40 countries, flights have been rerouted or canceled.<sup>13</sup> The most heavily impacted markets are Europe-Asia and Asia-North America. This includes flights between the United States and Northeast Asia and between Northern Europe and most of Asia.

As for cargo, Russia accounted for 2.5% of global total dedicated cargo flights in 2021, but the importance of these flights for global heavy-weight cargo is significant, and the corresponding capacity will be difficult to replace.<sup>14</sup> Both domestic and international dedicated cargo flights for Russia have deteriorated markedly since the invasion started. Jet fuel prices have risen sharply since the start of the invasion. They were at \$158 per barrel on May 26, 2022, up about 114% year over year.<sup>15</sup> Upward pressures on prices could continue, mainly if more stringent sanctions are applied to the Russian energy sector and depending on potential increases in production elsewhere. Rising jet fuel prices and the loss of capacity are likely to push air cargo rates even higher, which are already close to record highs.

The impact on passenger and cargo traffic could affect order books and deliveries for OEMs. As new orders are uncertain or likely to remain subdued in 2022, the aircraft backlog could decline further. Any OEM rate reductions could adversely impact the extended commercial aerospace manufacturing supply chain, especially the mid-to-lower-tier suppliers. Moreover, due to expected lower aircraft utilization rates, the sale of aftermarket parts and services could also remain weak. Specifically, the potential decline in aircraft sales to Russian airlines could create openings for airlines from other geographies to purchase the new aircraft. Commercial aerospace companies could also likely experience a loss in revenue associated with MRO activity on aircraft from Russian airlines.

Fuel expenses, which factor in consumption, hedging, and other elements, represented around 25% of airlines' operating expenses before the pandemic.<sup>16</sup> For airlines, an increase in operating expenses due to rising jet fuel prices may hit hard as the industry is recovering from the pandemic. This could, in turn, create further uncertainty around aircraft orders placed at commercial aerospace manufacturing companies.

**The interconnected nature of supply networks in today's globalized world means that disruptions in one region could have global impacts as A&D companies today rely on much more heavily interconnected global networks built for efficiency.**

### **3. Increased defense spending and localization**

The invasion has prompted many countries to raise their defense budgets. European countries and those outside of the continent are increasing or contemplating an increase in their defense budgets in response to the invasion. Early into the invasion, Germany announced it was committing \$113 billion in military spending.<sup>17</sup> The country plans to invest more than 2% of its gross domestic product in defense. Sweden said it would enhance its expenditure on security to strengthen military capabilities and bring forward the rearments.<sup>18</sup> In addition, other countries such as the United Kingdom, France, and Canada are contemplating a rise in their defense spending.<sup>19,20</sup> As a result, the defense industry is expected to see an unprecedented boost in revenue.

The invasion is also changing the defense procurement balance. It could catalyze changes in procurement priorities, and defense companies must be ready for this change. For example, Ukraine's successful fielding of the Turkish unmanned combat aerial vehicle (UCAV) against Russian forces could encourage defense customers to choose UCAV from different vendors that match their operational requirements. Compared to the US alternatives, these solutions are generally cheaper and can be procured rapidly off the shelf with no government-imposed constraints on the end user. Defense manufacturers from countries like Turkey also offer domestic co-production options, which are attractive to customers keen to develop their indigenous industry, cutting into the market share of US suppliers, possibly even in traditional US defense sales strongholds. In addition, the procurement modus operandi in Europe could also change because of the invasion. For example, Germany, which has traditionally favored joint military procurement programs, could be more open now to accelerated off the shelf purchases to improve operational readiness and look at nontraditional military suppliers to diversify its equipment portfolio.

Furthermore, the invasion has highlighted the importance of digitally integrated air defense systems and military cybersecurity within the defense supply chains. As the potential for cyberattacks continues to grow, defense industry affiliates could look beyond the minimum requirements within the self-reported compliance checklist and build a proactive, broader approach to managing risks within their enterprises. This approach would include formalized policies and identifying patterns and practices mapped to existing defense department requirements to assess supply chain risks and better manage potential supply chain vulnerabilities. As militaries cannot afford to have unreliable entities in their supplier network, the invasion could drive further localization and sourcing from "trusted trading nations" that share the same objectives.

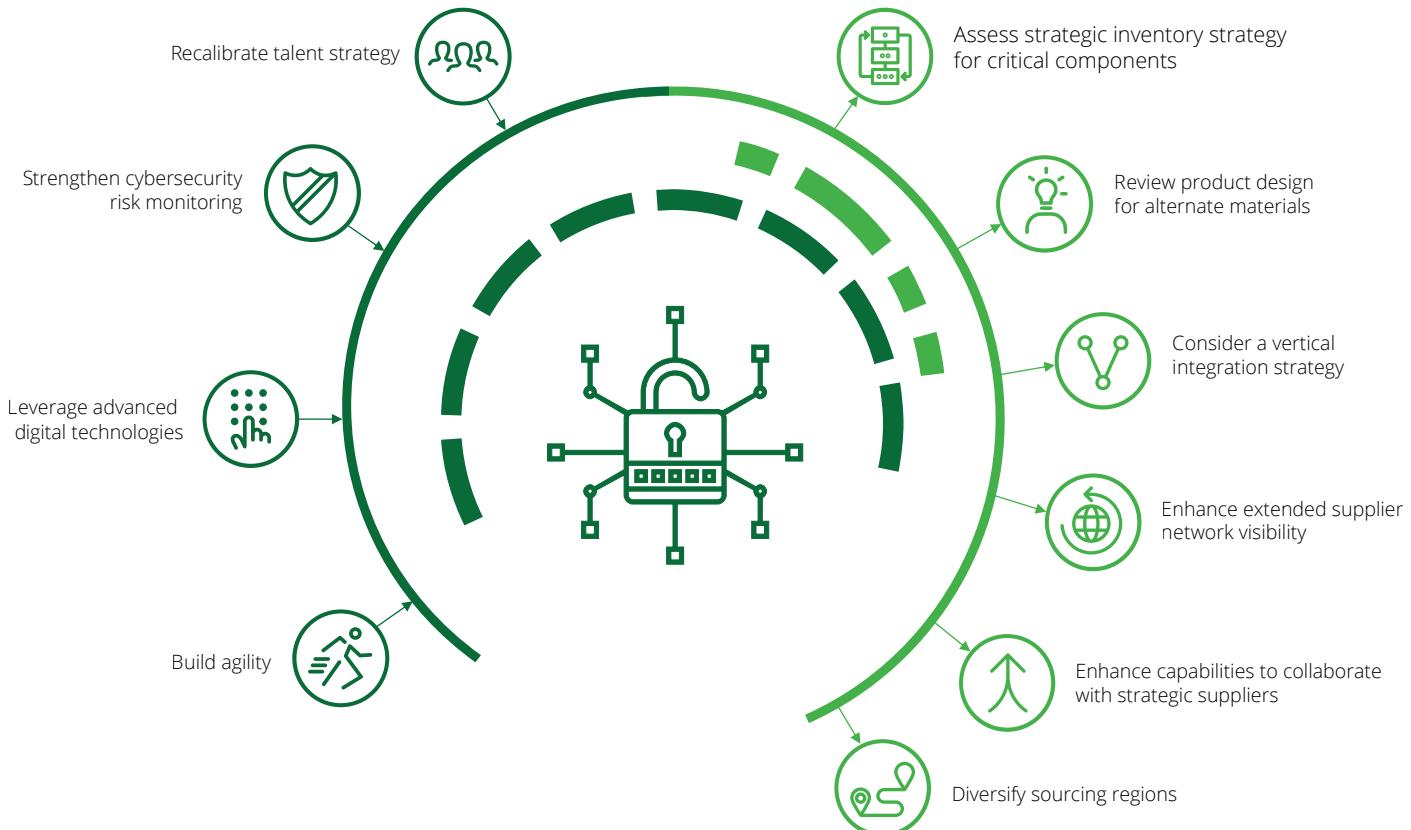
*Any OEM rate reductions could adversely impact the extended commercial aerospace manufacturing supply chain, especially the mid-to-lower-tier suppliers.*

# The way forward: Building and managing resilient A&D supply chains

To better manage supply chain volatility and disruptions, A&D companies should build resilient supply chains. They should have a comprehensive long-term strategy in place, which can help build resilience in the face of shifting geopolitical landscapes and trade flows.

Industry leaders should put their energies into supply chain improvements and make strategic decisions that mitigate risks and drive long-term growth. There are 10 critical approaches to consider in building and managing supply chain resilience (figure 3).

**Figure 3. Building and managing resilient A&D supply chains**



Source: Deloitte analysis.

## 1. Assess strategic inventory strategy for critical components.

Traditional statistical safety stock approaches buffer against only normal demand and supply variability, not the types of significant disruption seen through the COVID-19 pandemic and now the invasion. Beyond components, this analysis should also include key commodities and strategies to ensure access to supply.

## 2. Review product design for alternate materials.

As the supply of many critical minerals is relatively concentrated, including in high-risk geographies such as Russia, A&D organizations should evaluate alternate materials. For example, some companies are already shifting from palladium to platinum to reduce sourcing risk.

## 3. Consider a vertical integration strategy.

A&D companies should evaluate opportunities to secure the supply of critical materials through direct contract arrangements with upstream suppliers. For example, a leading carmaker is securing the critical minerals required for modern batteries through a strategy of vertical integration. A&D companies may also want to consider bringing specific capabilities in-house. For example, the ability to rewrite software code to work with available semiconductor supply has provided some companies with the flexibility required to complete products and keep supply chains flowing.

## 4. Enhance extended supplier network visibility.

A&D companies should enhance their ability to track and monitor supply chain events and patterns, enabling proactive actions by monitoring supplier performance and compliance, monitoring the flow of material from upstream (e.g., tier 2 and tier 3) suppliers to end users, and having a line of sight into end-user consumption and usage patterns. This could help A&D companies to adapt to disruptions without significantly increasing operational costs quickly. OEMs have a significant opportunity to use technology to increase visibility

beyond tier 1 suppliers in the supply chain—to control better and understand where risks lie. A&D companies should also enhance their supplier network risk-sensing capability by opening new suppliers' channels and focusing on strategic sourcing activities, including the geographic concentration of suppliers.

## 5. Enhance capabilities to collaborate with strategic suppliers.

A&D companies should further improve their ability to shift manufacturing capacity when needed. A strategy to collaborate with leading local players in the critical production regions provides A&D companies with the flexibility to adapt to the changing geopolitical and trade shifts. Identification of alternate suppliers that can manufacture products in the event of a disruption provides A&D companies with the ability to reroute materials to meet changing demands. While some risks exist, such as capacity constraints, enhancing capabilities to collaborate with strategic suppliers requires a well-defined and technology-enabled collaborative workflow to ensure that constraints are visible, priorities are clear, and end-to-end supply chain flows are synchronized. Moreover, by establishing alternate suppliers, A&D companies can reduce the risk and reliance on a single supplier or a supplier of significant concentration.

## 6. Diversify sourcing regions.

A&D companies should diversify sourcing regions of critical metals such as titanium to source directly from other countries. For example, before the invasion, Russia provided up to 20% of the world's raw titanium. So, A&D companies can diversify their sourcing to other regions, such as China, Japan, Kazakhstan, and the United States, which produce the balance of the world's supply of titanium. "Friend-shoring" is an important consideration in looking at new regions, as is ensuring that the supply ecosystem is also diversified in moving to a new region. For example, moving supplier sources from China to countries in Southeast Asia may reduce risk. However, if the supplier networks to these Southeast Asian suppliers are still concentrated in China, the risk has not materially changed.



### **7. Build agility.**

A&D companies should build the agility to alter inventory levels during periods of disruption by measuring the level of risk for critical suppliers and components. By developing deep symbiotic and trust-based relationships with supply chain partners and other key strategic networks, companies can access end-to-end supply chain inventory data and supplier capacity constraints. Companies can then mitigate single points of failure by using strong relationships with small- and medium-sized vendor firms, including providing support and access to financing. Also, read [Deloitte's recent article](#) on the case for an agile supply chain.



### **8. Leverage advanced digital technologies.**

A&D companies can make data-driven decisions and better prepare and position themselves to deal with uncertainty by leveraging advanced enterprise resource planning (ERP) systems, digital technologies such as digital twin, and digital supply networks (DSNs). A&D companies could embrace increased use of advanced digital technologies to boost productivity—automating internal processes and streamlining workflows, implementing smart management systems, and using data analytics could help them better prepare and position themselves to deal with uncertainty.

The war is also changing the defense procurement balance. It could catalyze changes in procurement priorities, and defense companies must be ready for this change.



### **9. Strengthen cybersecurity risk monitoring.**

As supply chains become digital, digital attacks could now be part of modern warfare. Industry players should reinforce the critical need for military cybersecurity, military cloud privacy, and the resilience of the systems and automation to be prepared effectively for any state-sponsored and organized attacks within core operations and with key suppliers.



### **10. Recalibrate talent strategy.**

A&D companies should remodel and revamp their talent strategy to incorporate workforce demands relative to scaling up production and developing the digital skills needed today and in the future. Industry leaders should recalibrate their talent strategy by investing in training and developing their workforce with the necessary skills when production must be moved. A&D companies that spend time and energy engaging and equipping talent can enable their supply chain networks to remain cutting edge.

A&D companies should take informed, decisive action to respond to the immediate and long-term risks of the invasion to stabilize global supply chains. And from a longer-term standpoint, A&D leaders should take the proper steps to build and manage resilience in their supply chains—which can translate to better anticipating, reacting to, and recovering from the unexpected and emerging stronger as a result.

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Industry leaders must redirect their energies into supply chain improvements and make strategic decisions that mitigate risks and drive long-term growth.

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