

Deloitte.



**2023 aerospace and defense
industry outlook**

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About the Deloitte survey

To understand the outlook and perspectives of organizations across the aerospace and defense industry, Deloitte fielded a survey of nearly 50 US executives and other senior leaders in August 2022. The survey captured insights from respondents in four specific industry segments: commercial aerospace, defense and military, space, and advanced air mobility.

Navigating uncertain times to capitalize on change

With the global economy gradually recovering from the COVID-19 pandemic, the aerospace and defense (A&D) industry has shown signs of a strong rebound in 2022, but supply chain and talent issues continue to limit the industry's growth. According to Deloitte's outlook survey, supply chain disruptions and talent shortages may be the biggest risks or challenges for A&D organizations in 2023. Furthermore, the Russian invasion of Ukraine (the invasion) disrupted global supply chains, especially for critical metals and rare earth elements, and exacerbated fuel price volatility. Inflation remains a challenge for the entire industry—54% of respondents in Deloitte's outlook survey report that price increases are one of the key risks in 2023.

As demand for passenger travel is correlated to ticket prices, which, in turn, depend on jet fuel prices, a quick and sustained rise in jet fuel prices can affect traffic and increase market volatility. To address this challenge, aircraft manufacturers are investing in aircraft and engine design to make them more fuel-efficient, lower operating costs, and explore lower- and zero-emissions commercial aircraft for the future. The strong recovery in air travel is leading to increased aircraft orders and aftermarket activity. Domestic traffic levels registered about 81% of the pre-pandemic 2019 levels (in September 2022), and international traffic levels have shown strong growth with easing travel restrictions worldwide.¹ Leading global commercial aerospace original equipment manufacturers (OEMs) estimate that global passenger traffic will return to 2019 levels by the end of 2023 or early 2024. This could, in turn, result in production ramp-ups to remediate the growing backlog and drive industry revenue in 2023.

The defense segment remained stable through 2022 and is expected to outperform the commercial aerospace segment as an increase in defense budgets in the wake of the invasion is boosting demand for military equipment globally. The US defense budget for FY2023 emphasizes perceived strategic threats from China and Russia, with a key focus on electronic warfare and cybersecurity. European nations are modernizing armed forces with a planned increased budget to address rising geopolitical tensions. These nations have announced an increase of about \$204 billion in the defense budget in the first three months of the invasion focusing primarily on future military technologies.²

Emerging markets such as space and advanced air mobility (AAM) gained further traction in 2022 with more electric vertical takeoff and landing (eVTOL) flight tests and aircraft and pilot certification.³ Worldwide, 347 entities are currently working on more than 700 eVTOL aircraft concepts and designs, highlighting the industry's focus on the future of mobility.⁴ Meanwhile, private participation in space resulted in solid growth in the space economy in recent years. The segment witnessed 72 rockets launching 1,022 spacecraft into space in H1 2022, with the commercial sector accounting for about 94% of the launches.⁵

According to Deloitte's outlook survey, 88% of surveyed senior executives indicated that they believe the general business outlook for the A&D industry for the next year is "somewhat to very positive." There are more reasons for this optimistic outlook. These include growth in new technologies and segments such as AAM, evolving business models in areas such as space, and the use of digital thread and smart factories. All these factors should help the industry grow and create new markets in the coming year. A&D companies focused on innovation and prepared to capitalize on new emerging opportunities could outperform their peers in 2023.

1

Supply chain

Focus on supply chain visibility and resilience mitigates broader set of risks

The COVID-19 pandemic, workforce shortages, and, most recently, the invasion have exacerbated supply chain complexity for the A&D industry. Deloitte's analysis suggests that 90% of surveyed manufacturing executives have experienced an increased frequency of disruptions.⁶ In response, industry players across the value chain are building resilient supply chains to mitigate risk and drive long-term growth.

The A&D supply chain with multiple tiers of suppliers is very complex. An average American commercial aerospace company has more than 12,000 tier-2 suppliers.⁷ This creates unique challenges, such as a lack of visibility beyond tier-1 suppliers.⁸ The ongoing disruption is affecting the industry's manufacturing plans by raising costs and increasing the shortage of materials and components.

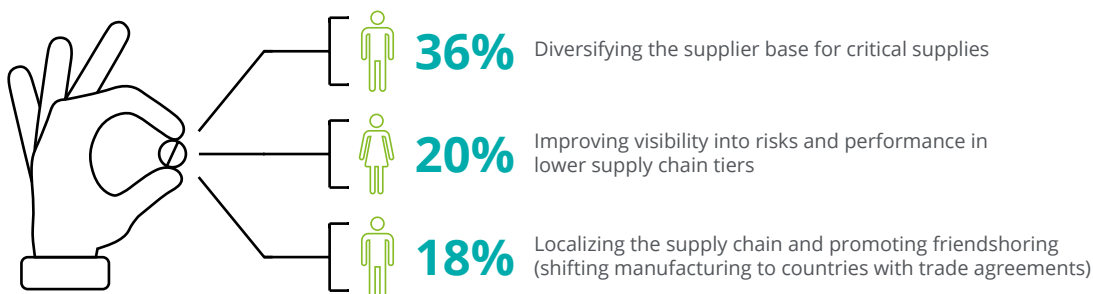
Major defense primes have also recently highlighted supply chain challenges as the leading cause of missing revenue targets and cutting back growth forecasts.⁹ Most defense suppliers supply to both aerospace and defense equipment manufacturers, which complicates the challenges for the entire industry. The US Department of Defense (DoD) released seven foundational recommendations, including building domestic production capabilities critical for national defense, building supply chain resilience, and analyzing data to expand the visibility of the supply chain to secure the defense supply chain.¹⁰

The risk of concentrated supply has become evident as demand for narrow-body aircraft has risen as the result of the pandemic. Supply chain issues for aircraft engines have hampered aircraft delivery plans. As aircraft engine deliveries are delayed, aircraft OEMs are unable to deliver fully built aircraft.¹¹ In addition, the invasion has forced major OEMs to find alternatives to the Russian supply of titanium, as about 50% of the A&D-grade titanium is sourced from Russia.¹² Cabin interior and seat manufacturers are also facing delays in delivery due to a shortage of critical components.¹³

Given these challenges, the coming year will likely see an acceleration of the shift from global to regional sourcing, including the exchange of raw materials, parts, and finished A&D goods globally (figure 1). Companies will likely emphasize supply chain diversification, including local sourcing and nearshoring, to avoid concentration risk. They are also likely to build relationships with suppliers from countries with free trade agreements (FTAs).¹⁴

Most A&D companies are expected to also focus on creating visibility deep into their supply chains to improve supply control and coordination and to better manage third-party risk. A&D primes have an opportunity to introduce a digital supply chain and leverage data and technology solutions to increase supply chain visibility and monitor supplier risk,¹⁵ as most disruptions usually occur beyond tier 1. Moreover, industry players will likely reinforce the need for cybersecurity, cloud privacy, and the resilience of the systems and automation to be prepared effectively for any risks within core operations and with key suppliers.

Figure 1. Diversifying supplier base for critical supplies is top priority for survey respondents of A&D companies to build and manage supply chain resiliency



Survey question: In your view, what is the top priority for your organization to build and manage supply chain resiliency over the next year?

Source: Deloitte outlook survey.

2

Digital transformation

Acceleration of digital thread and smart factory can drive improved efficiencies

Digital technologies and capabilities are expected to increasingly be a source of competitive advantage and, in some cases, a requirement to compete for specific government programs. With new entrants disrupting the market, even on legacy platform programs, A&D companies will likely increasingly leverage digital thread and smart factory to streamline the design and development of products and achieve improved efficiencies.

Digital thread and model-based enterprise (MBE)

A&D companies are increasingly being expected to be more agile with production capabilities to navigate future disruptions. The digital thread, which connects engineering, supply chain, manufacturing, and aftermarket to enable a model-based enterprise (MBE), is expected to play an even more prominent role in building agility in 2023. The growing needs and expectations of A&D customers have forced many companies to digitally transform through the MBE. MBE is the first step to digital transformation that integrates multiple processes from design to build into a unified environment, and data created by one step in the process is directly used by the next, which can help evaluate the impact of changes on the product across the value chain. Deloitte research indicates that over 85% of the surveyed manufacturing enterprises across industries are undertaking initiatives in core MBE capabilities.¹⁶

Advanced technologies such as cloud, big data, artificial intelligence/machine learning (AI/ML), digital twins, and the Internet of Things (IoT) may enable A&D companies to address operational challenges. For instance, a leading aircraft engine manufacturer is leveraging digital thread to accelerate digitization and innovate at every level of the product life cycle.¹⁷

Deloitte sees that less than 5% of manufacturing companies have deployed digital thread, but about 85% of companies have a plan to leverage it in the future. Deloitte research indicates that digital thread enables 7%–10% throughput improvement, 35%–45% reduction in engineering hours/unit, 25%–40% reduction in labor, and 15%–20% improvement in asset efficiency.¹⁸ In 2023, investment in the digital thread is expected to increase. Companies across the A&D value chain will likely invest in disruptive digital technologies to automate production lines, develop more profound insights into the extended supply chain, and improve predictive maintenance for delivering superior aftermarket service. For instance, AM Forward, a Federal initiative for large manufacturers designed to help US-based small and medium-size enterprises (SMEs) to increase the use of additive manufacturing (AM), could help drive supply chain resilience, speed, and flexibility of production and reduce lead times. This initiative will likely foster the

growth of Industry 4.0 and reduce A&D manufacturers' dependence on foreign inputs, as manufacturers committed to AM Forward can procure AM parts from US SMEs.¹⁹

Smart factory

The industry's increased focus on shortening lead times, improving cycle times, and increasing factory efficiency could push many A&D companies to embrace "smart factory" initiatives in 2023. A smart factory approach can help A&D manufacturers to adapt more quickly to demand fluctuations, supply chain adjustments, and changes in other parts of the value chain.²⁰ It connects the individual processes within and beyond production sites—from engineering to manufacturing and aftermarket. Further, it can help to gain critical material and component supply visibility (inventory visibility) to ensure efficient production and faster design to delivery.²¹

Achieving scale is the most important focal point for the smart factory, which comprises getting past pilots and creating scalable, often cloud-based solutions.

This poses both a challenge and success for the smart factory. It requires high information technology and operations collaboration in areas where A&D companies haven't traditionally invested in talent. There is also a new wave of greenfield sites for new advanced technologies such as hypersonics.

Organizational change management is another key success factor. A&D companies are immersed in traditional manufacturing methods and processes, and the introduction of new enabling technologies that pose a challenge to that culture must be addressed at all levels in the organization. Having a structured change management approach can be critical for smart factory adoption and value capture.

According to Deloitte's outlook survey, 36% of respondents reported their company had not yet started the smart factory journey, and 26% said their company is currently implementing a few initiatives related to smart factory. Smart factory initiatives are expected to move from proof of concept to more holistic efforts across A&D manufacturing networks in 2023 as companies pursue improvements in cycle time, throughput, inventory levels, and utilization.

3

Talent

Attracting, retaining, and developing top talent remains a challenge

Though most jobs lost in 2020 were added back,²² the workforce turnover rate is still high, and an aging workforce contributes to the workforce shortage. The ongoing shortage is increasing competition for talent within and beyond the industry.²³ It has also led to lower production and created delays in new contracts in the past two years. Meanwhile automation and the use of advanced digital technologies are bringing a change in the industry's workforce composition, driving the need for a workforce with more advanced aerospace engineering, math, data science, and digital skills than before. Many prime contractors have also cut back their sales forecasts. For instance, leading A&D companies reported that the labor shortage has further exacerbated supply chain issues and lowered the revenue outlook for 2022 as factories producing equipment are running slow.²⁴

The invasion has created enormous demand for defense-related equipment, and the workforce shortage is affecting the defense sector's response to new orders and increasing costs. Aircraft manufacturers' plans to increase production in the coming years could also face a setback as suppliers grapple with workforce shortages. For instance, a leading A&D company had to hire 2.5 times the planned engineer hires due to high attrition rates.²⁵ Also, there is substantial demand for talent in the commercial aerospace industry. For example, a leading global aerospace OEM estimates that the commercial aerospace segment could require an additional 610,000 technicians for the maintenance division alone in the next two decades, with the North American region accounting for about 22% of the overall requirement.²⁶

Furthermore, an aging workforce is leading to a skills gap. For instance, an engineering and technology firm serving leading prime contractors reported that while defense companies are trying to modernize their operations, they face challenges in recruiting and replacing the expertise of an aging workforce.²⁷

To capture growth opportunities, A&D companies should have a long-term strategy to meet existing and future workforce demands. To develop a future-ready workforce, companies should focus on encouraging a culture of innovation and building digital skills. According to Deloitte's outlook survey, three out of five senior industry executives surveyed believe that offering clearer pathways for career progression is the best strategy to attract, retain, and develop top talent. The US A&D industry continues to pay wages above the national average to address this challenge. The average US production worker wage in A&D is \$91,500, which is 81% above the national average.²⁸

A&D companies should consider these approaches (figure 2) to attract, retain, and develop top talent:

Figure 2. Strategies for A&D companies that can help to attract, retain, and develop top talent



Source: Deloitte analysis.

- Focus on branding the industry as a talent destination. On the one hand, this means leaning into the strength of A&D as a mission-driven industry, which has a unique appeal that many other industries can't match. On the other hand, this also means countering perceptions of A&D companies as slow-moving or bureaucratic, especially in competing for technology and engineering talent that has many cross-industry options.
- To influence perceptions of the industry and build talent pipelines, reach deep into communities and schools through partnerships; internships; co-investment; and close, sustained collaboration between industry and education on specific workforce skills and capacity needs.
- Incorporate greater flexibility into workforce schedules, environment, and career paths to meet today's workforce expectations. This will likely require challenging orthodoxies about how, when, and where work gets done—all while jobs are being redesigned as a result of the introduction of new technologies.
- Deepen and target employee listening programs—beyond annual surveys—to diagnose root causes of specific workforce challenges (e.g., attrition in particular roles, facilities, gender, racial, ethnic, or generational cohorts) and develop targeted interventions.

4

Decarbonization

Lowering emissions and implementing sustainable manufacturing remain business priorities

With climate change garnering increased policy and regulatory attention and generating consumer activism, A&D companies continued to work toward reducing direct emissions in 2022. As one of the most challenging industries to decarbonize, the A&D industry has been at the forefront of adopting new and advanced manufacturing technologies, which can help address the sustainability challenge. However, much remains to be done by the industry to address emissions across the value chain. According to Deloitte's outlook survey, a lack of feasible alternatives, high costs, and unclear benefits are the biggest challenges for respondents to reducing the commercial aerospace industry's Scope 3 emissions.

Leading A&D primes have shown meaningful progress in reducing Scope 1 and Scope 2 emissions in 2022. However, A&D manufacturers face challenges in tracking emissions across operations and the value chain. According to the International Data Corporation, 80% of global manufacturers will incorporate environmental sustainability in their products by 2024, which can improve sales by 3%.²⁹ A&D primes set a target to reduce greenhouse gas (GHG) emissions, water, waste, and energy and are progressing toward meeting their 2025 and 2030 sustainability targets. For instance, major A&D primes have set a target to reduce more than 50% of GHG emissions by 2030.³⁰ In 2023, many A&D companies are expected to continue to develop viable alternatives to lower emissions and work toward greener options such as alternative fuels, efficient aircraft design, and new propulsion technologies. However, with the rebound in air travel, taking up new aircraft orders poses a challenge to the industry's decarbonization efforts.

Carbon emissions are categorized as Scope 1, Scope 2, and Scope 3. Scope 1 emissions are emissions an A&D company makes directly during manufacturing. Scope 2 emissions are emissions an A&D company makes indirectly during manufacturing and operations. Scope 3 emissions are emissions an A&D company is indirectly responsible for when its products are used, such as emissions from an aircraft in flight. While it is relatively easy for A&D companies to reduce Scope 1 and Scope 2 emissions because emissions are generated from their own operations, addressing Scope 3 emissions is a challenge. Scope 3 emissions represent the largest portion of the total carbon footprint for the A&D industry, and addressing them is important for lowering total industry emissions.

To address this concern, the industry is likely to move toward using sustainable aviation fuels (SAFs)³¹ at scale and new propulsion technologies such as electric, hydrogen, and hybrid. Electric propulsion could be a potential zero-emission solution for decarbonization in the long term, particularly for regional and urban air mobility (UAM).³² In the past two years, AAM has matured in eVTOL technology and is progressing toward promising aircraft certification—which can address emissions from related ground transportation for regional or urban movement. A recent Deloitte study estimated that AAM can reduce travel time by 75% with zero

operating emissions for a 25-mile intracity trip.³³ The AAM industry is also exploring hybrid propulsion technology, and 2023 could see further advancements in key stakeholders' collaboration across the entire aerospace value chain for electric propulsion.

Further, hybrid propulsion can also reduce carbon emissions and could become a linchpin between renewable energy and energy-intensive industries such as aviation. However, changes in aircraft design to use hybrid propulsion is a key challenge—highlighting SAF as a scalable option. The International Air Transport Association (IATA) projected SAF production to reach about 65% of total fuel requirement by 2050, compared to 2% in 2025.³⁴ The industry foresees a considerable market for SAF, with many countries introducing SAF policies³⁵ that mandate respective nations to use SAF as a percentage of total fuel in line with the IATA focus. In 2023, more countries are expected to sign the SAF policy to support the commercial aviation industry's commitment to achieving net-zero carbon emissions.

2023 will likely see increased production of SAF to meet IATA targets and further advancements in electric and hybrid propulsion technologies. In 2021, 125 million liters of SAF were available and completely utilized by the airlines, even as the cost of SAF was more than double that of conventional jet fuel.³⁶ According to the IATA, there was \$17 billion worth of SAF in forward purchase agreements in 2022.³⁷ Implementing economically feasible and scalable solutions and scaling production requires regulatory support, and 2023 could see an increase in incentives to boost SAF production. For example, the Inflation Reduction Act of 2022 gives SAF a more valuable credit than biodiesel and renewable diesel starting in 2023. The new \$1.25/gallon SAF blending credit applies toward SAF, which reduces emissions by at least 50% compared to standard jet fuel.³⁸ An additional \$0.01/gallon will be given for each percentage point over 50% up to a maximum of \$1.75/gallon.³⁹

The IATA called for governments to place incentives to expand the consumption of SAF to achieve net-zero emissions by 2050.⁴⁰ In its efforts to advance decarbonization, the industry will likely establish multiple partnerships comprising technology investors, energy companies, airlines, and government agencies. Moreover, 2023 could also see commercial aerospace companies expanding renewable electricity use to reduce emissions at manufacturing facilities. Over the next two years, major airlines are expected to invest in hydrogen propulsion systems and add hydrogen-powered aircraft to their fleet, especially to power regional jets. These investments may play a critical role in the future of sustainable aviation.

5

Emerging markets

Innovation accelerates growth in emerging areas

Emerging markets such as space, supersonics/hypersonics, and AAM are poised to change the industry landscape and capabilities in the coming years. 2023 will likely be an important year for these emerging markets in terms of investments, technology evolution, and regulation. According to Deloitte's outlook survey, organizations are most likely to invest in space-related technologies and AAM in 2023.

Space

The space segment has seen private companies and new space startups showing strong interest in investing with ambitious launch plans. The segment registered strong growth in the past two years in orbital and spacecraft launches. In 2021, there were 145 reported orbital launches, an increase of 27% over the previous year.⁴¹ This strong growth continued with 125 launches in the first three quarters of 2022.⁴² Numerous opportunities, including in-space manufacturing, asteroid mining, space tourism, and space-based solar power, are driving significant interest from private companies.

In 2023, innovation and reusability will likely reduce launch costs further. Companies such as Blue Origin, SpaceX, and Relativity Space are expected to continue to develop reusable launch vehicles to launch multiple communication satellites to Low Earth Orbit (LEO). NASA's Space Launch System (SLS) launch vehicle⁴³ and SpaceX's reusable Starship rocket have been talking points in the industry in 2022. The SLS heavy-lift launch vehicle could benefit human space exploration beyond Earth's orbit, and the Starship rocket is expected to reach orbits at a cost less than \$10 million in two to three years.⁴⁴

2023 could see further developments in earth observation/remote sensing, satellite communications, and technology development. As industries are combating climate change, space companies can monitor and track Earth and benefit manufacturers with advanced technologies such as IoT to improve productivity and reduce emissions.

The industry could also focus on reducing space debris to address safety and sustainability concerns in 2023. New players are developing and manufacturing small satellite launch vehicles, and the industry has about 125 small satellite launch vehicle companies as of October 10, 2022.⁴⁵

More than 3,500 broadband satellites could be in LEO by the end of 2023, providing high-speed internet to nearly a million subscribers on all parts of the planet, no matter how remote. Space companies are also likely to make significant advances in manufacturing through innovative technologies fueled by digitalization and the increased global interplay of governments, the private sector, academia, and the community.

Supersonics/hypersonics

The commercial aerospace industry is considering relaunching supersonic aircraft operations, which were suspended in 2003 due to higher fuel consumption and environmental damage.⁴⁶ This time, however, OEMs claim that they are developing more sustainable aircraft. For example, Boom Supersonic is developing its Overture aircraft for commercial operations, designed to travel two times faster and fly using 100% SAF to claim net-zero carbon emissions.⁴⁷ United Airlines and American Airlines committed to purchasing Boom Supersonics' Overture aircraft (with plans to fly the first passengers by 2029), highlighting the interest in a commercial supersonic jet.⁴⁸

The US Air Force (USAF) signed a strategic partnership with Boom Supersonic (worth \$60 million) for supersonic capabilities⁴⁹ and Hermeus (worth \$60 million) for hypersonic aircraft.⁵⁰ NASA and Lockheed Martin are developing a quiet supersonic X-59 QueSST aircraft. They have completed a second wind tunnel test in 2022 and plan acoustic tests in 2023 to fly X-59 in 2024 to understand public acceptance of noise.⁵¹ Venus Aerospace aims to launch a hypersonic plane traveling at the atmosphere's edge. The company revealed the first conceptual vehicle design of its Stargazer hypersonic aircraft in 2022.⁵²

Beyond hypersonic aircraft, the development of hypersonic weapons has been a priority for the US DoD, as its counterparts, China and Russia, have already demonstrated hypersonic capabilities. The United States has fast-tracked the development, testing, and deployment of hypersonic weapons in 2022 and tested four different weapons with a 75% success rate. For example, Operational Fires (OpFires) and Hypersonic Air-breathing Weapon Concept (HAWC) were successfully tested by the Defense Advanced Research Projects Agency (DARPA).⁵³ Overall, 2023 could see further developments and authorities are likely to work on establishing new rules for supersonic and hypersonic aircraft.

5

Emerging markets

Innovation accelerates growth in emerging areas (continued)

AAM

2023 could be another milestone year for the AAM market as eVTOL aircraft companies will likely see significant technological and regulatory progress. The Federal Aviation Administration (FAA) has modified the regulatory approach for aircraft certification for powered lift and pilot certification in 2022.⁵⁴ The FAA also released a “draft” engineering brief for vertiport design to guide operators in handling vertical takeoff and landing (VTOL) operations.⁵⁵ The European Union Aviation Safety Agency (EASA) published a new regulatory framework for eVTOL aircraft certification and operations.⁵⁶ Growing investments and a fast-moving certification process for eVTOL aircraft globally will likely shift AAM companies’ focus on pilot training to achieve commercial operations by 2025. The industry may see several announcements in 2023 about where eVTOL companies plan to launch their operations and explore potential routes.

As regulatory agencies work to establish standards and practices specific to AAM, they will also likely stress long-term training procedure changes to meet AAM’s ultimate objective—autonomy. NASA is likely to accelerate eVTOL flight testing in 2023 as part of its AAM National Campaign, which would benefit the industry by advancing the inclusion of AAM aircraft in the national airspace system.

In 2023, eVTOL and A&D companies may also increase collaboration with automotive OEMs to drive mass production and supply chain management expertise. Legacy aerospace players could increasingly partner with AAM startups to work toward launching their eVTOL aircraft in the market. For instance, Wisk Aero, an AAM startup, received \$450 million from a leading A&D OEM to advance the certification of eVTOL aircraft.⁵⁷



Business agility and digital transformation will be key to staying ahead

Economic recovery for the A&D industry gained momentum in 2022 on the heels of the COVID-19 vaccine rollout and rising demand for air travel. As passenger traffic gradually returns to pre-pandemic levels, strong increases in new aircraft and military orders signal growth continuing in 2023. However, optimism around growth is held in check by caution from ongoing risks. Supply chain disruptions, talent shortages, and inflation will likely be the biggest challenges for the industry in 2023. Cost pressure and inflation may remain high in 2023 and could further reduce the operational efficiency and margins of A&D companies. Furthermore, A&D companies can expect elevated uncertainty from various potential global disrupters. The coming year could see increased competition in three areas in particular:

1. **Digitally skilled talent** (from other industries)
2. **Materials** (due to the shift of supply chain through nearshoring)
3. **Customers** (from new players entering the AAM and space market)

Some of the top signposts for A&D companies to watch in 2023 are:

- **Business agility:** Achieving agility could be critical for A&D companies seeking to operate through turbulence and compete in the next growth period.
- **Emerging technologies:** Investing in emerging technologies and smart factory solutions can help companies address supply chain challenges, optimize production capacity, progress toward sustainability goals, and improve employee retention.
- **Emissions reduction:** A&D companies can further reduce emissions in 2023 across the value chain, specifically by helping ramp up the production capability of SAF.
- **Developing business areas:** The growing interest in space, supersonics, hypersonics, and AAM will likely generate more business and employment opportunities, and the value chain may further expand in 2023.

Let's talk



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