

AEROSPACE & DEFENSE NAVIGATING THE LANDSCAPE

White Paper



OPPORTUNITY-RICH MINEFIELD

With the exceptions of business aviation and civil rotorcraft, the near- to mid-term prospects for the aerospace industry could hardly appear brighter.

Commercial airframe manufacturers are sitting on backlogs equivalent to about eight years of production. In the defense sector, the need to modernize weapons systems throughout NATO, particularly for the U.S., has never been more urgent, and the new administration is pushing hard for substantial increases in investment in procurement and Research, Development, Testing and Evaluation (RDT&E) on an accelerated time line. "A bow wave of [weapons] modernization is coming, the likes of which we have not seen in many years," Rep. Robert Whitman, chairman of the House Armed Services Committee, Seapower and Projection Forces Subcommittee, recently stated. There is resurging interest in both unmanned and manned space exploration, and a plethora of X-plane demonstration projects are underway. It is no wonder that industry officials publicly and privately are expressing greater optimism about the future than they have in years.

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DISRUPTION AHEAD

But industry is cautioned to not underestimate the challenges they may confront in navigating this otherwise entreaty landscape.

In commercial aviation, non-traditional players are entering the marketplace in greater numbers, bringing with them commercial practices that enable them to be more agile, an appetite for greater risk, and a demonstrated track record of rapid innovation. Such competition is a testament to just how far barriers to entry have fallen, allowing non-traditional players to not just gain a foothold in core markets, but also to upend legacy players.

For their part, defense contractors' ability to capitalize on opportunities will depend as much on their own behaviors as it will on the business environment itself. For example, government customers are becoming more demanding and companies' inclination to maximize short-term value creation at the expense of strategic investments could leave them vulnerable to competitors.

Moreover, companies serving government customers are not the only businesses that should be reassessing how to sharpen their competitive edge. In the space segment, a roster of highly innovative technology companies, led by SpaceX and Blue Origin, is in the vanguard of commercializing space. They have all but leapfrogged much larger enterprises and NASA is actively encouraging them to set their sights high. Andrew Hunter, a senior fellow in the International Security Program and director of the Defense-Industrial Initiatives Group at the Center for Strategic and International Studies (CSIS), recently stated: "If you can disrupt the space launch market, there is no other market that cannot be disrupted."

Another example is the current pursuit of supersonic passenger aircraft and hybrid-electric propulsion. Top-tier companies are involved, of course, but it is the relatively small, less well-known companies that are leading the pack in the race to commercialize new products. Two such entrepreneurial-driven enterprises are Aerion Corporation and Boom.

This trend of non-traditional players seeking to upend mature market segments by leveraging disruptive and commercial technologies and processes is just one of the trends that will help change the aerospace industry landscape.

Program execution will continue to be a potential spoiler for companies that stand to benefit from the opportunities now materializing—even more so going forward in defense markets due to competing demands for resources. Whether suppliers will take the steps that could help them become stronger competitors over the longer-term remains to be seen.

For example, most large-system integrators are building the framework to implement digital Future Factories, which almost certainly will enable them to be more competitive. However, the pace at which Original Equipment Manufacturers (OEMs) are pursuing Industry 4.0 varies widely, and relatively few lower-tier suppliers seem to be following the lead of these OEMs with troubling implications for program-performance outcomes.

In another example, subcontractors should expect the Pentagon to take increasingly tough negotiating positions in future procurements. As part of this trend, the U.S. Department of Defense (DoD) will increase pressure on companies to invest in cost-cutting initiatives to lower the price of the products they sell. Further, DoD wants to see second- and third-tier companies demonstrate a greater sense of urgency in implementing such initiatives. Whether they truly listen to their end-use customers, versus merely paying lip service, is another open question.

"If you can disrupt the space launch market, there is no other market that cannot be disrupted."

Andrew Hunter

Sr. Fellow, International Security Program and Director, Defense-Industries Initiatives Group

NEW SCRUTINY FOR DEFENSE CONTRACTORS

"This is not an issue of suppressing margins; it's about suppliers undertaking cost-cutting initiatives of their own volition," according to the Pentagon's Shay D. Assad, director, Defense Pricing. Companies that heed DoD's call will be rewarded with larger margins, he flatly declared. To steer industry in this direction, Assad and other DoD procurement officials plan to break out the subcontractor component of the overall cost of weapons systems it buys. "We want greater transparency, and we want to see a reduction in the cost of products we're buying," he stated. DoD also plans to create "real" competition at the subcontractor level wherever possible, as well as expand competition where it already exists.

"There needs to be a recognition [among defense contractors] that there's a different risk in the defense business than in the commercial world," Assad said. Referencing the many significant programs in DoD's product pipeline, he added: "If you're in the acquisition business, this is an exciting time, because I see a tremendous environment for opportunity."

Underlying all of this opportunity is that the world has become a more dangerous place and the U.S. has to recapitalize much of its military, particularly aircraft and ships, because of the procurement holiday from 1990 to 2015. In parallel are the huge advances that Russia and China have made in recent years in their own weapons modernization and the Pentagon's core value of embracing technology for long-term military superiority.

China spends nearly as much as the U.S. on annual research and development. As a result, policy leaders have shifted to focusing on innovation from process and control, mindful of the many lessons to be learned from the commercial sector, and the fact that the defense industry at one time was capable of designing and building new weapons systems much faster than today's relatively torpid pace.

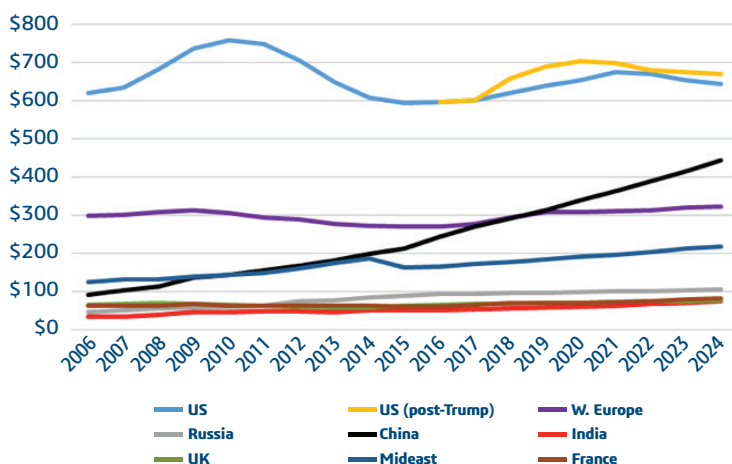
Going forward, DoD is determined to not allow the pursuit of perfection to stand in the way of fielding more capable and more sustainable weapons systems that meet the needs of warfighters quicker. When Lt. Gen. Arnold W. Brunch, Jr., military deputy in the Office of the Assistant Secretary of the Air Force for Acquisition, recently stated, "We have got to move faster in [completing] our programs," he was expressing views shared by his counterparts across the military acquisition community. He warned: "We still have an advantage, but our potential adversaries are either nipping at our heels or are at parity."

Thinking strategically about the defense landscape over the next five years, it is imperative that contractors begin challenging their own assumptions and do a better job of incorporating their customers' insistence on higher levels of efficiency and quicker innovation into how they operate. As Brunch, Assad, and other senior DoD officials have made very clear in open forums, commercial processes and technologies must drive more of what DoD equipment suppliers do and how they do it.

"If you're in the acquisition business, this is an exciting time because I see a tremendous environment for opportunity."

*Shay D. Assad,
Director, Defense Pricing*

WORLD DEFENSE SPENDING: TOP COUNTRIES



Source: The Teal Group

TECHNOLOGIES IN GREATEST DEMAND

With more than 100 years of ground-breaking technology advances behind it, the aerospace industry in the next 10 years will experience equally dramatic developments in multiple fields.

An array of technologies, some of which are still emerging, will give civil and military platforms capabilities that far exceed what's considered cutting edge today.

These technologies support manufacturers in achieving greater effectiveness and versatility in manned and unmanned weapons systems, greater fuel efficiency in commercial aircraft, and increased reliability and cost-effectiveness across the board. Government customers are demanding more value for the money, while civil aviation customers are expecting more capable systems to improve safety and to help them become more competitive on the basis of costs and the cabin experience they deliver to air travelers.

As an example, under its new Aviation Horizons initiative, NASA proposes building a series of large-scale X-planes during the next 10 years to demonstrate technologies for future ultra-efficient subsonic transports. The agency currently is developing system requirements for flight demonstrators in five different configurations—and it is casting the net beyond established airframe manufacturers to accelerate the adoption of new technologies.

Some of the technologies, such as Additive Manufacturing, Artificial Intelligence (AI), Big Data, robotics and advanced sensors—among others—also will be essential to seamlessly integrating the digital and physical worlds, with the ultimate goal of interconnecting every process required for the production of aircraft and other aviation platforms. All of the large systems integrators already have started down the path toward Industry 4.0, with lower-tier suppliers under pressure to follow their example.

The Defense Science Board concluded in its 2016 summer study that autonomy and AI have “attained a tipping point in value.” The operational value of these technologies needs to be verified before they can gain wider acceptance, but there is growing confidence that AI will play a central role in weapons systems as well as in commercial applications. AI already has demonstrated its critical importance in weapons systems, such as the UK's Taranis and the U.S.'s X-47B Unmanned Combat Air Vehicles (UCAV). AI will enable future generations of these and other UCAVs to attain higher degrees of survivability and autonomous targeting capabilities.

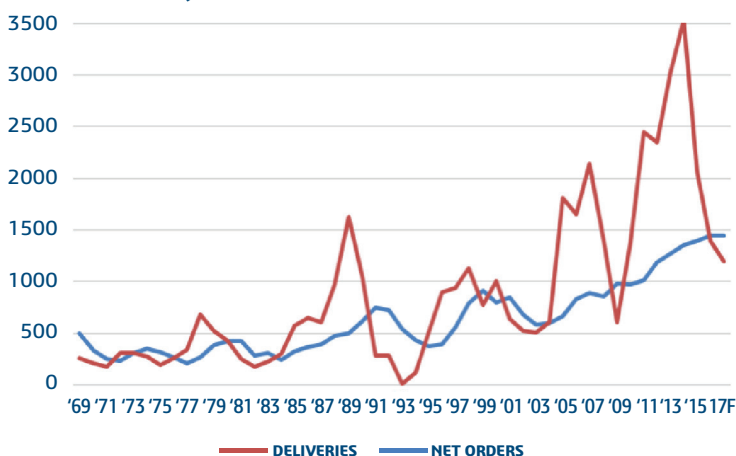
The requirement for advanced materials, already in huge demand, will become more urgent as technologists work toward creating new generations of weapons systems, manned and unmanned platforms, and propulsion systems to power them. There is an especially strong desire to make greater use of Ceramic Matrix Composites (CMC), which were developed for the fierce temperatures and pressures inside jet engines. “CMCs will allow us to do things that we have never done before,” said Robert LeDuc, president of Pratt & Whitney. “Going forward, the only pacing item is the rate at which we can learn.”

Indeed, materials will play a critical role in the design of next-generation engine architectures for both military and civil aircraft. Geared turbofans, direct drive, open rotor—all of them will be driven by a turbine, and turbine efficiency will compel greater use of ceramics throughout the hot section. By 2030, engine suppliers envision electric-hybrid and multiple smaller electric motors embedded in the wing of some aircraft, with advanced materials continuing to be a major technology enabler.

Technologies in greatest demand

- Additive Manufacturing
- Advanced computing
- Advanced materials
- Artificial Intelligence
- Augmented reality
- Advanced sensors
- Autonomy
- Big Data
- Cyber, with special attention to cyber resiliency
- Electronic warfare
- Electric and hybrid-electric propulsion
- Hypersonics
- Multi-domain command and control
- Robotics
- Unmanned systems

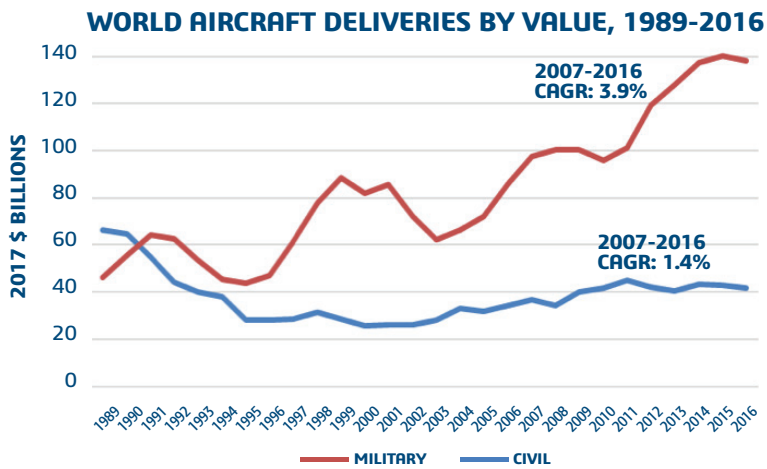
LARGE JETLINER ORDERS AND DELIVERIES



Source: The Teal Group

COMMERCIAL AVIATION'S CHALLENGING BACKLOG

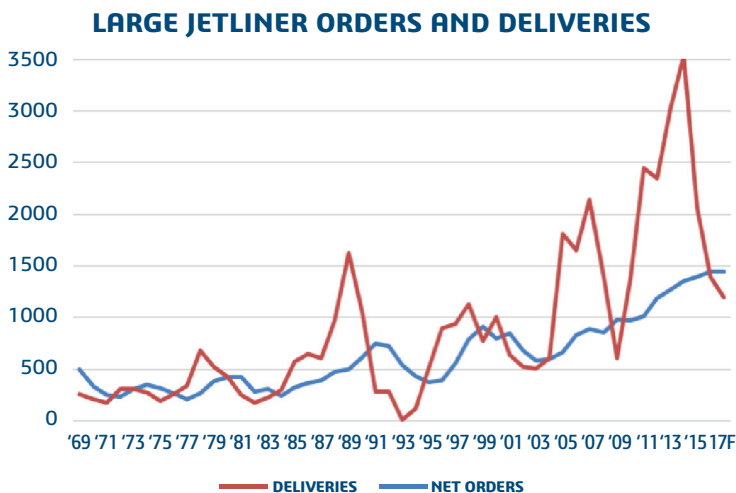
In the civil aircraft field—the area that accounts for the largest share of annual aerospace industry sales globally—there will be some additional modest growth in airliner deliveries starting in 2017, but it will be in the 3-4% range rather than the 9% or more that the aerospace industry has enjoyed over the past 12 years.



Source: The Teal Group

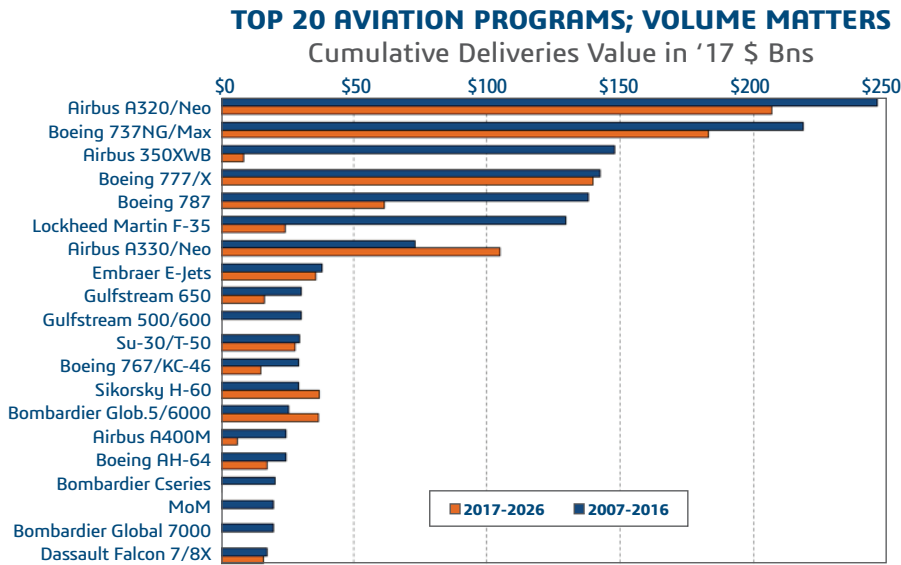
The twin-aisle market for some period will be flat, at best, with only one new program, Airbus's A350XWB starting to ramp up. Production rates for the other twin-aisle jets—the Boeing 777, 787, 767 and 747 and Airbus A330 and A380—are either flat or declining. After 2022, analysts anticipate a modest correction as the airliner market reaches the end of an extraordinary 12-year growth surge.

Still, the likelihood of a substantial production downcycle may be lower than in the past. Such cycles have been moderating since the start of the modern jet age. Deliveries have increased over time along with traffic, and each down-cycle has been less severe. With traffic growth of more than 5% expected for the next two years, the global fleet can absorb a lot of airplanes. As of mid-2017, Boeing essentially was sold out at the 57-per-month rate planned for the B737 in 2019.



Source: The Teal Group

A new generation of dedicated mid-market aircraft will not appear for at least another seven years or so, but a New Mid-range Airplane (NMA) is under study. Boeing considers the niche between the 737 and 787 to be underserved. It has identified a twin-aisle, 200-250-passenger aircraft with a range of more than 4,000 nautical miles as the ideal product.



Source: The Teal Group

The biggest pacing item is whether suppliers—already under tremendous pressure to meet increasing production rates—can support yet another development program. Boeing also needs to determine how much it can improve manufacturing efficiency to be able to offer a more compelling value proposition compared to other twin-aisle models already in production. If Boeing decides to push ahead, the company could launch a new mid-range airplane as early as 2018, creating additional stress on an already stretched supply chain.

MANAGING INCREASED DEMAND FOR AIR TRAVEL

Airframe and engine OEMs believe travel demand will continue growing more than 5% annually over the next 20 years, fueled by an increase in the world's middle class. Airbus Chief Operating Officer John Leahy presents what is perhaps the most convincing case for such projections.

Since the millennium, air travel across the world has doubled, with the middle class accounting for about 40% of the global population, compared to 26% in 2000 and only 16% in 1970. In 2016, the aircraft passenger fleet was 50% larger than it was in 2000—and more than six times larger since 1970. In 2030, more than half of the world's population will belong to the middle or "consuming" class, with nearly 1.5 billion more people who can afford to take a passenger jet flight; most of these new passengers will live in emerging economies.

"Some people question whether such optimistic forecasts are realistic, given all the signs of stress in the global economy," Leahy said. "Air traffic has continued to double every 15 years—despite the oil crises of the 1970s and the early 1980s, the Gulf War of 1991, the Asian financial crisis of the late 1990s, and despite the Sept. 11th attacks and the SARS outbreak." Since the global financial crisis of 2008, he added, demand for air travel has grown at almost double the rate of GDP expansion. He asserted: "Commercial aviation has proved remarkably resilient throughout the past four decades." Bottom line: Leahy and the International Civil Aviation Organization (ICAO) forecast air traffic to double again in the next 15 years.

To satisfy this growing demand, according to industry analysts and OEMs, many more single-aisle jets will be required in the future. New programs such as the Airbus A320neo, Boeing 737MAX and Bombardier Cseries are just beginning, and production schedules are ramping up to rates unimaginable a decade ago.

Like government contractors, companies that compete in civil aviation markets may find their biggest challenge is delivering products on time while reducing costs and improving quality. On recent major aircraft development programs, some OEMs have demonstrated they are willing to replace legacy suppliers with their competitors. As Airbus and Boeing increase production

rates of single-aisle aircraft, entire supply chains will be under growing pressure to introduce new processes to allow for more competitive pricing and shorten the time to field new products.

As an Airbus manufacturing executive recently stated: “Our production rates are already very high, and as they continue to increase to reflect the doubling of global air traffic every 15 years, our production system needs to have the capability for this growth.” He noted that in 2015 Airbus delivered a record 635 airliners to 85 customers, surpassing the previous year-end record of 629. The company’s funded backlog stood at a record 6,831 aircraft valued at more than \$1 trillion. “To keep up with this inexorable rise in output, we can’t simply make our factories bigger. Rather, we have to reorganize them to make them leaner, more agile, and more connected with smart technologies, extending into our supply chains, hence becoming more efficient overall.”

RESTRUCTURING REACHES INTO THE SUPPLY CHAIN

Across the broader aerospace industry, restructuring will continue for the foreseeable future and help shape the competitive landscape, primarily at the middle and lower tiers of the supply chain. Driving continued mergers and acquisitions will be companies’ desire to penetrate deeper into high-growth markets, acquire enabling technologies, and/or position themselves for new sales opportunities.

At times, continued consolidation will seem reminiscent of the Great Consolidation of 1993-2003 in terms of the scale of some transactions. Rather than activity being near-continuous, as it was during that 10-year Darwinian process, industry professionals can expect to see the industry periodically lurch forward with sizeable mergers and acquisitions. Emerging will be a small handful of super-suppliers intent on dominating as broad a range of subsystem markets as regulators—and airframe manufacturers—will permit.

One of the biggest consolidators could turn out to be United Technologies Corp. (UTC). In the third quarter of 2017, UTC announced the acquisition of Rockwell Collins Corp., which itself was still closing its acquisition of B/E Aerospace in 2016.

Another landscape-shaping trend suppliers can expect is additional insourcing of some parts by airframe builders as they establish more centers of excellence and address affordability issues—all of which will become more pronounced as production rates increase. Airframe manufacturers demand innovation across their supply chain to allow more competitive pricing.

OEMs’ gradual implementation of Future Factories could add to the pressure on suppliers. With supplier participation essential to the success of Industry 4.0, those who choose not to go down this path or drag their feet could find themselves vulnerable to the loss of work to insourcing or to other suppliers prepared to support OEMs’ Future Factory initiatives.

CONCLUSION

To succeed in the future, the entire aerospace industry will need to do more than merely be aware that major forces will reshape the industry landscape. Rather, the spoils will go to companies that are prepared to adapt to those forces and that have a strategic vision of where they want to be in longer term.

The alternative is to slowly become irrelevant, despite the plethora of business opportunities in nearly every segment of aerospace, as competitors rise to the challenge.

A 24-year veteran of Aviation Week, Tony Velocci is former Editor-in-Chief of *Aviation Week & Space Technology* magazine as well as Editorial Director of Aviation Week Group.

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