

Overview

日本との
パートナーシップ




民間航空機市場の
見通し

環境への取り組みや目標

コロナ感染予防対策






2025 Sustainability Goal

Global 2025 Strategy for Environmental Leadership – 2019

Strategy Pillar	Progress Details
Innovate for Performance 	<p>Innovation is crucial throughout Boeing, from design and manufacturing to operations and services. Addressing our environmental footprint from the beginning to the end of service is important for environmentally responsible manufacturing solutions, including energy efficiencies, while also working toward eliminating hazardous chemicals in production.</p> <p>In January 2020, Boeing began test flights of the 777X, the most fuel efficient twin-engine jet in the world. (See page 3 for full story.)</p>
Excellence in Sustainability 	<p>Boeing made progress in 2019 by reducing solid waste by 15% and water use by 7% from the 2017 levels. Boeing is leading with recycling and procuring renewable energy programs.</p> <p>The CDP (formerly called the Carbon Disclosure Project), the industry standard for environmental reporting, recognized Boeing with a B rating for our CO₂ emissions reduction and transparent reporting.</p>
Inspire Global Collaboration 	<p>The National Association of Manufacturing awarded Boeing with its environmental sustainability leadership award in 2019 for its leading work in developing a process to recycle excess carbon fiber, a commercially viable endeavor. Boeing is a leader in sharing this thought leadership with other major manufacturers. (See page 8 for full story.)</p>

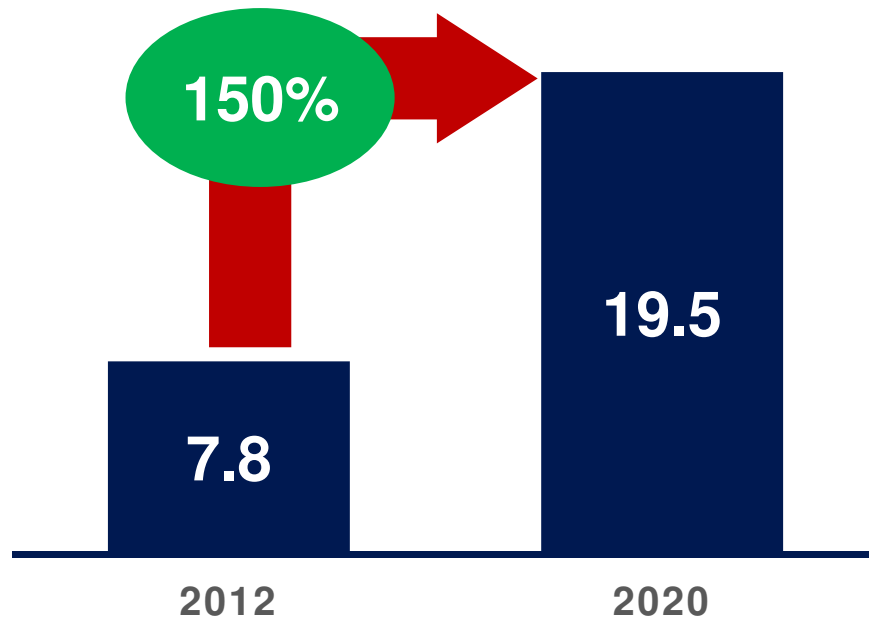


Progress Toward 2025 Goals in 2019 (from 2017)

2025 Reduction Goals	Progress Details
 Reduce greenhouse gas emissions by 25%	Reduced 2.8%
 Reduce water consumption by 20%	Reduced 7%
 Reduce solid waste to landfill by 20%	Reduced by 15%
 Reduce energy consumption by 10%	Increased 0.3%
 Reduce hazardous waste by 5%	Increased 2.7%

Sustainable aerospace growth with composites: **reduce, reuse, recycle**

AEROSPACE CARBON FIBER CONSUMPTION



- Continued aerospace growth
- Sustainability questions
- Systematic approach

*Data from Composite Market Reports Presentation, Carbon Fiber 2012 Conference



Recycling 100% of carbon fiber waste

- National Association of Manufacturers award – Leadership in Sustainability
- upcycling excess airplane carbon fiber

Road to 2050 on Carbon Reduction

Commercial Aviation Carbon Reduction Goals		
2010	2020	2050
1.5% per year fuel efficiency	Carbon-neutral growth	Reduce carbon emissions by 50%
▼	▼	▼
Working toward carbon-neutral growth	Implementation of global sectoral approach	Half the net aviation CO ₂ of 2005



Our mission



Innovate

Learn by doing, discover quickly

Collaborate

With airlines, government, suppliers, academia, industry

Accelerate

Speed path to products, services and production



Accelerating innovation for a sustainable future

Our history



2020 program



Quieter for the community

- NASA acoustics research
- Safran landing gear noise reduction



Airspace and operational efficiency

- Digital communications live flight demo
- Time-based management arrivals demo

Onboard sanitization

- Ultraviolet light wand



Sustainable aviation fuel

- Technology readiness demonstration

August		September		
△ Aug. 14 Live flight demo from Boeing South Carolina to Seattle		△ Late August Flight tests begin in Glasgow, Montana		
		△ Early September Flight tests end in Montana		
		△ Mid-September Live flight demo from Seattle to Boeing South Carolina		
		△ Late September Delivery flight to Abu Dhabi, UAE		

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コロナ感染予防対策

A person wearing a yellow jacket, a brown hat, and a backpack is standing in an airport terminal, looking at flight information boards. The boards display flight numbers, destinations, and times. The person is holding a black suitcase. The background shows the airport's interior with other flight boards and seating areas.

Confident Travel Initiative

Aircraft cabins are designed to provide **a safe environment** for passengers and crew

Boeing is **continuously studying and advancing new technologies** that help deliver an even safer cabin

Combating COVID-19 requires a **coordinated industry approach**



A Multi-layered approach to protect the passenger journey



Boeing is providing guidance to airlines

Multi-Operator Message (MOM)

First released January 27
Revision 6 released May 28



MOM Contents

- General Information on Boeing's Recommendations
- Flight Deck Disinfection and Cleaning
- Passenger Cabin Disinfection and Cleaning
- Cabin Air Filtration and Recirculation

Flight deck disinfection and cleaning: based on compatibility with surfaces



**DISINFECTANT
COMPATIBILITY**



**CURRENT
DISINFECTANT AND
CLEANING
PRACTICES**



**FLIGHT CREW
BEST PRACTICES**



Passenger cabin disinfection and cleaning: based on compatibility with surfaces



**ALTERNATIVE
DISINFECTANTS**



**DISINFECTANT
WARNINGS**



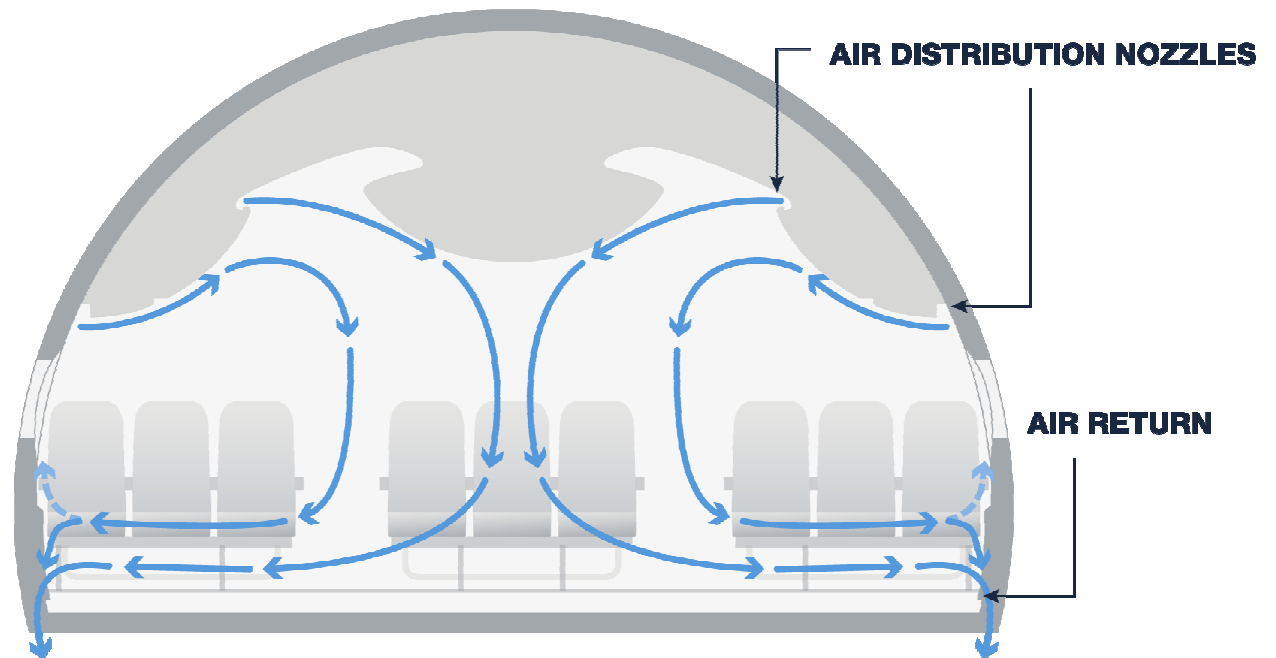
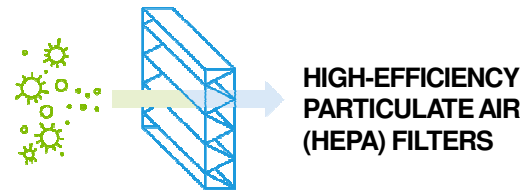
**NON-RECOMMENDED
TECHNIQUES**



Protecting today's airplane interiors

Cabin airflow

- Cabin air is constantly exchanged and recirculated with a mix of outside air and inside filtered air
- This air exchange happens about every two to three minutes
- HEPA filters have been shown to be 99.9+% effective at removing particulates such as viruses, bacteria and fungi from recirculated air
- Air flows from the ceiling to floor, not front to back, which helps minimize particulates spreading throughout the cabin



How does cabin air compare to everyday places?

How often is the air exchanged?

What about the particle dispersion from a cough?

What is filtered out of the air and what isn't?
(Based on typical air filter [MERV] ratings.)



ONCE AN HOUR, OR LONGER



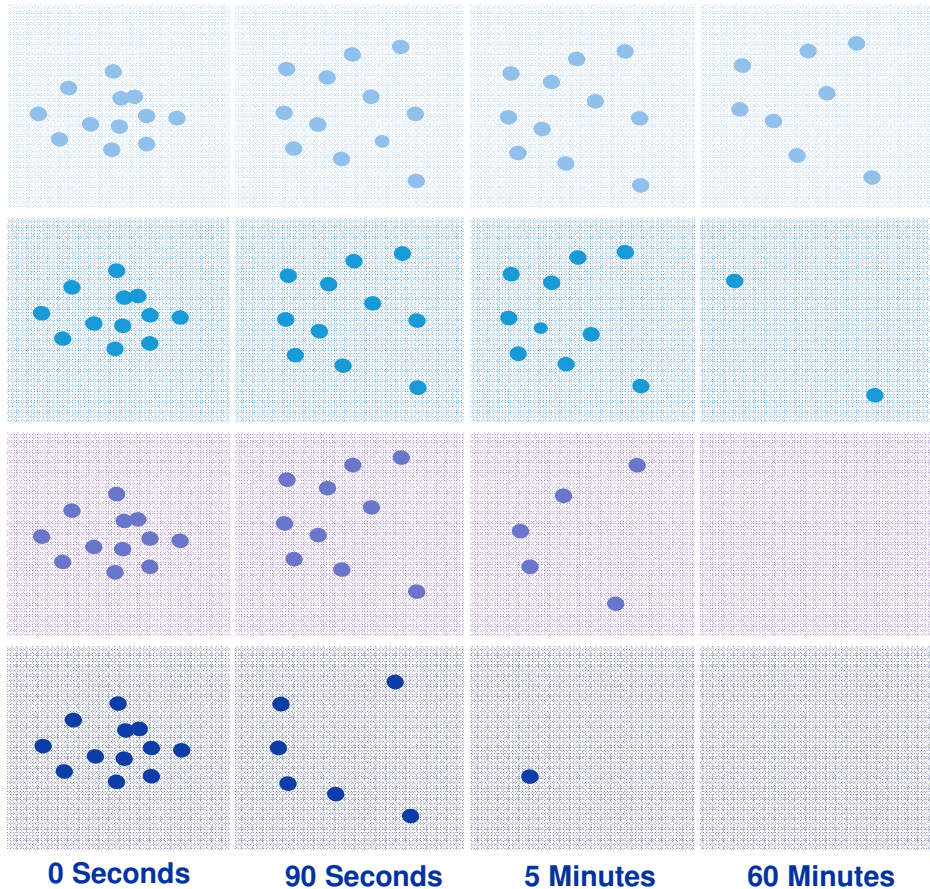
EVERY 12 – 30 MINUTES



EVERY 6 – 10 MINUTES



EVERY 2 – 3 MINUTES



Particulates Removed (MERV 2-6):

- ✓ Dust/Lint
- ✓ Pollen

Particulates Removed (MERV 5-8):

- ✓ Dust/Lint
- ✓ Pollen
- ✓ Mold
- ✓ Dust Mites

Particulates Removed (MERV 13+):

- | | | |
|-------------|--------------|--------------|
| ✓ Virus | ✓ Dust/Lint | ✓ Smoke |
| ✓ Bacteria | ✓ Pollen | ✓ Pet Dander |
| ✓ Allergens | ✓ Mold | |
| ✓ Smog | ✓ Dust Mites | |

Particulates Removed (MERV 17+):

- | | | |
|-------------|--------------|--------------|
| ✓ Virus | ✓ Dust/Lint | ✓ Smoke |
| ✓ Bacteria | ✓ Pollen | ✓ Pet Dander |
| ✓ Allergens | ✓ Mold | |
| ✓ Smog | ✓ Dust Mites | |

Boeing is helping airlines protect passengers from a virus



CHEMICAL DISINFECTANTS

*20 tested, 9 Boeing approved
disinfectants*



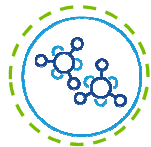
UV TECHNOLOGY

*For use in flight deck
today, cabin is under study*



THERMAL DISINFECTION

Eliminating viruses with heat



IONIZATION TECHNOLOGY

*Electrically charging the air to
make it even cleaner*

TODAY'S SOLUTIONS

TOMORROW'S POTENTIAL SOLUTIONS

 = UNDER STUDY



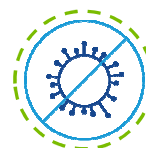
ELECTROSTATIC SPRAYERS

*Efficient application for hard
to reach areas*



ANTIMICROBIAL COATINGS

*Developing our own, validating
others' for a long lasting solution*



BOEING ANTI-VIRAL COATING

*Breakthrough anti-microbial
with high kill rate, long life*



UV BUILT INTO THE AIRPLANE

*Continuous disinfection
through the travel journey*

How Boeing knows this is effective



ANALYSIS OF THE AIRPLANE

The diagram illustrates a computer simulation of cabin airflow. It shows a cross-section of an airplane cabin with passengers. A large blue arrow points downwards from the front of the cabin, indicating the flow of air. A pink circular area highlights the region around the passengers, representing the area of interest for the analysis.

Computer simulation of cabin airflow

Particle dispersion analysis

Analysis on Fomite transmission



TESTING IN THE LAB:

A scientist wearing a white lab coat, a purple face mask, and purple gloves is working in a laboratory. They are using a pipette to transfer liquid into a small container. The background shows laboratory equipment and a computer monitor.

Material compatibility with disinfectants

Flammability

UV resistance

Fluid intrusion & electronic function



TESTING ON AN AIRPLANE

A person wearing a white protective suit, a blue face mask, and blue gloves is working in a laboratory. They are using a pipette to transfer liquid into a small container. The background shows laboratory equipment and a computer monitor.

Cough simulations on airplane

Live virus testing with different disinfecting technologies



THIRD PARTY REVIEWS

A person wearing a white protective suit, a blue face mask, and blue gloves is working in a laboratory. They are using a pipette to transfer liquid into a small container. The background shows laboratory equipment and a computer monitor.

Use of medical and academic professionals to review and validate

Tested cleaning technologies on a live virus

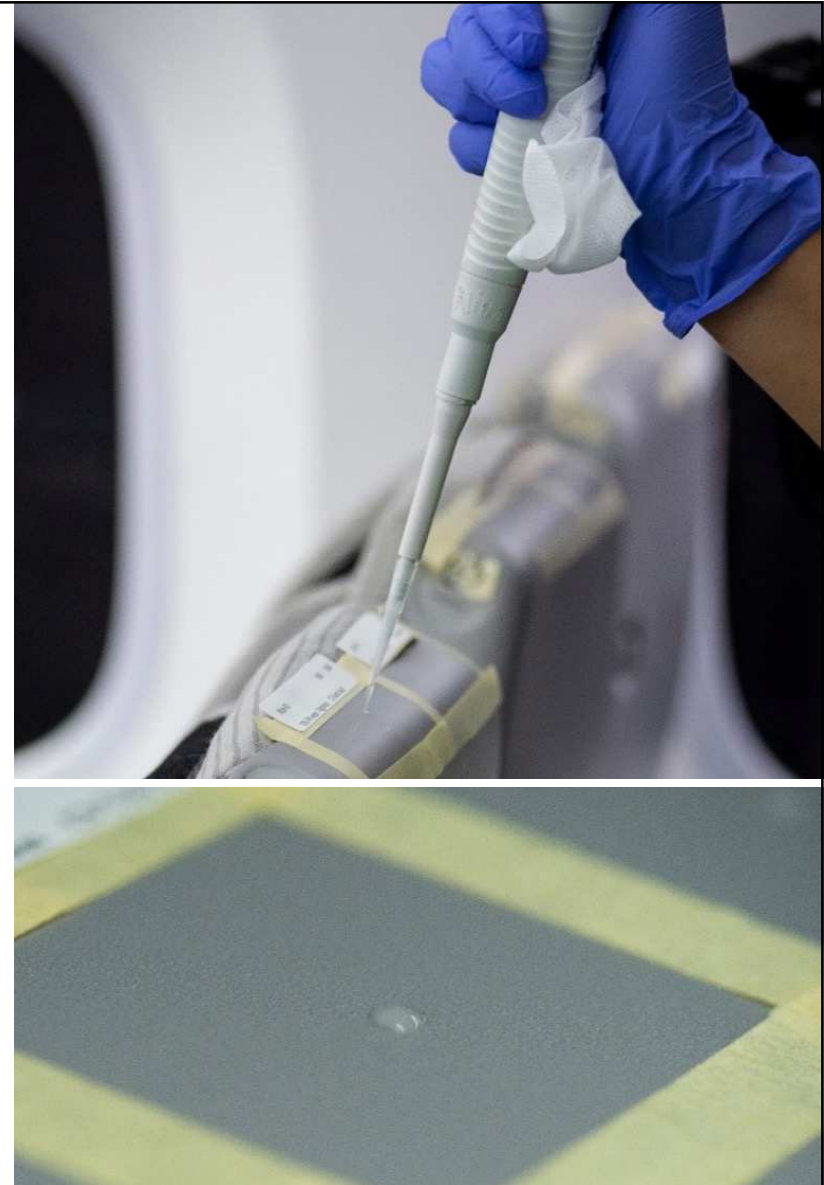
In partnership with the University of Arizona

The Goal

- Test the effectiveness of cleaning products, methods and technologies against a human-safe live virus (MS2) in a cabin

The Method

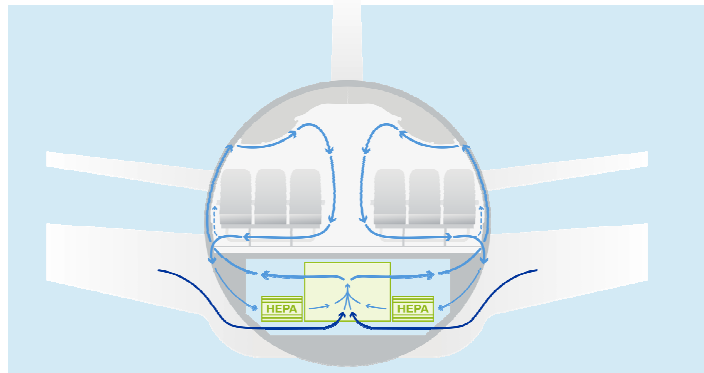
- The virus was placed on strategic points throughout the cabin and disinfected using one of the following:
 - Chemical disinfectants
 - Electrostatic sprayer
 - Antimicrobial coatings
 - Ultraviolet wand



What next?

Working with airlines, industry bodies:

- ✓ Educate the flying public on the safety of the air travel system



Advocacy with government agencies, international organizations

- ❑ Identify ways to safely reduce international travel restrictions



BR&T Overview

Boeing Research & Technology

Lead Boeing Into a New Era of Innovation

We **deliver** aerospace technology capabilities that **transform** markets,
capture business opportunity, and **benefit** humanity

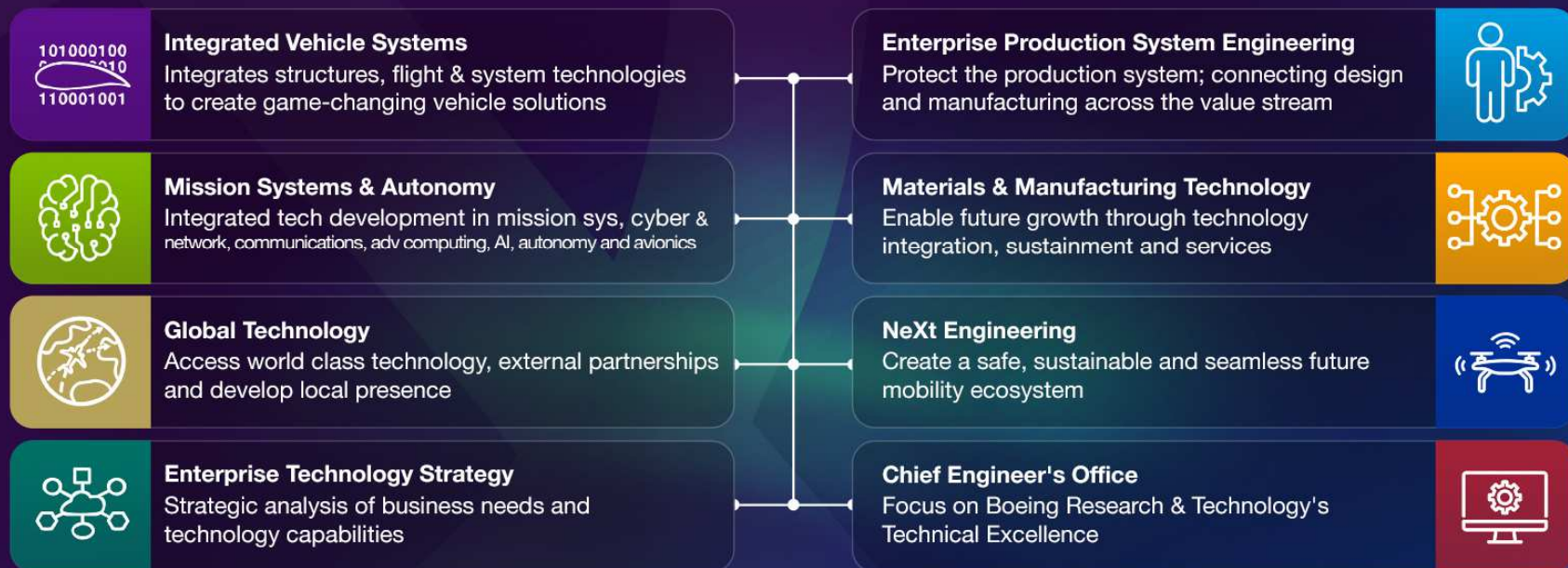
Protecting the Second Century

Supporting innovative product development



Boeing Research & Technology

Lead Boeing Into a New Era of Innovation



We **deliver** aerospace technology capabilities that **transform** markets,
capture business opportunity, and **benefit** humanity

Aerospace's Innovation Drivers

Environmental concerns

Production efficiency

Platform performance

Customer satisfaction



Boeing's Technology Investments Focused on Future Needs

Extreme Affordability

Breakthrough Performance

Enduring Maintainability

Environmentally Responsible



Delivering solutions that generate the value our customers demand

Sources of Improved Capabilities



Systems



Engines



Materials



Aerodynamics

Multiple sources complement each other – but must be integrated

What's Needed to Accelerate Future Progress?

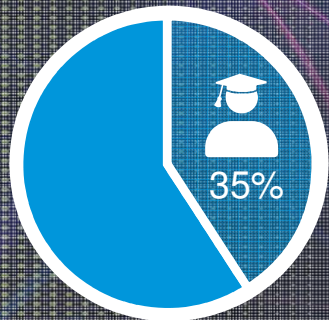
- *Fundamental changes in development, for larger steps forward*
- *Better ways to qualify changes*
- *Advanced design tools*
- *Concurrent development of production systems*
- *Proper development of workforce*
- *Awareness, improved technical capabilities from customers, certifying authorities*



BR&T By the Numbers

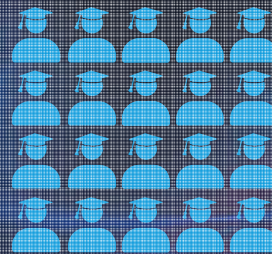
4,000+

Employees in BR&T



1,400+

Employees with
Advanced Degrees

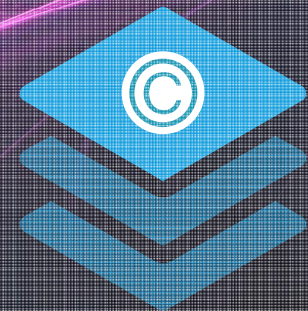


300+

Technical Fellows

1,100+

Average BR&T Patents and
Invention Disclosures Per Year



Supporting innovation around the world 24/7



BR&T International Research Centers

Technology Capabilities

AUSTRALIA

- Advanced Resin Infusion Composites, Structures, Production Systems
- Autonomous Systems
- Cobotics & Automation Production Systems
- Computational Mechanics Modeling
- Mixed Reality (AR/VR)



BRAZIL

- Aeroacoustics
- Airspace Operational Efficiency & Services
- Sustainable Biofuels



CHINA

- Advanced Manufacturing & Materials
- Air Traffic Management
- Computer Vision & Machine Translation
- Sustainable Energy



EUROPE

- Actuation Systems
- Airspace Operational Efficiency & Services
- Integrated Model-Based Engineering
- Mass Production of Composites



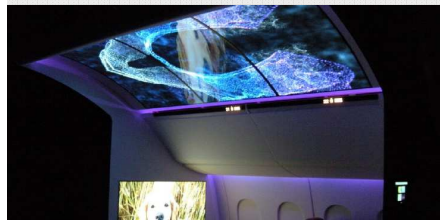
INDIA

- Advanced Mfg., Automation Standardization
- Artificial Intelligence, Machine Learning and Internet of Things
- CFD, Computational Structural Analysis
- Chemical Technology
- Product Analysis & Teardown
- Supplier Qualification



KOREA

- Artificial Intelligence, Autonomy & Analysis
- Avionics Controls and Displays
- Connected Cabin
- Factory Enterprise Systems
- Mobile Device Solutions



RUSSIA

- Computational Fluid Dynamics and Aeroacoustics
- Flight Training
- Metals Modeling and Structural Analysis
- New Titanium Alloy Technologies



BR&T International Research Offices

Technology Capabilities

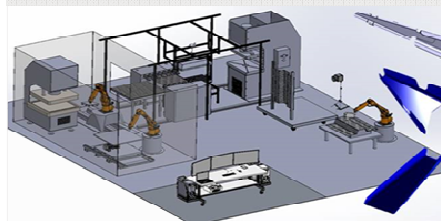
SAUDI ARABIA

- Artificial Intelligence, Machine Learning and Autonomy
- Combustion & Flame Propagation
- Metals Machining
- Structural Certification & Qualification



TURKEY

- Airline Decision Support Services
- Composites Materials
- Program & Manufacturing Support



UNITED ARAB EMIRATES

- Advanced Manufacturing
- Biofuel Technology
- Program & Manufacturing Support
- Transformational Training & Development



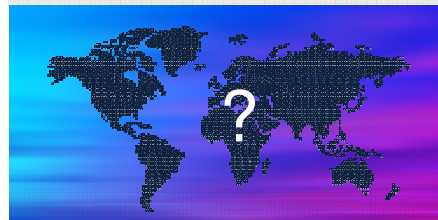
JAPAN

- Autonomy and Robotics
- Electrical Power
- Composites Materials
- Program Support

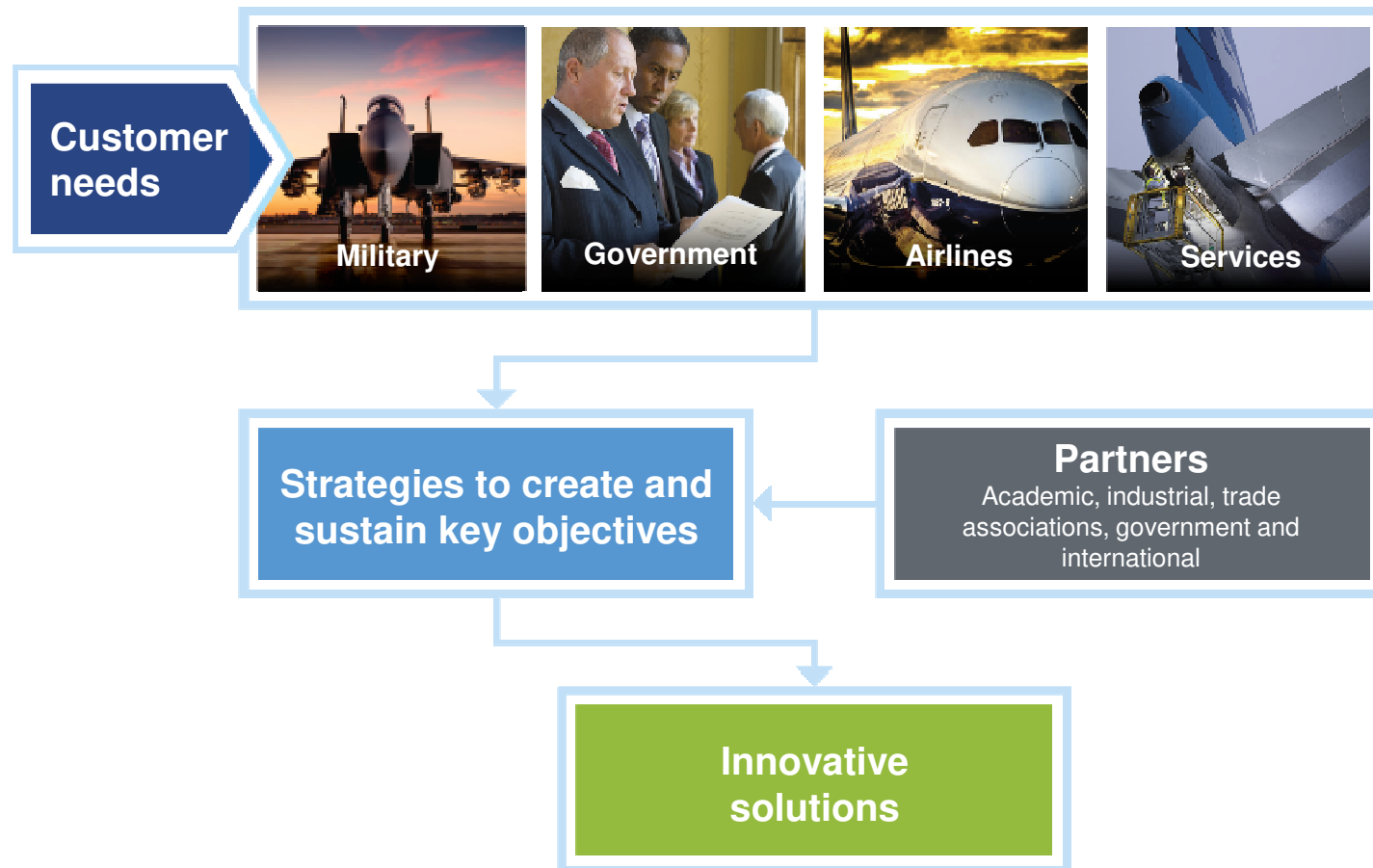


NEXT ...

- Accessing World Class Technologies, Leveraging R&D Co-Investments and Advancing Local Presence

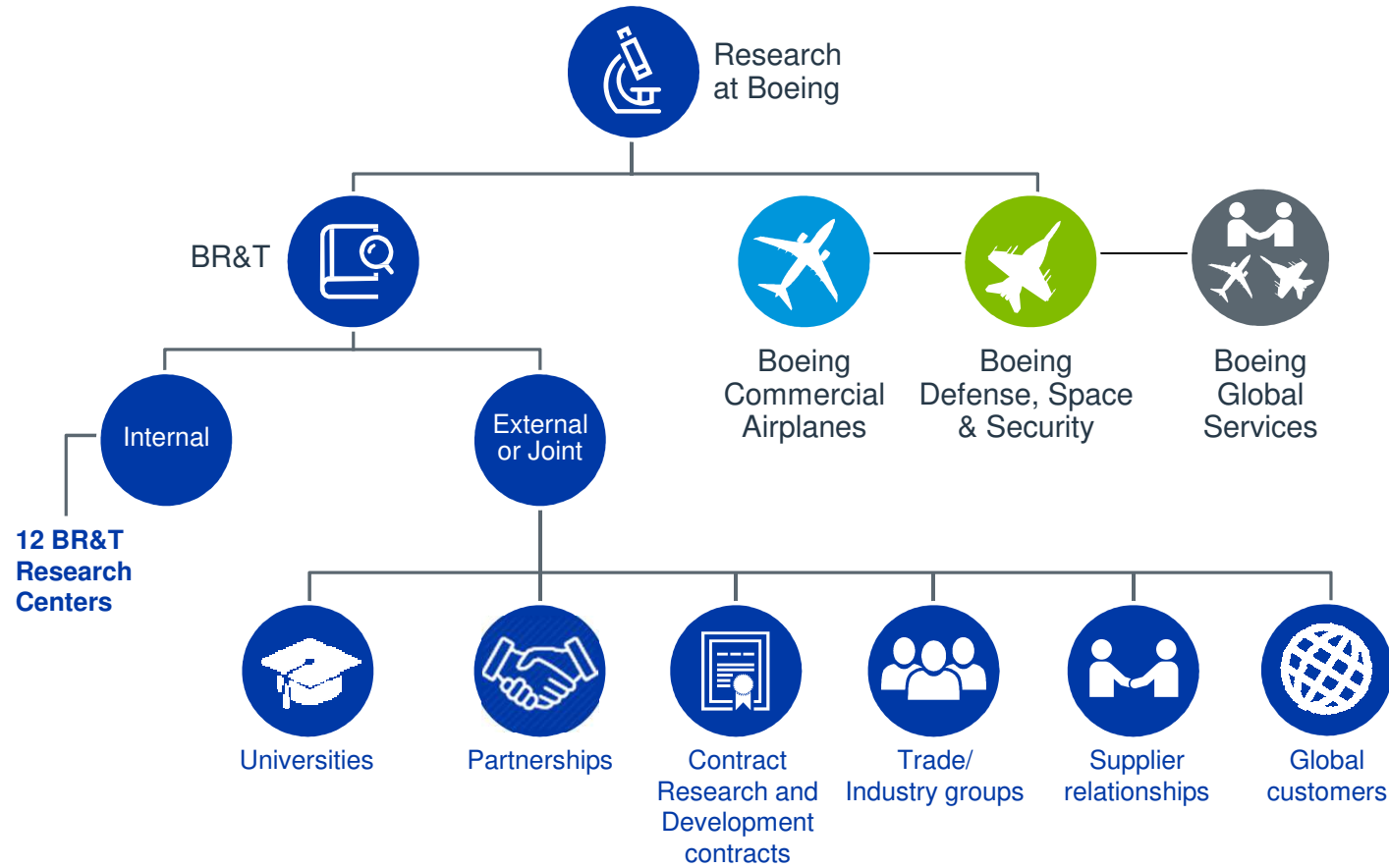


How do we view strategy?



Research & Development at Boeing

Robust, widespread, and integrated





*The rate of change
will continue to accelerate*

What is currently changing aerospace?

- > Digitization
- > Artificial Intelligence & Autonomy
- > Cyber Security & Quantum Technologies
- > Advanced Materials & Manufacturing
- > Electrification
- > Environment & Sustainability
- > Increased access to space

Dawn of a New Golden Age of Aerospace



Passenger Air Vehicle



Cargo Air Vehicle



Transonic Truss-Braced Wing



Disruptive Computing



Boeing Research & Technology