

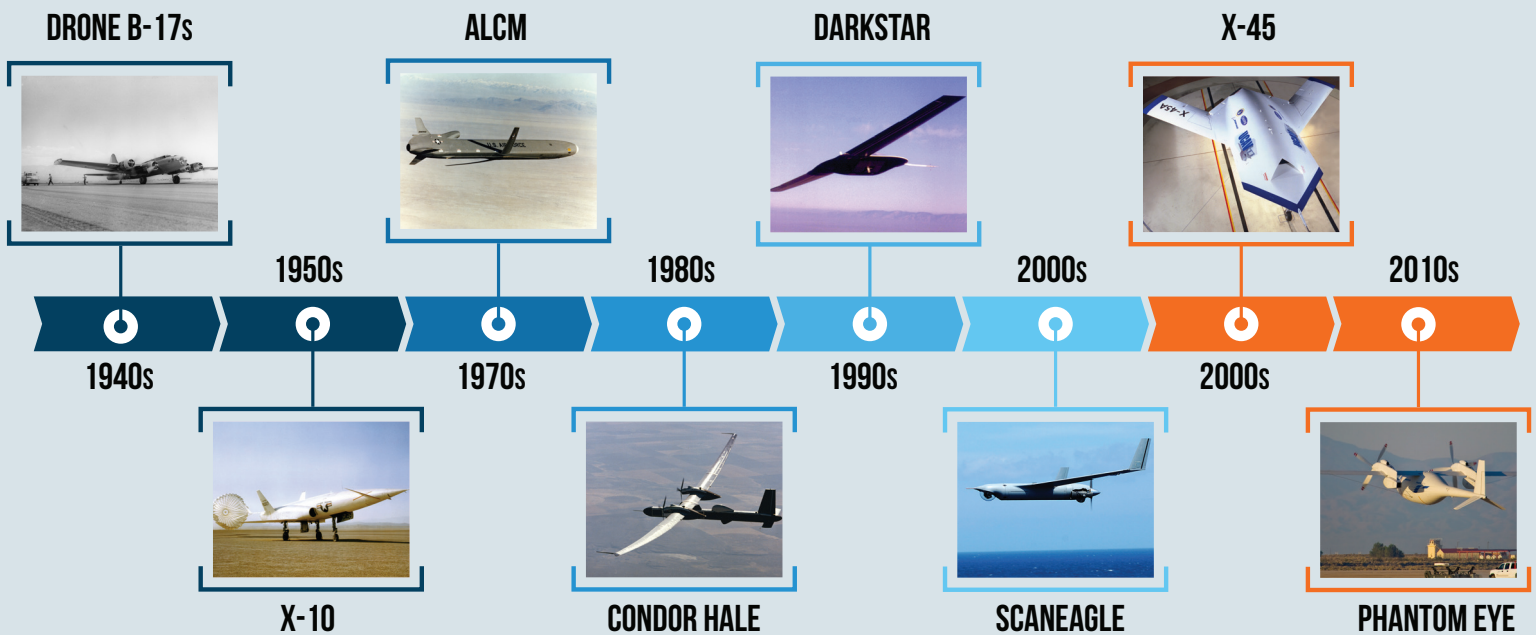
# AIR DOMINANCE: HOW THE FUTURE FIGHT WILL BE WON

Autonomy evolution leading to a new era in aviation.

As allied nations look to safeguard air superiority and military readiness — amidst an evolving security environment — industry must take a holistic approach. The key to victory no longer lies in a single new aircraft or weapon but in a family of crewed and autonomous systems working together.

Boeing is building on 80 years of autonomous innovation to enable the warfighter across all domains at the speed of relevance.

To accelerate an autonomous future, draw on the past.



Boeing's first forays into autonomy date back to World War II, when converted B-17s flew as drones on missions deemed too dangerous for crews. Since then, Boeing has invested in and advanced state-of-the-art autonomous systems and innovations for the warfighter, including:

- Remotely piloted aircraft, beginning in the 1950s.
- Self-guided missiles, beginning in the 1970s.
- High-altitude, long-endurance uncrewed aircraft, beginning in the 1980s.
- Stealthy, uncrewed reconnaissance aircraft in the 1990s.
- Turnkey maritime intelligence, surveillance and reconnaissance services (ISR) beginning with ScanEagle in the 2000s.

- First uncrewed airborne system designed specifically for network-centric combat operations with the X-45 in the 2000s.
- Persistent ISR with the high-altitude, long-endurance Phantom Eye in the 2010s.
- Rapid prototyping and further technology advances with Phantom Ray in the 2010s.

The depth of knowledge from past work shapes emerging and evolving systems. Phantom Works, the advanced research and development unit within Boeing Defense, Space & Security, is an industry leader in this space.

## Forge the path: MQ-25 and MQ-28



*From left, the MQ-28 Ghost Bat and MQ-25 Stingray. (Boeing photo)*

Two platforms in particular draw on the decades of investment Boeing has made in autonomy. Both will bring the warfighter never-before-seen capability while paving the way for future innovation.

With the U.S. Navy's **MQ-25 Stingray program**, Phantom Works designed the world's first operational carrier-based uncrewed aircraft designed for refueling capability.

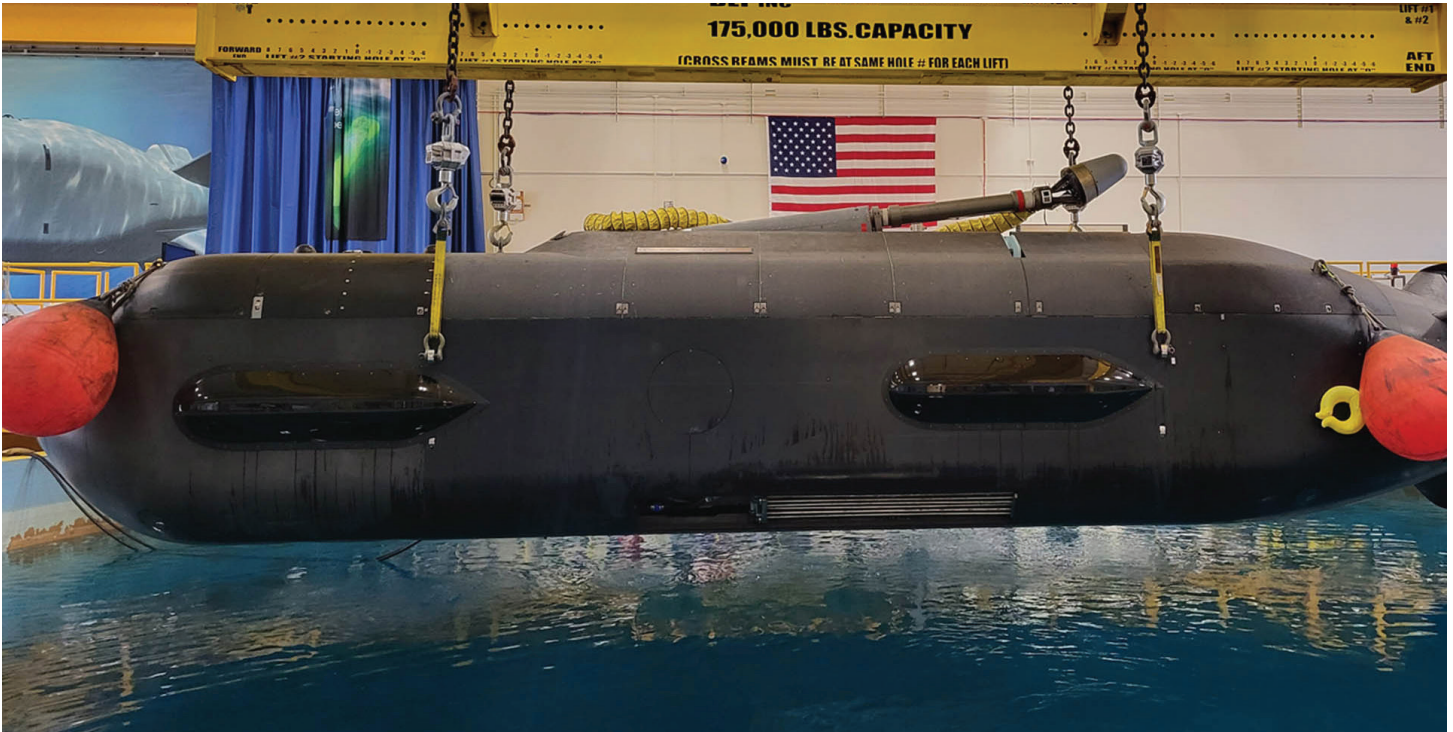
- **Why MQ-25 matters to the future:**

- It will enable safe, reliable and routine uncrewed aircraft support to combat operations.
- More broadly, as autonomy and artificial intelligence become prevalent in aviation, the MQ-25 will serve as a platform to develop and test future uncrewed systems and technologies.

With the **MQ-28 Ghost Bat**, Phantom Works Global is helping Boeing Australia and the Royal Australian Air Force develop an uncrewed, collaborative combat aircraft.

- **Why MQ-28 matters to the future:**

- It is designed to be a force multiplier, working collaboratively with crewed and uncrewed aircraft.
- The flexibility in configuration will allow the MQ-28 to perform a number of roles in support of advanced multi-mission air combat operations.



*Boeing delivered the first Extra Large Uncrewed Undersea Vehicle (XLUUV) to the U.S. Navy in 2023.*

While the MQ-25 and MQ-28 programs demonstrate how Phantom Works hyper-focuses on autonomy, consider the full breadth of Boeing's autonomy footprint. For instance, when the Extra Large Uncrewed Undersea Vehicle travels deep in the ocean, that is Boeing autonomy at work.

## Transform the build

To stay ahead of the rapidly evolving threat environment, industry must focus on advancing disruptive technologies but also how those technologies are developed, fielded and supported. As digitally engineered aircraft, the MQ-25 and MQ-28 demonstrate the benefits of advanced manufacturing techniques.

The MQ-28, for instance, will “fly” thousands of times in digital form, testing aircraft performance before production ever begins. Meanwhile, as an early adopter of full-size determinant assembly (FSDA), the MQ-25 combines the power of digital engineering with precision machining, improving both quality and the ease of manufacturing and assembly.

Boeing is committed to next-generation development and production. The company has invested more than \$1 billion in infrastructure, including:

- Several new production facilities in Missouri and Illinois.
- An Advanced Coatings Center, operated by Phantom Works, to house state-of-the-art post-assembly phases of future military aircraft production.
- An Advanced Composite Fabrication Center in Arizona.

These facilities will accommodate even further advances in manufacturing, maximizing first-time quality and eliminating duplicative efforts in design, analysis, test and sustainment.

## Collaborate and invest in the future



*An MQ-25 test vehicle, left, refuels a U.S. Navy F/A-18 Super Hornet in 2021, marking the first time in history an uncrewed aircraft refueled another aircraft.*

With artificial intelligence, cyber warfare and quantum computing changing the face of warfare, no one entity is solely equipped to handle the full spectrum of threats. Boeing is actively seeking partnerships with startups or nontraditional companies specializing in autonomy and AI technologies. Militaries and industry must face into modern complexities together to get in front of evolving threats.

Meanwhile, as the next generation of uncrewed systems takes shape, groundwork must be laid to ensure those systems work seamlessly with their crewed counterparts. Early efforts in this arena demonstrate that uncrewed systems are up to the task.

Already the MQ-25 has shown it can receive commands from and team with crewed aircraft in the future. During a recent demonstration, Boeing used an onboard, nonproprietary autonomy framework to show how a P-8A Poseidon, F/A-18 Block III Super Hornet and E-2D Advanced Hawkeye safely and efficiently tasked four virtual MQ-25s to conduct ISR missions.

Through exercises such as these, Boeing is helping the warfighter create and demonstrate the building blocks for manned-unmanned teaming.

## Deliver results that matter

With a rich heritage in autonomous systems, Boeing continues to push the boundaries of science and technology. The battle for air dominance begins with innovators on the ground —and Boeing is all in.