Engineering, Test & Technology

Paul Pasquier
Vice President
ET&T Supplier Management
2050 focus areas

- Solutions for developing countries
- Low-stress travel
- Regional and urban mobility
- Connectivity and big data
- Sustainability
Protecting the Second Century
Supporting innovative product development

Boeing Commercial Airplanes
Product Development

Boeing Global Services

Boeing Engineering, Test & Technology

Independent R&D / Test organization
Connect, protect, explore and inspire the world through aerospace innovation

Boeing Defense, Space & Security
Phantom Works
Research centers
Supporting innovation around the world 24/7

Number of BR&T Research Centers: 11
Number of U.S. BR&T Research Centers: 5
Number of International BR&T Research Centers: 6
BR&T Research Centers

Alabama
- Simulation and decision analytics
- Communications and sensing technology
- Vehicle management systems integration
- Metals and ceramics

California
- Flight sciences
- Electronics and networked systems
- Structures technologies
- Extreme environments
- Cybersecurity
- Failure analysis

Missouri
- Systems Technology
- Digital aviation and support technology
- Rate-independent production
- Next-generation materials

South Carolina
- Advanced manufacturing technology
- Composite fuselage / propulsion production

Washington
- Manufacturing technology integration
- Composite wing manufacturing

Australia
- Resin infused composites
- Unmanned aerial vehicles
- Human factors
- Robotics
- Modeling and simulation

Brazil
- Biofuels
- Metals
- Air traffic management
- Aero sciences & remote sensing

China
- Biofuels
- Advanced materials
- Support & services
- Cabin technology

Europe
- Air traffic management
- Avionics model based engineering
- Fuel cell systems
- Composite and additive manufacturing
- Safety

India
- Advanced computational methods
- Active flow control
- Propulsion
- Engineering analysis
- Cyber security
- Airplane health management

Russia
- Materials & process technology
- Aeronautics
- Testing
- Machine learning and data analytics
Technologies

Aurora Flight Sciences

Cabin Environment

HorizonX

Additive Manufacturing

ATM

Avionics
- Common Core System
- Electrical Power
- Flight Control Electronics
- Flight Management
- Li-ion batteries
How Do We View Strategy?

Customer needs

Strategies to create and sustain key objectives

Partners
Academic, industrial, trade associations, government and international

Innovative solutions

Military

Government

Airlines

Services
Research & Development at Boeing
Robust and widespread

BR&T

Internal

External or Joint

Boeing Commercial Airplanes

Boeing Defense, Space & Security

Boeing Global Services

11 BR&T Research Centers

Universities

Partnerships

Contract Research and Development contracts

Trade/Industry groups

Supplier relationships

Global customers
Breakthrough Technologies

XS-1 Reusable first-stage launch vehicle

World's largest solid 3-D-printed item (Video)

Blended Wing Body

Fuselage Automated Upright Build (Video)

Bug phobic coatings

Hypersonic flight
Boeing Test & Evaluation
Boeing Test & Evaluation Locations
Dedicated to ensuring the safety and integrity of Boeing products

54 Sites across U.S.
22 Number of states
3 International locations
Validation Process

AIRPLANE CHANGE ➔ NEW AIRPLANE
➔ MAJOR CHANGE
➔ NEW SYSTEM
➔ MODIFIED SYSTEM
➔ NEW PART
➔ MODIFIED PART
➔ NO CHANGE

Analytical Computational Fluid Design Modeling
Wind Tunnel Simulation Integration Lab Simulation Flight Test Factory

VALIDATED AIRPLANE
Boeing Test & Evaluation - Test Environments

Test Environment Summary
- Over 250 Test Environments (Multi-use and Program/Product specific applications)
- Over 3 Million Sq Ft of Test Environment footprint

**Aero, Noise & Propulsion**
23 Test Environments across 4 Major Sites
- Wind Tunnels, Propulsion and Noise Labs

**Electromagnetics**
29 Test Environments across 5 Major sites
- Electromagnetic Effects, Interference, Compatibility
- Lightning, Radiation and Scattering
- Antennas & Radar Cross Section

**Enterprise Simulation & System Integration (ESSI)**
50+ Test Environments across 7 Major Sites
- Avionics Integration, Flight Hardware Integration,
- Operator-In-The-Loop
- Software Development, Modeling Applications

**Environmental Test**
22 Test Environments across 3 Major Sites
- Thermal Test, Thermal Vacuum, Radiation, Humidity,
  Vibration, Acoustic, Ground Vibration Test, and Flutter
Boeing Test & Evaluation - Test Environments (cont.)

**Structures/Materials Test**
16 Test Environments across 5 Major Sites
- Structural Test, Materials Test, Transmission Testing, Bird Strike Tests

**Systems Test**
5 Test Environments across 4 Major Sites
- Plan and execute Systems (Platform), SoS (system), and Distributed Net-Centric SoS (Operational) Testing of Airborne, Ground, Sea, Space & Cyber Space platforms

**Fabrication, Assembly, Set-Up, & Test (FAST)**
6 Different Unions across the Enterprise
- Mechanical Assemblers, Electrical Fabricators, Machinists, Model Builders, Strain Gagers, Welders, Industrial Engineers

**Metrology & Test Equipment Services (MATES)**
40 Test Environments across 17 Major Sites
- Calibration & repair, process ownership, measurement solutions & calibration supplier network support
- Test Asset Management, inventory visibility

**Flight Test Operations/Systems Test Support**
Test Environments across 7 Major Sites
- Flight Test, Launch Support
Aurora Flight Sciences
Boeing acquires autonomous technology company Aurora Flight Sciences

Five Core Technologies

- Autonomy
- Electric Propulsion
- Advanced Manufacturing
- Operations in the NAS
- Advanced Aircraft Design
Global economic & demographic shifts altering consumer desires

Business Model Disruptions
Overturning Industries
To find opportunities that Boeing Business Units would [or could] not pursue on their own, but which fall within Boeing’s strategic scope
Core Business

Long cycles
Business Cycles
Sustaining innovation
Organizational Mindset
0-5 year approach
Environmental Approach
Capital intensive projects
Project Investment

Short cycles
Disruptive innovation
5+ year approach
Small bets, future core
The HorizonX Group is driven by an innovation strategy and includes corporate venture capital, non-traditional partnerships, and program management of concepts with potential to disrupt Boeing's core business.
Boeing’s unmanned aerial vehicle prototype could shape 21st century autonomous air travel and transport
Investment Focus Areas

- Disruptive Mobility
- Advanced Logistics
- Connectivity
- Autonomy

- Advanced Manufacturing
- Advanced Materials
- A&D Grade Cybersecurity
- Artificial Intelligence / Machine Learning

- Industrial IoT
- Space
- Alternative Energy Systems
- Business Model Innovation
Opportunities

Machined Parts

Aerospace Materials

Research

Build to Print

Cables / Wire Bundles

3-D Printing

Autonomy

Machine Learning
Questions