From beams to batteries

Strategic advancements in systems and subsystems are strengthening Boeing's products—and competitive position

by Bill Seil

The human body is made up of many systems—respiratory, circulatory, digestive, nervous—that keep us alive, engaged and productive.

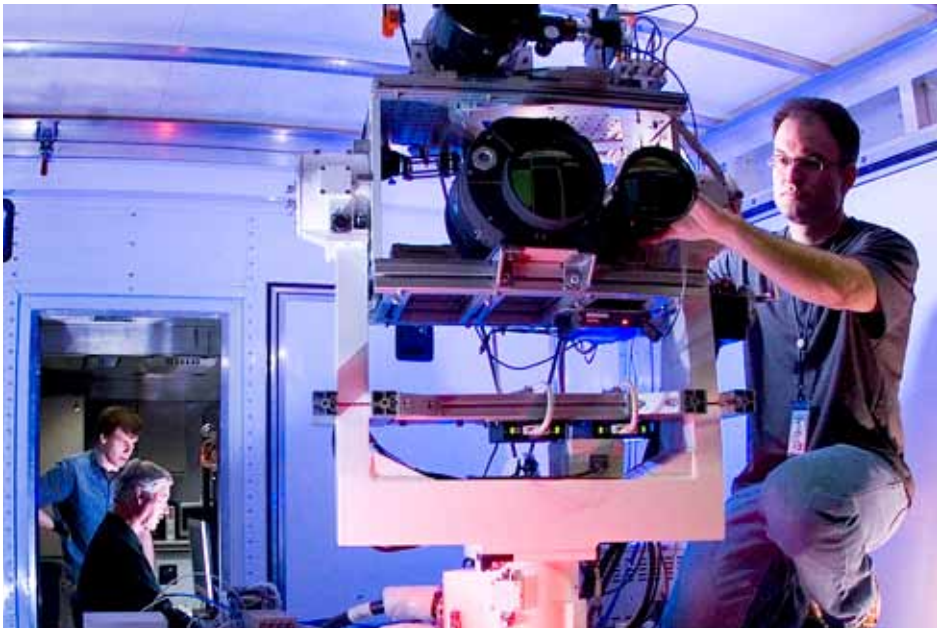
Similarly, Boeing products are filled with complex networks of systems and subsystems that allow them to carry out their various missions—from maintaining a safe cabin environment in jetliners to guiding satellite orbits.

Boeing devotes considerable resources to developing systems that make use of the best and latest technology. The goal is to minimize a product's size, weight and power consumption to improve performance and speed, and reduce cost. Systems and subsystems research and development leads to enhanced capabilities in Boeing products, and that drives the company's competitive advantage.

The Platform Systems and Subsystems technology domain is one of eight areas in Boeing's Enterprise Technology Strategy, established in 2007, which gives Boeing a coordinated "One Company" approach to technology development. It is the largest of the domains, responsible for about one-fourth of the company's advanced research and development investments.

Investment in each domain is based on business units' plans for current and next-generation products to ensure that technologies are ready when needed. It's one way Boeing research teams are helping support the goal of being the world's best and best-integrated aerospace-based company.

"In the first year, much of our effort was devoted to organizing the domains and aligning investments with technology areas that were of greatest value to the enterprise," said Doug Swanson, the domain's leader. "Today, we've become an effective group of teams that is developing new technologies and sharing information on technologies that already exist within the company."

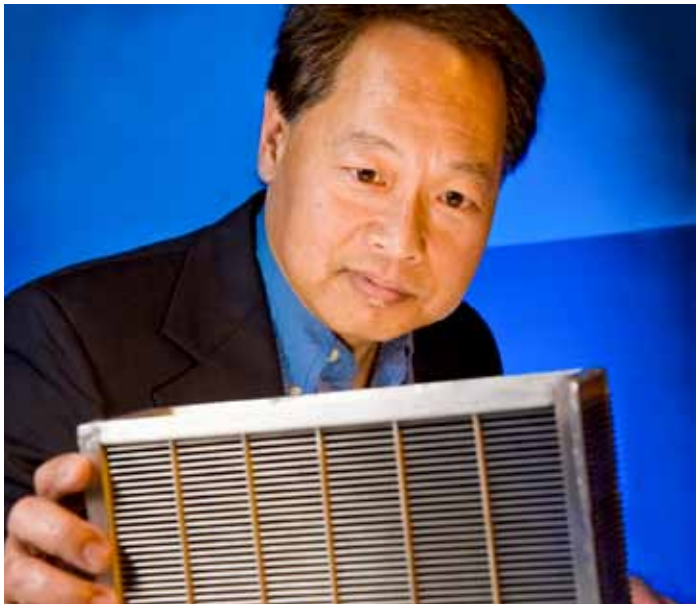


Systems and subsystems teams are working in sophisticated areas such as directed-energy weapons, electronic systems, and sensors and sensor exploitation. Researchers are finding new ways to optimize the effectiveness of energy systems to reduce costs, improve fuel efficiency and enhance product performance. Advancements are being made in onboard systems integration, which will make the next generation of Boeing products more effective. In addition, new tools and process are being developed that will improve the way complex systems are designed.

The technology domain architecture has been effective in getting business units to collaborate on technologies that have multiple applications across various platforms. For example, the team determined that a lightweight heat exchanger used in Boeing Defense, Space & Security Systems' internally funded High Altitude Long Endurance prototype aircraft could be used in the 787 Dreamliner, resulting in a significant weight savings.

Platform systems and subsystems is

PHOTO: Rafe Guidice, senior engineer, prepares for a test at Boeing Directed Energy System's facility in Albuquerque, N.M. BOB FERGUSON/BOEING



an area where diverse components are combined to perform a specific function. Each of these components could be owned by Boeing, a supplier or even a competitor. Consequently, the domain has followed BDS' lead in making selective use of vertical integration to ensure access to needed components.

In general, Boeing acts as a systems integrator, overseeing the work and products from a group of partners and suppliers. But in vertical integration, the company is directly involved in the technologies from top to bottom—not only the systems and subsystems but also the components and even the devices within the components.

Vertical integration guides the company to develop advanced technologies that make Boeing products more competitive, said Don Cowher, director of BDS Electrical Engineering. One example of work at the device level is research in new materials that allow electronic subsystems to run at higher frequencies and higher temperatures, which could lead to better, more economical and faster devices.

When vertical integration is not appropriate, subsystems to support system requirements are adapted from existing products or specially developed by suppliers. Boeing routinely works with suppliers and others within the aerospace industry to anticipate future system technologies and ensure their availability.

"Good collaborative relationships with suppliers also are important to acquiring the right systems for Boeing products," said Jerry Holmes, who leads Platform Systems and Subsystems technology activity for Commercial Airplanes.

One area of interest to Commercial Airplanes is "backplane technology," which could replace wiring junction boxes with smaller, lighter devices. The substitution would enable easier, faster assembly and significantly reduce the system's weight. The team is also supporting the development of lightweight, low-pressure ducting that replaces glass fiber with lightweight foam core material.

The domain addresses not only technologies that meet near-term systems needs but also breakthroughs for the next generation of Boeing products. That requires keeping pace with rapidly changing technologies and evolving business priorities driven by the competitive marketplace.

"We have outstanding teams of talented people who follow new developments and are able to anticipate change," said Joe Grasso, a manager in the Electronics, Communications & Sensing Technology organization of Boeing Research & Technology and a member of the Platform Systems and Subsystems domain steering team. "They adapt and shift direction to address new priorities. Often they see opportunities and help to drive change."

One trend is toward more highly integrated and efficient systems and subsystems, Grasso said. There is a demand for systems to have more functionality while, at the same time, being lighter, smaller and less power-hungry, he said.

In addition, there's been research on batteries. They're an essential part of most Boeing products, yet there had been little coordination between business units on how batteries are acquired or designed for special needs, said Ron Morinishi, a Platform Systems and Subsystems manager and domain steering team member.

"While lithium-ion batteries are now being integrated into our current platforms, there are more advanced batteries in development that will be lighter and orders of magnitude more efficient," Morinishi said. "We need to work at the enterprise level to move toward these new technologies and adapt them to our future programs."

With research happening in so many areas, it's little wonder that the people overseeing this domain speak enthusiastically about its activities.

"This is the kind of thing I've always found fascinating," said Ken Hays, the Senior Technical Fellow on the Platform Systems and Subsystems domain leadership team. "You look at the details of technology and work them up through the organization and into products. Those products are then sold to customers who put them to work. It's a very complex process that can be quite challenging. But it's also very rewarding." ■

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This article is part of a continuing series that looks at the Enterprise Technology Strategy and its eight technology domains. Here are the previous stories in the series.

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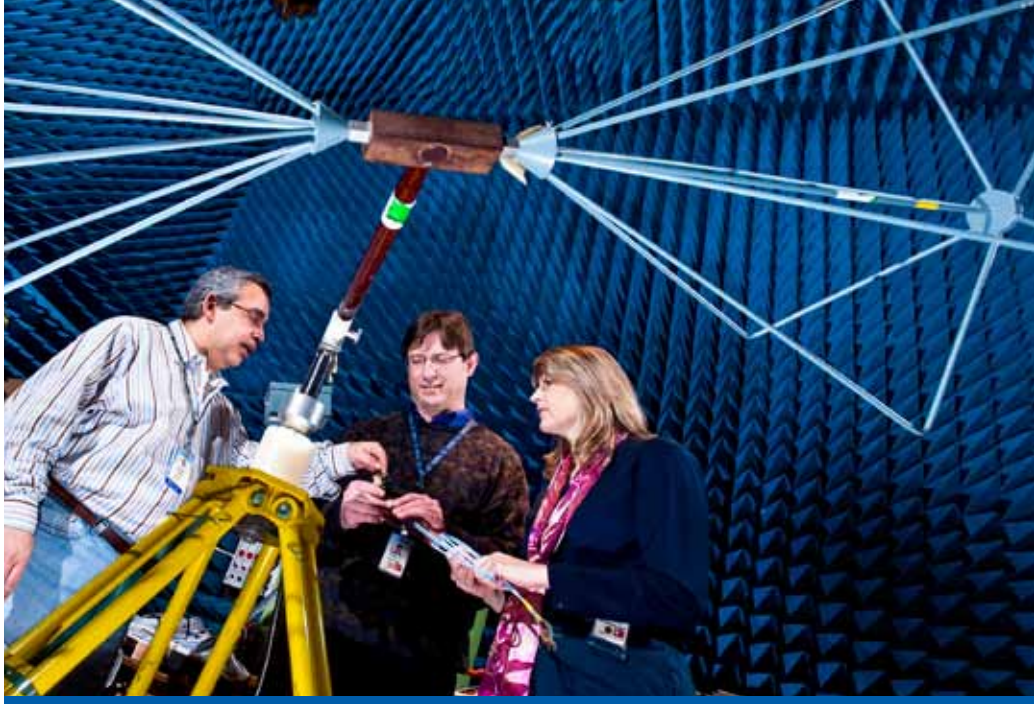

PHOTOS: (Far left) Platform Systems and Subsystems leader Doug Swanson (right) and Senior Technical Fellow Kamiar Karimi monitor a Variable Frequency Start Generator at the Boeing Test & Evaluation Aircraft Energy Management Lab in Seattle. MARIAN LOCKHART/BOEING

(Left) Ron Morinishi, a manager in Boeing Research & Technology's Platform Systems and Subsystems Technology organization, examines a new lightweight heat exchanger for Boeing defense and commercial products. RON BOOKOUT/BOEING

Charge it!

Expertise in electromagnetic effects is driving process and product improvements companywide

The Electromagnetic Effects Technology group of Boeing Research & Technology is truly a team "charged" with a critical task.

Diane Heidlebaugh, senior manager of the team, whose work supports the Platform Systems and Subsystems domain, said her group's efforts relate to most of the company's eight technology domains, since structures, systems and platforms must all be protected from electromagnetic threats such as lightning, static charges, broadcast signals and electromagnetic weapons. There also are issues of electromagnetic compatibility, where nearby systems must be designed so they don't interfere with one another.

"Electromagnetic effects have a huge hidden cost on programs across the enterprise," Heidlebaugh said. "People don't realize the scope of their cost because they are so widely distributed among various parts of the platform."

Her team is developing a suite of analysis tools that can determine how systems and structures will react to electromagnetic fields before they are built. Over time, these tools will reduce the need for time-consuming tests on prototype equipment.

In 2009, the Electromagnetic Effects Technology group won a Boeing Technical Replications Award, which recognizes the application of technical ideas to new areas or programs that drive product and process improvements. The team was honored for its development of a lightweight aluminum foil wire mesh that is placed over carbon and glass-fiber surfaces and dissipates energy from lightning strikes before it can damage the structure below.

– Bill Seil

PHOTO: The Electromagnetic Effects Technology team is developing a suite of computer-based analysis tools that can predict the effects of electromagnetic fields on products and systems still in the design stage. From left are Omar Zubi, lead engineer for electromagnetic effects labs; Frank Lenning, a Technical Fellow with this team; and Diane Heidlebaugh, the team's senior manager. MARIAN LOCKHART/BOEING