

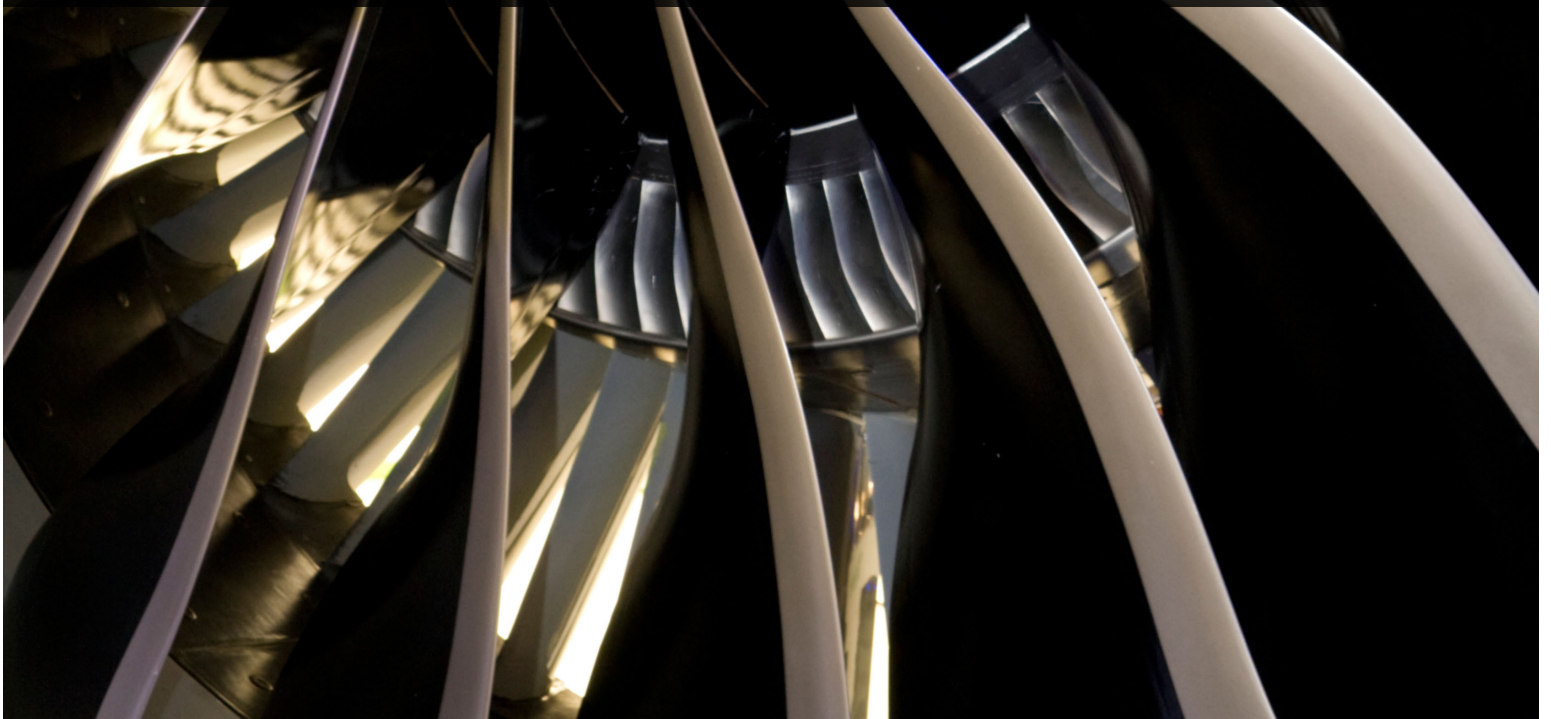


# While defense continues to soar, commercial aerospace is experiencing a short descent

After a strong year in 2018, the global aerospace and defense (A&D) industry has experienced a descent in 2019. While the defense sector has continued to soar, growth in the commercial aerospace sector has slowed. In 2020, the A&D industry is expected to get back to its growth trajectory with the commercial aerospace sector recovering from its decline in 2019.

The defense sector has sustained its growth in 2019 as security threats have intensified, requiring governments worldwide to continue increasing their defense budgets. Defense expenditure is expected to grow between 3 and 4 percent in 2020 to reach an estimated US\$1.9 trillion,<sup>1</sup> as governments worldwide continue to modernize and recapitalize their militaries. Most of the growth will likely be driven by increased defense spending in the United States, as well as in other regions, such as China and India.

The commercial aerospace sector has experienced a decline in deliveries in 2019 due to production-related issues in certain aircraft models. Order backlog of commercial aircraft has also decreased from the 2018 peak levels of about 14,700 aircraft to slightly more than 14,000 at the end of August 2019.<sup>2</sup> This was a result of order cancellations and a drop in new orders. However, commercial aerospace sector growth is likely to recuperate from 2020 onward as the long-term demand for commercial aircraft continues to remain robust, with nearly 40,000 units expected to be produced over the next two decades.<sup>3</sup>





## Defense

### Military expenditures are on the rise as security threats continue to intensify

Demand for military equipment is on the rise as governments across the globe focus on military modernization, given increasing global security concerns. The uncertainty and sustained complexity of the international security environment worldwide is likely to boost global defense spending over the next five years. Global defense spending is expected to grow at a CAGR of about 3 percent over the 2019–2023 period to reach US\$2.1 trillion by 2023.<sup>4</sup> While the US administration's increased focus on strengthening the military is expected to be a key growth driver for defense spending in 2020, other large nations, such as China, Russia, and India, are also likely to embark on higher spending on defense equipment.

US foreign military sales (FMS) also remained steady as global threats persisted, and this is likely to continue to add to the robust performance of the defense sector. In 2018, US FMS rose 33 percent to reach US\$55.7 billion, and in the first nine months of 2019 achieved US\$44.2 billion, with a likelihood of reaching the 2018 total.<sup>5</sup> Strong US FMS continues to boost export opportunities for defense contractors in the United States. However, a strengthening dollar could dampen growth in FMS as some of the European defense exporting nations could become more price competitive.

In Asia, higher defense spending by major regional powers such as India, China, and Japan will likely contribute to global sector growth. In Europe, members of NATO are also increasing defense budgets to reach a defense spending target of 2 percent of GDP. Apart from this, ongoing geopolitical tensions in the Middle East are creating a strong demand for military equipment.

Increasing global defense spending would continue to create opportunities for defense contractors and their supply chains. To meet the increased demand and improve production yields, defense companies should leverage highly agile production that adapts to changes in demand, including digital technologies. For instance, adopting smart factory initiatives could drive 10–12 percent gains in factory utilization and labor productivity without major capital investment.<sup>6</sup>





# 2

## Commercial aerospace

### Commercial aircraft backlog is declining from peak levels while regional jet demand is taking off

The commercial aircraft order backlog continues to be high, at about 14,000 unfilled orders through September 2019. However, the backlog declined from 2018 peak levels of about 14,700 aircraft<sup>7</sup> due to order cancellations and lower-than-expected new orders.<sup>8</sup> While original equipment manufacturers (OEMs) have been pushing the envelope in creating state-of-the-art aircraft—which are fuel-efficient, connected, and highly automated—many are still grappling with production-related issues. Specifically, OEMs are continually aiming to increase production rates and pushing suppliers to ramp up, and the sector is facing production-related challenges with certain aircraft models. Consequently, OEMs are experiencing order cancellations and delays in taking deliveries from their primary customers, airlines.<sup>9</sup>

Aircraft deliveries are estimated to be lower in 2019 compared to 2018, largely due to the decrease in production rates for certain aircraft models. In 2020–2021, deliveries are expected to be back on track as Boeing announced its goal to have the 737 MAX back in service by January 2020.<sup>10</sup> Moreover, with China's narrow-body aircraft deliveries anticipated to begin in 2021, the current duopoly<sup>11</sup> may raise production rates further between now and 2021 to capture China's domestic aircraft backlog before C919 deliveries begin. As a result, commercial aircraft production is projected to be about 1,900 aircraft in 2020, up from an estimated 1,450 aircraft in 2019.<sup>12</sup>

The outlook for the regional jet market remains robust, as forecasts anticipate more than 5,000 regional jets will be required over the next 20 years.<sup>13</sup> This is expected to primarily be driven by an aging fleet and demand from Asia-Pacific, the Middle East, and Latin America, as they continue to expand regional connectivity. Over the last two years, the regional jet market experienced some major tie-ups—Airbus's acquisition of majority ownership in Bombardier's C-Series aircraft program, Boeing's proposed deal to buy Embraer's passenger jet unit, and Mitsubishi Heavy Industries' proposed acquisition of Bombardier's CRJ regional jet program. These program realignments could allow supply chain and manufacturing consolidations, resulting in reduced production costs.<sup>14</sup>

The commercial aerospace aftermarket landscape is also evolving, due to a changing aircraft fleet mix, pressure on airlines to reduce maintenance costs, and the emergence of new advanced technologies. This is resulting in an increased aftermarket opportunity for the overall commercial aircraft value chain, including OEMs. With the increasing aircraft backlog and production rates, OEMs are focusing on expanding aftermarket revenues by seeking partnerships and exploring new business lines to diversify. For example, Boeing's 2018 services revenue stood at about US\$17 billion, and it aims to triple its service revenue to US\$50 billion in the next five years.<sup>15</sup>



# 3

## Space

### Innovation in space technologies driving toward modernization

The global commercial space sector is likely to see steady investments in new and existing space technologies and services, with funding coming primarily from governments and venture capital. Currently, revenues in the commercial space market primarily come from manufacturing of satellites used for earth observation and communications, and launch vehicles used to place these payloads in orbit. While new space technologies and services are likely, most are expected to continue to be in the proof-of-concept phase and will thus likely require additional funds and development before providing broader commercial services and economic returns. Existing commercial space service providers will likely continue to evaluate their business models and technology to prepare for shifts in the market but are not expected to make significant changes beyond research and development (R&D) until new products and services are proven.

2020 may be a year of firsts for significant milestones on the way to grow the space ecosystem, laying the foundation for more significant change in the earlier part of the next decade. However, due to the generally nascent stage of development defining much of the emerging commercial space sector and the cautious approach adopted by established commercial space companies, 2020 is unlikely to produce significant changes in the commercial space sector.

An increased focus on the modernization of military space missions and the resiliency of space capabilities is likely to continue. New government appreciation for threats posed by anti-satellite (ASAT) weapons has caused a sharp increase in concern over the military use of near-Earth space. Based on the ASAT threat, the United States and other countries are increasing investments in research, technology, and commercial services, as well as altering organizational strategies to improve the resiliency of their military space capabilities and capacities. We have already seen the US government push for innovation and modernization result in new acquisition authorities, substantially increased sources of government funding, and the design of new space-based military concepts of operation. Over the next year, these investments and organizational changes should be expected to continue, but significant changes to the military use of space, i.e., placing non-satellite weapons into space, remains unlikely, and the deployment of new military space concepts will not occur until later in the decade.



# 4

## Mergers and acquisitions

### Long-term A&D industry growth drivers are shaping M&A activity

M&A activity has been strong since 2015 and is expected to be shaped further by growth drivers in areas such as C5ISR (Command, Control, Communications, Computers, Combat Systems, Intelligence, Surveillance, and Reconnaissance), commercial aerospace MRO, unmanned and autonomous vehicles, hypersonics, and the need to achieve scale. The impact of the US Presidential elections in 2020, the focus on achieving quality excellence in aerospace manufacturing, and a potential economic slowdown will be added considerations in M&A. While popular wisdom may suggest that it is less likely that the megadeals the sector experienced in the recent past will continue, given the strain in overcoming regulatory hurdles, disruptive M&A that can further unlock value also remains a distinct focus. For instance, we witnessed the merger of two major communications and electronics contractors, and more recently, the mergers of two A&D giants—one of the largest deals in the history of aerospace and defense.<sup>16</sup>

As the A&D supply chain focuses on transformation for cost and scale effectiveness, further industry consolidation is possible as some of the smaller companies may not be able to meet the increased financial, program management, skills, risk-taking, and investment requirements. Consolidation by parts family, i.e., components, aero-structures, electronics, and interiors, is expected to continue as companies focus on gaining economies of scale. Apart from this, large prime contractors may use acquisitions to gain access to new and advanced technologies as well as to expand global reach.





# Regional perspectives

The United States continues to be the primary growth driver for the A&D industry; however, increasing passenger growth worldwide and a complex international security environment could result in several other regions and countries contributing to industry performance. Asia and the Middle East are driving growth in both commercial aerospace and defense sectors, whereas Japan is expected to be a key market primarily for the defense sector. In Europe, NATO members, such as France, are reportedly targeting to increase defense spending as the United States constantly encourages NATO countries to increase military spending to 2.0 percent of GDP.<sup>17</sup>

## CHINA

China, the fastest-growing aviation market globally, could require 8,090 aircraft over the next 20 years, worth about US\$1.3 trillion, with nearly 75 percent being single-aisle aircraft.<sup>18</sup> The robust aircraft demand is also likely to create a US\$1.6 trillion opportunity for aftermarket services for its aircraft fleet over the 2019–2028 period.<sup>19</sup> China continues to remain the second-largest defense spending nation after the United States, with a 14 percent share in global defense spending.<sup>20</sup> However, China's 2019 defense spending growth, at 7.5 percent year over year to US\$177.6 billion, is lower than the 8.1 percent growth in 2018 and much below the double-digit increases in prior years.<sup>21</sup>

## FRANCE

France allocated US\$48 billion to the 2019 defense budget, which is a 4.7 percent year-over-year increase and 1.8 percent of its GDP.<sup>22</sup> France plans to boost its defense spending by 40 percent by 2025 as it aims to meet the NATO target of “2 percent of GDP” spent on defense.<sup>23</sup> The defense ministry is targeting to increase defense spending of approximately US\$2 billion per year between 2019 and 2022 and US\$3.5 billion each year during the 2023–2025 period.<sup>24</sup>

## GERMANY

Germany increased the 2019 defense budget by 10 percent over 2018 to US\$53 billion (€47.3 billion), the largest increase since the Cold War.<sup>25</sup> The country expects to further increase its budget to US\$56.4 billion (€50.3 billion) for 2020, however, falling short of the 2 percent NATO target.<sup>26</sup> By 2024, Germany aims to increase its military spending to 1.5 percent of GDP and achieve the 2 percent of GDP target by 2031.<sup>27</sup>

## INDIA

Growth in low-cost carriers and rising passenger traffic is expected to result in a demand for about 2,300 aircraft over the next two decades, valued at US\$320 billion in India.<sup>28</sup> The majority of these aircraft (more than 80 percent) will likely be single-aisle aircraft, with a seating capacity between 90 and 200.<sup>29</sup> India is emerging as one of the major countries in space exploration. The country recently launched a civilian moon mission—Chandrayaan-2—and is also working on a manned space mission, Gaganyaan. India continues to increase its defense spending, with a defense budget of US\$44.6 billion for 2019–2020, up 9.3 percent.<sup>30</sup> Over the next five years, India plans to spend US\$130 billion to modernize armed forces and strengthen combat capabilities.<sup>31</sup>





## JAPAN

Japan's passenger traffic is expected to grow at about 3.0 percent over the next 20 years.<sup>32</sup> Growth in low-cost carriers (LCCs) is likely to drive demand for narrow-body commercial aircraft—LCCs account for 17 and 26 percent of domestic and international seat capacity, respectively, compared to 9 and 3 percent in 2011.<sup>33</sup> Moreover, Japan's two major airlines are expanding their network to Southeast Asia to capture the solid demand from the region, which is expected to contribute to passenger traffic growth in the near term. The country is also developing its first mid-sized commercial aircraft, which is expected to challenge the existing commercial aircraft duopoly. To strengthen its military, Japan announced a defense budget of US\$50.3 billion for 2019–2020, up 1.2 percent, marking the eighth consecutive annual increase; however, it remained below 1.0 percent of GDP.<sup>34</sup> Japan is also developing a domestically designed sixth-generation twin-engine stealth fighter, F-3, with a first-flight target of 2030. It is developing the F-3 aircraft primarily to replace older F-2 single-engine fighter aircraft fleet as well as to complement its existing fleet of F-35 aircraft.<sup>35</sup>

## RUSSIA

Russia is developing a commercial aircraft, MC-21, and the country anticipates this aircraft to be competitively priced to gain market share.<sup>36</sup> MC-21 has already received 175 orders; however, most of these orders are from Russian airlines and leasing companies.<sup>37</sup> Due to a slowing economy, Russia's defense spending declined 3.5 percent in 2018 to US\$61.4 billion, which led to Russia slipping out of the top five defense-spending nations for the first time since 2006.<sup>38</sup> Defense spending as a percentage of GDP was at 3.9 percent in 2018, higher than that of the United States (3.2 percent in 2018).<sup>39</sup>

## THE MIDDLE EAST

Over the 2019–2038 period, passenger traffic in the Middle East is anticipated to grow at 5.1 percent CAGR, which could create a demand for 3,130 new aircraft, worth US\$725 billion.<sup>40</sup> In the Middle East, wide-body aircraft are expected to account for nearly half of the total aircraft demand as the region caters to high-volume flights to Asia and Europe and also operates ultra-long-haul flights.<sup>41</sup> Defense spending declined 1.9 percent in 2018 to US\$145 billion, despite high levels of arms imports and ongoing military intervention in Yemen by Saudi Arabia, which is the top military spender in the region.<sup>42</sup> Six out of the top ten countries with the highest military expenditure as a percentage of GDP are in the Middle East—Saudi Arabia, Oman, Kuwait, Lebanon, Jordan, and Israel.<sup>43</sup>

## THE UNITED KINGDOM (UK)

The UK's defense budget of US\$49 billion (£38 billion) stood slightly above 2 percent of GDP and has declined from about 4 percent at the end of the Cold War era.<sup>44</sup> However, the UK's defense committee has been recommending increasing the budget to 3 percent of GDP to strengthen the country's armed forces.<sup>45</sup> The potential impact of Brexit creates uncertainty for the UK A&D industry—for example, the risk of disruption in supply chains or new tariff structures when the UK renegotiates trade agreements with the EU and other nations.



# What's on the horizon beyond 2020?

Technological developments and innovation continually shape the A&D industry. Some of the significant developments that are likely to have implications in the medium-to-long-term include:

**Electric propulsion aircraft:** While aerospace manufacturers have built more fuel-efficient aircraft over the last few decades, rapid growth in air travel demand has continued to result in an increase in carbon emissions by the aviation industry. With technology evolving rapidly, there are several companies globally that are developing electric propulsion systems, which would reduce carbon emissions, make flights quieter, and decrease costs. Electric propulsion systems could also support the emerging urban air mobility (UAM) ecosystem, consisting of passenger drones, most of which are likely to be either electric or hybrid-electric. Apart from large aerospace propulsion companies, such as Rolls-Royce and Safran, there are various technology startups also involved in the development of electric propulsion engines.

**Urban air mobility:** The development of UAM vehicles is expected to accelerate over the next decade. However, there are significant challenges that would need to be ironed out.<sup>46</sup> Most importantly, there would need to be the formulation of regulations for pilotless vehicles, airworthiness certifications, and the use of airspace. Implementing efficient energy management systems, onboard sensors, collision detection systems, and other advanced technologies would also need to address the technological challenges.<sup>47</sup> In addition, the

industry should build takeoff and landing zones, parking lots, charging stations, and vertiports to support the infrastructure needs of UAM.<sup>48</sup> Apart from this, creating a robust air traffic management system integrated with other modes of transport would be needed to enable smooth operations of UAM vehicles.<sup>49</sup> Lastly, the industry would require a flawless operational and mechanical safety record to overcome psychological challenges associated with the idea of flying in an unmanned aircraft.<sup>50</sup> To address these challenges, vehicle manufacturers have begun testing vehicles, ecosystem participants are collaborating on developing a robust regulatory framework, and technology is advancing swiftly.

**Automated flight deck:** Although commercial aircraft manufacturers are increasingly relying on automated flight controls, including automated cockpits, the commercial aerospace sector is aiming to transition to fully automated flight decks. Such a transition will likely reduce the number of crew members in the cockpit, resulting in lower costs for airlines. Moreover, automated flight decks would also address the growing pilot shortage issue currently faced by the aviation industry, which will likely be accentuated in the future as the commercial aircraft fleet continues to grow.



# Technology investments required to make major shifts in the A&D industry

With higher production requirements for both commercial aircraft and defense equipment, it is important for A&D companies to adopt new and advanced manufacturing technologies. As A&D customers become more demanding in terms of delivery schedules and customization, industry players are expected to increasingly need highly agile production and predictive quality controls. By investing in digital technologies, the industry could be at the forefront of manufacturing, enhancing productivity and efficiency.





# Endnotes

1. Deloitte estimates and Deloitte analysis of data from Stockholm International Peace Research Institute (SIPRI) Military Expenditure Database, <https://www.sipri.org/databases/milex>, accessed October 1, 2019.
2. Deloitte analysis of the following data: The Boeing Company, "Order and deliveries," <http://active.boeing.com/commercial/orders/index.cfm>, accessed on October 1, 2019; Airbus Group, "Orders and deliveries," <https://www.airbus.com/aircraft/market/orders-deliveries.html>, accessed October 1, 2019.
3. Deloitte estimates.
4. Deloitte analysis of data from SIPRI Military Expenditure Database; Deloitte estimates.
5. Andrea Shalal, "U.S. foreign arms sales hit \$44.15 billion in first three quarters of FY2019," Reuters, June 19, 2019, <https://www.reuters.com/article/us-france-airshow-usa-arms/u-s-foreign-arms-sales-hit-44-15-billion-in-first-three-quarters-of-fy2019-idUSKCN1TK1TO>, accessed October 1, 2019.
6. Paul Wellener et al., 2019 Deloitte and MAPI Smart Factory Study: Capturing value through the digital journey, Deloitte Insights, <https://www2.deloitte.com/us/en/insights/industry/manufacturing/driving-value-smart-factory-technologies.html>, accessed October 1, 2019.
7. Deloitte analysis of the following data: The Boeing Company, "Order and deliveries"; Airbus Group, "Orders and deliveries."
8. Ibid.
9. Ibid.
10. Boeing, "737 MAX Progress Report," <https://boeing.mediaroom.com/news-releases-statements?item=130556>, accessed November 11, 2019.
11. Duopoly in commercial aerospace refers to Airbus and Boeing, who together account for 99 percent of the large plane market.
12. Deloitte estimates and Deloitte analysis of the following data: The Boeing Company, "Order and deliveries"; Airbus Group, "Orders and deliveries"; Barclays, "Gauging Impact of MAX and Slowing Traffic on Comm Aero Cycle," September 4, 2019, accessed October 1, 2019; Forecast International, "Airbus and Boeing Report July 2019 Commercial Aircraft Orders and Deliveries," August 20, 2019, <https://dsm.forecastinternational.com/wordpress/2019/08/20/airbus-and-boeing-report-july-2019-commercial-aircraft-orders-and-deliveries/>, accessed October 1, 2019.
13. Mitsubishi Aircraft Corporation, "A vital but neglected market: Bringing new value to regional aviation," June 7, 2019, <https://www.mitsubishi-aircraft.com/latest/a-vital-but-neglected-market-bringing-new-value-to-regional-aviation>, accessed October 5, 2019.
14. Airbus, "Airbus' majority stake in C Series partnership with Bombardier and Investissement Québec comes into effect," July 1, 2018, <https://www.airbus.com/newsroom/press-releases/en/2018/07/airbus-majority-stake-in-c-series-partnership-with-bombardier-a.html>, accessed October 5, 2019; Boeing, "Boeing-Embraer Strategic Partnership Taking Shape," October 3, 2019, <https://boeing.mediaroom.com/2019-10-03-Boeing-Embraer-Strategic-Partnership-Taking-Shape>, accessed October 5, 2019; Allison Lampert and Debroop Roy, "UPDATE 6-Bombardier exits commercial aviation with sale of regional jet business to Mitsubishi," CNBC, June 25, 2019, <https://www.cnbc.com/2019/06/25/reuters-america-update-6-bombardier-exits-commercial-aviation-with-sale-of-regional-jet-business-to-mitsubishi.html>, accessed October 5, 2019.
15. Jamie Freed and Fathin Ungku, "Boeing signs nearly \$1 billion of services deals, eyes \$50 billion target," Reuters, February 5, 2018, <https://www.reuters.com/article/us-singapore-airlines-boeing-services/boeing-signs-nearly-1-billion-of-services-deals-eyes-50-billion-target-idUSKBN1FQ0F1>, accessed October 5, 2019.
16. L3 Harris, "Harris Corporation and L3 Technologies Set Closing Date for Merger," June 21, 2019, <https://www.harris.com/press-releases/2019/06/harris-corporation-and-l3-technologies-set-closing-date-for-merger>, accessed October 5, 2019; Doug Cameron, "Investors approve UTC-Raytheon merger," Wall Street Journal, October 11, 2019, <https://www.wsj.com/articles/investors-approve-utc-raytheon-merger-11570801608>, accessed October 5, 2019.
17. Heather Souvaine Horn, "Is it fair for Trump to bash NATO over military spending?" New Republic, July 12, 2018, <https://newrepublic.com/article/149819/fair-trump-bash-nato-military-spending>, accessed October 5, 2019.
18. CNBC, "Boeing raises 20-year forecast for China aircraft demand," September 17, 2019, <https://www.cnbc.com/2019/09/17/boeing-raises-20-year-forecast-for-china-aircraft-demand.html>, accessed October 5, 2019.
19. Ibid.
20. Deloitte analysis of data from SIPRI Military Expenditure Database.
21. Kelly Olsen, "China's defense spending is growing more slowly. But that doesn't mean military tensions are easing," CNBC, March 5, 2019, <https://www.cnbc.com/2019/03/05/china-defense-budget-slowing-growth-in-2019-military-spending.html>, accessed October 5, 2019.
22. Army Technology, "The world's biggest defence budgets in 2019," June 13, 2019, <https://www.army-technology.com/features/biggest-military-budgets-world/>, accessed October 6, 2019.
23. Pierre Tran, "France to bolster defense spending by \$2 billion. Here's the military equipment already on order," DefenseNews, September 26, 2018, <https://www.defensenews.com/global/europe/2018/09/26/france-to-bolster-defense-spending-by-2-billion-heres-the-military-equipment-already-on-order/>, accessed October 6, 2019; Tony Cross, "France to hike defence spending to 300 billion euros over 6 years," RFI, February 8, 2018, <http://www.rfi.fr/en/20180208-france-hike-defence-spending-300-billion-euros>, accessed October 6, 2019.
24. Ibid.
25. Justin Huggler, "Germany announces biggest defence spending rise since end of Cold War," The Telegraph, May 17, 2019, <https://www.telegraph.co.uk/news/2019/05/17/germany-announces-biggest-defence-spending-rise-since-end-cold/>, accessed October 6, 2019.
26. ZEIT ONLINE, "Defense budget could rise to more than 50 billion euros," October 16, 2019, <https://www.zeit.de/politik/deutschland/2019-10/nato-verteidigungsausgaben-militaer-erhoehung-deutschland>, accessed October 10, 2019.

27. Ibid.
28. Boeing, "Boeing Forecasts Demand for 2,300 New Airplanes in India," December 19, 2018, <https://boeing.mediaroom.com/2018-12-19-Boeing-Forecasts-Demand-for-2-300-New-Airplanes-in-India>, accessed October 10, 2019.
29. Ibid.
30. Fazil Khan, "0.01% - The increase in defence allocation from interim budget as modernization put on hold," News18, July 5, 2019, <https://www.news18.com/news/business/budget-2019-0-01-the-increase-in-defence-allocation-from-interim-budget-as-modernisation-put-on-hold-2218861.html>, accessed October 6, 2019; Laxman Kumar Behera, "India's defence budget 2019-20," Institute for Defence Studies and Analyses, July 8, 2019, <https://idsa.in/issuebrief/indias-defence-budget-2019-20-lkbehera-080719>, accessed October 6, 2019.
31. Economic Times, "India to spend a whopping USD 130 billion to modernize forces," September 10, 2019, <https://economictimes.indiatimes.com/news/defence/india-to-spend-a-whopping-usd-130-billion-for-military-modernisation-in-next-5-7-years/articleshow/71053542.cms>, accessed October 6, 2019.
32. Japan Aircraft Development Corp., Worldwide Market Forecast (2019–2038), March 2019, [http://www.jadc.jp/files/topics/143\\_ext\\_01\\_en\\_0.pdf](http://www.jadc.jp/files/topics/143_ext_01_en_0.pdf), accessed October 6, 2019.
33. CAPA Centre of Aviation, "North Asia airline outlook: Rapid growth set to continue in 2019," January 31, 2019, <https://centreforaviation.com/analysis/airline-leader/north-asia-airline-outlook-rapid-growth-set-to-continue-in-2019-457919>, accessed October 6, 2019.
34. Alastair Gale and Chieko Tsuneoka, "Japan to beef up military with money for aircraft carrier, US jet fighters," Wall Street Journal, August 30, 2019, <https://www.wsj.com/articles/japan-to-beef-up-military-with-money-for-aircraft-carrier-u-s-jet-fighters-11567141391>, accessed October 6, 2019.
35. Sebastien Roblin, "F-35, RIP? Japan is working on a powerful, 6th generation stealth fighter," National Interest, September 11, 2019, <https://nationalinterest.org/blog/buzz/f-35-rip-japan-working-powerful-6th-generation-stealth-fighter-79521>.
36. Gulf News, "Irkut's MC-21, finally a Russian passenger plane to take on Boeing, Airbus?" August 28, 2019, <https://gulfnews.com/business/aviation/irkuts-mc-21-finally-a-russian-passenger-plane-to-take-on-boeing-airbus-1.1567017243897>, accessed October 10, 2019.
37. Ibid.
38. Deloitte analysis of data from SIPRI Military Expenditure Database.
39. Ibid.
40. Deloitte analysis of the following data: The Boeing Company, "Commercial Market Outlook 2019–2038," <https://www.boeing.com/commercial/market/commercial-market-outlook/>, accessed October 10, 2019.
41. Ibid.
42. Deloitte analysis of data from SIPRI Military Expenditure Database.
43. Ibid.
44. Andrew Chuter, "UK's top diplomat urges 'decisive' defense budget boost," DefenseNews, May 14, 2019, <https://www.defensenews.com/global/2019/05/14/uks-top-diplomat-urges-decisive-defense-budget-boost/>, accessed October 10, 2019.
45. Ibid.
46. Robin Lineberger, Aijaz Hussain, Siddhant Mehra, and Derek Pankratz, Elevating the future of mobility: Passenger drones and flying cars, Deloitte Insights, January 18, 2018, <https://www2.deloitte.com/insights/us/en/focus/future-of-mobility/passenger-drones-flying-cars.html>, accessed October 10, 2019.
47. Robin Lineberger, Aijaz Hussain, Vincent Rutgers, and Tim Hanley, Technological barriers to the elevated future of mobility: Can urban transportation be lifted off the ground? Deloitte Insights, 2 April 2019. <https://www2.deloitte.com/insights/us/en/focus/future-of-mobility/future-transportation-with-vtol.html>, accessed October 10, 2019.
48. Robin Lineberger, Aijaz Hussain, Matt Metcalfe, and Vincent Rutgers, Infrastructure barriers to the elevated future of mobility: Are cities ready with the infrastructure needed for urban air transportation? Deloitte Insights, May 28, 2019, <https://www2.deloitte.com/us/en/insights/focus/future-of-mobility/infrastructure-barriers-to-urban-air-mobility-with-VTOL.html>, accessed October 10, 2019.
49. Chris Metts, Martin Bowman, Robin Lineberger, and Aijaz Hussain, Managing the evolving skies: Unmanned aircraft system traffic management (UTM), the key enabler, Deloitte, July 2018. <https://www2.deloitte.com/global/en/pages/energy-and-resources/articles/managing-evolving-skies.html>, accessed October 10, 2019.
50. Robin Lineberger and Aijaz Hussain, Psychological barriers to the elevated future of mobility: Are consumers ready to take to the skies? Deloitte Insights, 26 November 2018. <https://www2.deloitte.com/insights/us/en/focus/future-of-mobility/psychological-barriers-to-elevated-mobility-autonomous-aerial-vehicles.html>, accessed October 10, 2019.



# Let's talk



**Robin Lineberger**

Global Aerospace & Defense Leader

Deloitte Global

[rlineberger@deloitte.com](mailto:rlineberger@deloitte.com)

+1 571 882 7100

Robin Lineberger is Deloitte's Global Aerospace & Defense leader and a principal with Deloitte United States (Deloitte Services LP). His career includes 35 years as a consultant to the aerospace and defense industry, having advised and served companies globally. He was also the leader for the Deloitte US Federal Government Services practice. Previously, Robin was a commissioned officer in the US Air Force, where he led the software development and testing for a major command and control platform. Robin serves on the United Services Organization (USO) Board of Governors and is very active in supporting military veteran issues such as mentoring, employment, and medical recovery.



#### **About this publication**

This publication contains general information only and Deloitte is not, by means of this publication, rendering accounting, business, financial, investment, legal, tax, or other professional advice or services. This publication is not a substitute for such professional advice or services, nor should it be used as a basis for any decision or action that may affect your business. Before making any decision or taking any action that may affect your business, you should consult a qualified professional advisor. This publication is solely for educational purposes. This publication should not be deemed or construed to be for the purpose of soliciting business for any of the companies/organizations included in this publication, nor does Deloitte advocate or endorse the services or products provided by these companies/organizations. Deloitte shall not be responsible for any loss sustained by any person who relies on this publication.

#### **About the Deloitte Research Center for Energy & Industrials**

Deloitte's Research Center for Energy & Industrials combines rigorous research with industry-specific knowledge and practice-led experience to deliver compelling insights that can drive business impact. The Energy, Resources, and Industrials industry is the nexus for building, powering, and securing the smart, connected world of tomorrow. To excel, leaders need actionable insights on the latest technologies and trends shaping the future. Through curated research delivered through a variety of mediums, we uncover the opportunities that can help businesses move ahead of their peers.

#### **About Deloitte**

Deloitte refers to one or more of Deloitte Touche Tohmatsu Limited, a UK private company limited by guarantee ("DTTL"), its network of member firms, and their related entities. DTTL and each of its member firms are legally separate and independent entities. DTTL (also referred to as "Deloitte Global") does not provide services to clients. In the United States, Deloitte refers to one or more of the US member firms of DTTL, their related entities that operate using the "Deloitte" name in the United States and their respective affiliates. Certain services may not be available to attest clients under the rules and regulations of public accounting. Please see [www.deloitte.com/about](http://www.deloitte.com/about) to learn more about our global network of member firms.