BOEING

December 2007 / January 2008

Challenge

AN ENGINEERING, OPERATIONS & TECHNOLOGY MAGAZINE

Engineering Ergonomics

Ergonomics experts are using high-tech 3-D tools to look for better and safer ways to build the 787 Dreamliner.

INSIDE

Leading by example

Welcome to another issue of *Challenge* magazine.

What an exciting year this has been. We continue to evolve as the needs of our customers, our industry and our company evolve. But amidst all the changes that we see around us, I never tire of hearing about the amazing products that we create at Boeing and the amazing people who design, build and maintain these products.

Challenge is a publication designed especially for the engineering, operations, supplier management and technology work force at Boeing. So as you go through its pages, you might think of it as a voyage of discovery. You are going to see the faces and words of some of the people who are making remarkable contributions on the shop floor, in the offices of our company and at our supplier locations. They are doing it by working together, putting the team and company first.

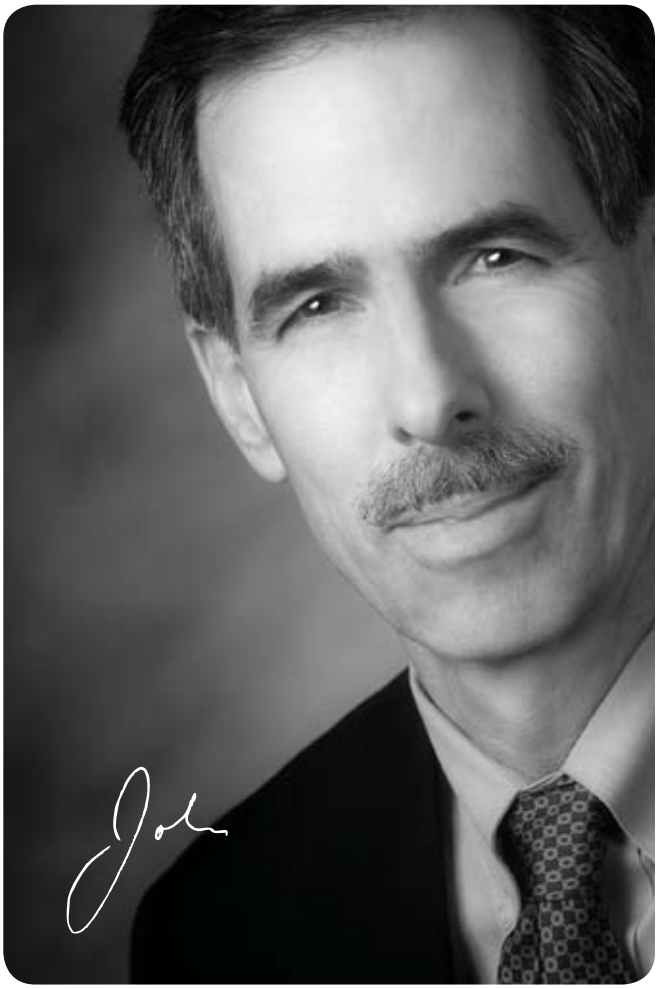
You will be reading about the team that is building ergonomics into the 787, and there are the members of the Process Action Teams, or PATs, who are saving millions of dollars for the company. You will learn about our new Chief Information Officer and his strategy to transform our IT organization, and also about some significant progress and change in the Development Process Excellence Initiative.

You will also get to meet those who resolutely do their work every day to maintain Boeing's leadership in the aerospace industry and demonstrate that there's no such thing as an ordinary job at Boeing. They work on assembly for the 737 and the F/A-18. They're designing the wing of the 747-8, working on intelligent flight controls for military aircraft, designing systems for repairing advanced composites, and providing the company with common processes and systems.

Finally, you will hear about how Boeing is addressing some of its business challenges by embracing greater diversity and focusing it on providing more innovative and affordable solutions for Boeing and our customers.

So we hope you will enjoy reading about the people and products of our Boeing team in this issue of *Challenge*, and perhaps learn something that will help you and your teams work more effectively together to improve Boeing's future growth and productivity.

Once again you've done a terrific job this year. Keep up the great work in 2008!



John Tracy

Boeing Senior Vice President of Engineering, Operations & Technology and Chief Technology Officer

Challenge magazine, focusing on engineering, operations and technology, is published twice a year for all Boeing employees.

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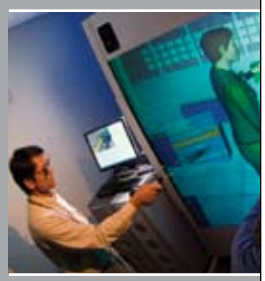
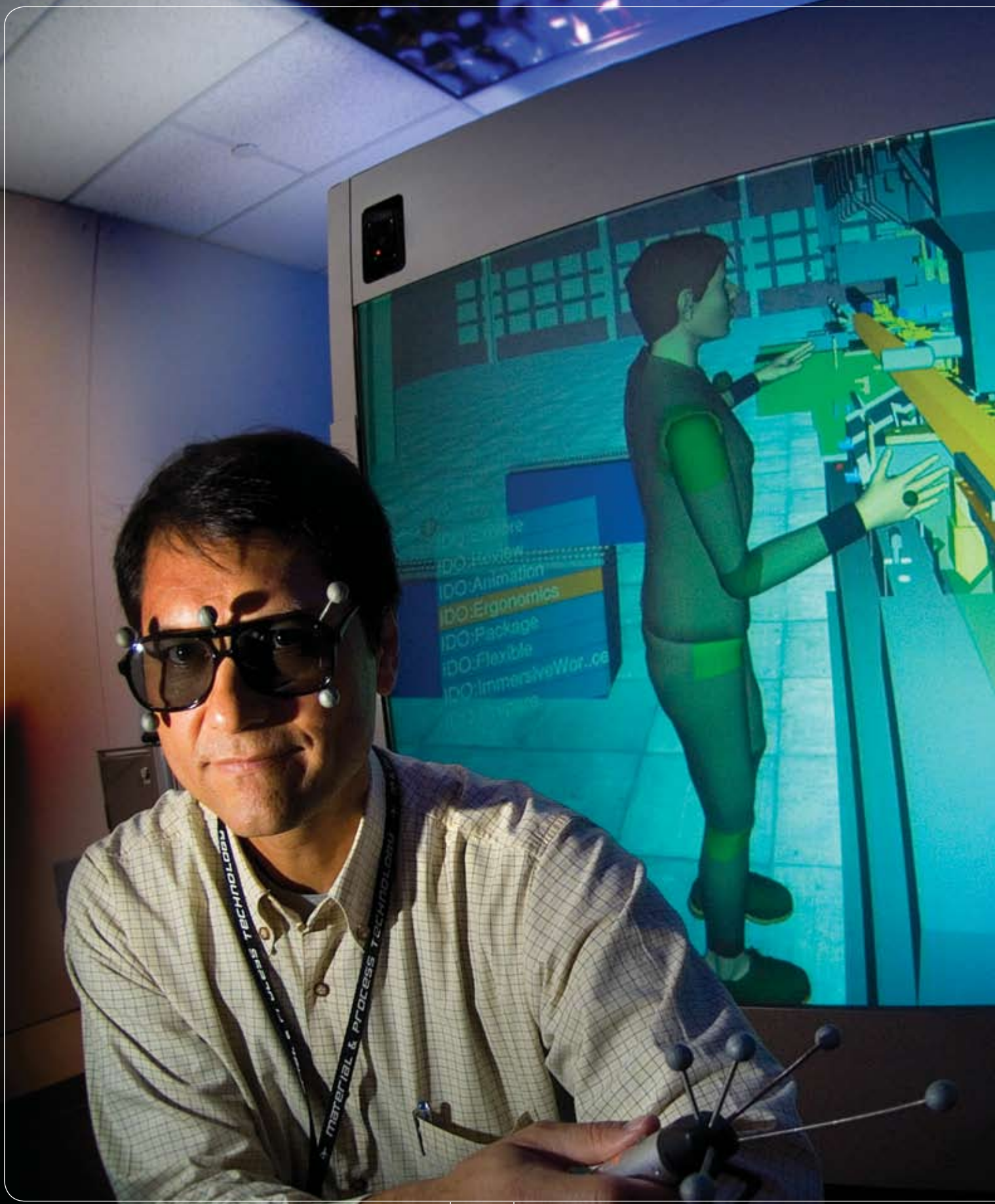
Ergonomics is being designed into the 787. Rich Gardner and Wade Wheeler are shown using 3-D technology in the Immersive Engineering Space in Everett, Wash. See page 4.




IDO:Animation
IDO:Ergonomics
IDO:Package
IDO:Flexible
material & process technology

Rich Gardner, lead ergonomist for the 787, in the Immersive Engineering Space in Everett, Wash. He's wearing stereo 3D glasses with head tracker targets and holding an immersive scene controller wand with hand tracking targets.

Ergonomics . . . a friend to the 787

Once pushed aside as an afterthought, ergonomics is now an integral part of airplane design. The 787 program is taking progressive steps to integrate ergonomics into the design and the build process of the new Dreamliner.

by William Cole

Working as a construction carpenter during college summer breaks, Richard Gardner got to know the meaning of hard physical labor. He also noticed how strenuous lifting and awkward access to tools and assemblies were exacting an unnecessary toll on some of his workmates.

It was an observation that would have a profound effect on his engineering career and ultimately lead to some important design elements on the 787 Dreamliner. On those construction sites in Colorado, Gardner was making his first acquaintance with ergonomics, or human engineering, which is defined as the proper matching of people with their work environments to produce maximum safety, efficiency and comfort.

Little did he know that one day he would be receiving industry praise for ergonomics breakthroughs on the most advanced airliner in the world. Or that he would be pioneering the use of "immersive engineering," a futuristic 3-D virtual reality technology designed to solve manufacturing ergonomics problems in hours, not days.

His first encounter with the science of ergonomics produced in him a lasting empathy for hard-working folks in physical manufacturing jobs. Now the lead manufacturing ergonomist for the revolutionary 787, Gardner says: "From that time to this, I have always been able to relate to the people who do the hands-on work and rarely get to enjoy the comforts of office life. I focus my engineering science skills on people in terms of what we know about them and the equipment they use."

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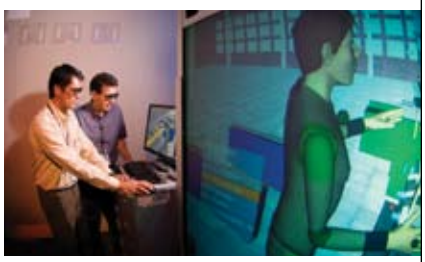
Those employees, more than anybody, appreciate his work: Ergonomics is their friend. The main priority of manufacturing ergonomics is to determine how comfortably and safely a production employee can do his or her job. It places tools and materials within easy reach. It designs areas, both on the plane and on the factory floor, to provide the maximum access for the safe installation and removal of systems. It tries to place everything of importance in plain sight.

Once a seemingly enigmatic concept, ergonomics was derived from early studies of efficiency, quality and safety in the workplace. "Assembling commercial airplanes is a uniquely complicated work of integration," says Gardner, "Because of that we've had difficulty leveraging the ergonomic gains that other less complex industries have made."

The 787 program shifted the focus of manufacturing ergonomics back to the design phase where changes are easier and more affordable. "Due to increased awareness of ergonomics and advances in design capabilities, we now have a seat at the design table," says Gardner, who has spent the past four years working with design teams to improve manufacturing techniques. Ergonomists are using the same tools and speaking the same language as the design engineers, and this makes it much easier to communicate and resolve the issues that in the past may not have been discovered until parts were being assembled in the factory.



Rich Gardner and Tony Blackner with the virtual reality monitor.

This year, Gardner's work was recognized by his peers in the industry when he became the first Boeing person to receive the Ergonomics Professional of the Year award from the Puget Sound Human Factors and Ergonomics Society.

"We have always wanted to get ergonomics into the hands of the designer to strengthen the relationship between design and manufacturing teams," says Gardner. "We've made great strides in this direction on the 787 program with engineers developing their designs in collaboration with those who build the airplanes."

"We were given the opportunity early in the development of the Dreamliner to create design requirements that specifically address worker safety and ergonomics attributes," says Gardner. "So instead of suggesting to designers that they ought to consider ergonomics in their designs, we now have design requirements that tell them they must do so."

This synchronized approach has paid off. In collaboration with the 787 program, Gardner and his team were able to make real differences in the design phase of the airplane. They were able to contribute while parts were being created, versus trying to work on them after the design was complete. They worked with wing designers to create a removable panel, for example, that provides a safer installation process and better access to the 787's main landing gear retract actuator.

The ergonomics team has addressed the design of heavy interior commodities such as galleys, passenger seats and lavatories and pushed to get lifting points incorporated into the designs to enable the convenient use of material handling equipment versus moving the items by hand. Similarly, better use of space in the aircraft and easier access to systems have become a key element for designers when deciding where to place parts and components.

The team successfully created a process to review and approve all factory tooling designs before they are released for use in production to ensure that the tools are safe and functional. The team also created training modules to teach the fundamentals of ergonomics to airplane designers, production system personnel and shop floor mechanics.

Gardner has many other achievements to his credit. He is one of the principal inventors of a process, used by 787 design engineers and manufacturing engineers to systematically evaluates thousands of work instructions for ergonomics risks. The system will also allow programs to monitor the way in which jobs are assigned to mechanics so that exposure to ergonomics risk can be properly controlled.

"Due to increased awareness of ergonomics and advances in design capabilities, we now have a seat at the design table."
– Rich Gardner

Gardner is also pioneering the use of virtual reality technology in a lab in Everett, Wash., home of the 787. Engineers, wearing special 3-D glasses, can operate hand controls to take them through simulated assembly processes portrayed in real-time on a giant screen.

"It immerses you into designs and manufacturing problems areas, allowing you to reach quicker solutions," says Gardner. "This technology reduces the need to build expensive physical mockups to evaluate access, reach and visualize parameters during the design phase. That helps us to catch things that may not have been discovered until after production commences, when making changes is more difficult."

Even humans are replicated digitally; Gardner has researched ways to apply virtual reality technology and digital human models to perform human factors and ergonomic assessments.

With successes gained on the 787 program, Gardner and his team have demonstrated the practical application of this exciting virtual reality technology at Boeing, especially as it applies to addressing ergonomics in design.

Still, Gardner is able to keep his fame in perspective, preferring to share the limelight with his team.

"I could not do this on my own," he says flatly. "I am working with a great group of talented professionals who have been given a once-in-a-lifetime opportunity to fundamentally change the way we address ergonomics in new design programs.

"Despite the many challenges we face in the kind of work we do, we're still like kids in a candy store," says Gardner. "We're having lots of fun and following our passion to make our products safer and easier for the people who have to build them." ■

Rich Gardner | at a glance

Current position: Boeing Associate Technical Fellow and 787 Program Ergonomist, leading the initiative to develop a comprehensive ergonomics program for the 787 airplane product design and manufacturing systems.

History: Joined Boeing as a systems engineering engineer for Human Factors and Ergonomics in 1997 and also served as an adjunct professor at Central Washington University's Lynnwood, Wash., campus. Prior to that Gardner was a rehabilitation engineer at Northwest Center Industries in Seattle, Wash., and a human factors engineer at the U.S. Naval Air Test Center in Patuxent River, Md., from 1986 to 1991.

Education: Master's degree in industrial engineering from Texas Tech University–Lubbock. Bachelor's degree in economics from the University of Colorado–Boulder.

Organizations: Member of the Puget Sound Chapter of the Human Factors and Ergonomics Society; vice president of the board of directors for Mobility Builders, a nonprofit agency based in Seattle that builds low-cost wheelchairs for developing countries.

Below, from left: Rich Gardner, 787 Ergonomist, Wade Wheeler, senior manager, Everett Site Environmental, Health & Safety (EHS) Tony Blackner, senior manager with 787 Environmental Performance, and EHS; evaluate the person/machine layout and operation of proposed 787 manufacturing in the Immersive Engineering Space in Everett, Wash.

Transforming IT

Chief Information Officer John Hinshaw knows exactly where to find success at Boeing – in the hearts and minds of his global team.

by Catherine Rudolph

He was so taken with Boeing products that he became engaged to his wife on a 757.

Now, John Hinshaw, Boeing's chief information officer and vice president of Information Technology, is so taken with boosting Boeing's productivity that he's engaging employees across the enterprise to transform the IT environment.

An unshakable believer in the power of collective effort and the effectiveness of face-to-face contact, the personable Hinshaw has met thousands of his global team members in meetings large and small to promote a crystal-clear six-point plan for success. He's already won fans among technical and nontechnical employees alike by, for example, by advocating simpler, more intuitive computer systems.

"I am listening to their ideas on how we can improve Information Technology together," says the hard-charging former Verizon CIO. He was handpicked to run the Boeing IT organization in June 2007.

What drives this man who confidently predicts that one day Boeing will have the best IT shop of any company in the world? He recently sat down with *Challenge* magazine to explain his focus and philosophy.

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John Hinshaw says that one day Boeing will have the best IT shop of any company in the world.

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What attracted you to Boeing?

I was drawn to Boeing for many reasons. First, Boeing is a company focused on the future and improving that future for the citizens of the world. Our new aircraft, such as the 787, will revolutionize travel for millions of fliers. Our defense products and services will ensure that our nation and friendly countries remain strong and secure.

Second, Boeing is a high-tech company. I've always loved technology and how it can improve the results of business operations. With a record backlog at Boeing, there is a great opportunity for productivity improvements enabled by technology to improve profitability.

Third, I've always loved airplanes and many of the other products Boeing makes and supports, such as the Space Shuttle and satellites. I met my wife on a Boeing 737 airplane in 1998, and we got engaged on a 757 in 2000, so Boeing has been in my soul for many years.

What are your priorities for IT?

I've set six key priorities for IT. The first is to simplify our IT environment. Today we have far too many redundant systems; they perform the same function but require multiple sets of IT infrastructure, systems development, processes and training. We will also find ways to add a lean focus to our IT environment to simplify the way we introduce information technology.

Second, we will ensure that our systems are secure and controlled. Information security is an extremely high priority for Boeing. Think about the data we house in our systems. Boeing is a worldwide enterprise that must continue to guard its data securely for customers, suppliers, and employees. Having solid controls is extremely important, and IT will continue our focus on these areas.

Third, we need to improve our users' experience on the systems we all use here at Boeing. As a new employee, I've discovered that some systems need significant improvements in user experience. We have teams in place to address this. Our systems should be intuitive and easy to use, with fewer mouse and keyboard clicks required. Our systems should also be easily upgradable to new versions of software, in a way that minimizes training required for users.

Fourth, IT will support the tremendous growth of the company. As Boeing continues to increase its airplane and defense sales, IT will be there to ensure that the capacity and scalability is in place. Additionally, as Boeing acquires strategic assets, an IT framework will be in place to more easily assimilate new ventures and partners into the Boeing family.

John Hinshaw | at a glance

Current position: Boeing Chief Information Officer and Vice President of Information Technology.

History: Hinshaw was appointed chief information officer of Verizon Wireless after holding other leadership positions. He also worked as a consultant for Accenture, providing information technology consultation for several Fortune 100 companies and government agencies. He served with the U.S. Department of Commerce in the American Embassy in London and with the Department of Defense Naval Engineering Command in Norfolk, Virginia.

Education: Bachelor of business administration in computer information systems from James Madison University, in Harrisonburg, Virginia.

Organizations: Member of the CIO advisory board of NCR Teradata. Served as a board member of Men Stopping Violence, a nonprofit organization that works to prevent domestic violence. Served on the advisory board for the Master's in Information Systems Program of Stevens Institute of Technology, and as chairman of PeopleSoft's Communications Industry Advisory Board.

"Almost any job or program in the company today is enabled through information technology – aircraft design and manufacturing, defense solutions, supplier relationships, financials, payroll, and support data for all of our programs. The strategic value of IT is enabling all of us at Boeing to do our jobs and run our programs more productively."

– John Hinshaw

Touring the AH-64D Apache Longbow assembly line in Mesa, Ariz., recently, John Hinshaw is reflected in the rotorcraft's Modernized Target Acquisition Designation Sight/Pilot Night Vision Sensor. Hinshaw was also in town as part of his companywide tour to speak directly to members of his global IT team about his strategy for the future.

Fifth, IT will improve the financial performance of the company by providing productivity-enhancing IT tools and innovation. Updating our IT systems and infrastructure to allow more rapid program deployments is vital. Additionally, the IT team will assist our defense and airplane programs, where unique IT requirements that will generate additional revenue opportunities.

Finally, my sixth priority is to communicate with and invest in the IT team. We have a very large IT population at Boeing, spanning the globe. In my first couple of months, I've had the opportunity to meet several thousand members of the IT team in small and large group meetings. I am listening to their ideas on how we can improve IT together. I am a strong believer in employee empowerment and engagement. I will also be investing training dollars in our IT team to ensure that we have the tools necessary for the future.

How do you see IT providing strategic value for the company?

Almost any job or program in the company today is enabled through information technology – aircraft design and manufacturing, defense solutions, supplier relationships, financials, payroll, and support data for all of our programs. IT is enabling all of us at Boeing to do our jobs and run our programs more productively. Faster time to market with new programs, quicker customer response, better financial management, and improved employee tools are just a few ways that IT provides strategic value.

Where do you see IT in Boeing's future?

Information technology is a larger and larger component of our products and services every day. Many of our defense programs base a large portion of their deliverables on integrated networks, security, and other IT components. Our 787 airplane is one of the most sophisticated computers in the sky. I would like to see our IT organization add more value to our programs, both from a perspective of what is possible, and also from an implementation perspective.

As we expand our global operations, IT will step up to support an ever-growing global supply chain and support infrastructure. This will require innovative thinking and quick responsiveness to changing business needs.

Finally, my crystal ball says that someday Boeing will be known around the world as having one of the best IT shops of any global company. We are already well on our way. ■

Boeing EA-18G Growler program manager Mike Gibbons and his team have been at the forefront of a new disciplined process, which is being used on development programs, called Opportunity Management. The process encourages engineers to look for opportunities to offset risk. These include design innovations that will save time and money. "Almost any Boeing team can benefit from Opportunity Management," says Gibbons.

Opportunity knocks

Boeing engineering leaders are today reaping the benefits of a simple yet powerful process that identifies and leverages opportunities on development programs.

by Jay Spenser

Most of us have heard of risk management. Aerospace engineers use it to identify potential risks in a development program and to create plans to mitigate them. But risk also has an upside that engineers can turn to a program's advantage. It's being done right now through a newly formalized Boeing process called Opportunity Management.

Developed within Engineering, Operations & Technology (EO&T), by Program Management Best Practices, Opportunity Management is a disciplined process for identifying and managing opportunities both within and beyond a program's stated purpose. In this context, an opportunity is a situation or circumstance with a realistic likelihood of occurring that could yield a potential technical, schedule or cost-performance benefit to the program.

For example, it prompts engineers to ask searching questions: If overall program performance achieves a specified threshold level, can a scheduled test be scaled back or eliminated? Can we machine a single part to do what a built-up assembly did in the past?

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The P-8A Poseidon anti-submarine and anti-surface warfare aircraft being developed by military and commercial teams at Boeing has been leveraging Opportunity Management. Poseidon program leader Bob Feldmann says that one day engineers across the enterprise will be assessing opportunities as readily as they do risks.

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Can suppliers deliver their parts ready for assembly, and can assembly times be reduced by sequencing subassemblies more efficiently?

Although Integrated Defense Systems is pioneering Opportunity Management, it is applicable across the enterprise. Any Boeing research and development effort, existing product and support program, or other complex team endeavor that involves products or services can benefit from it.

For all its rewards, Opportunity Management is surprisingly simple. Its six systematic decision-making steps guide users through setting improvement goals and objectives, identifying opportunities, analyzing those opportunities, dispositioning them, communicating and tracking them, and then developing and implementing effective plans to capture identified benefits to meet or exceed program goals.

Pioneering implementation

The Boeing EA-18G Growler program was among the first to experiment with Opportunity Management. "Opportunity Management played a big role in our flying and delivering early and staying within budget," says EA-18G Program Manager Mike Gibbons. "It let us identify and go capture potential benefits, including many that were beyond our program's defined scope."

Boeing invests in the future through development programs. Engineers and engineering managers across the enterprise know that these programs will be challenging. Because risks cannot be reduced to zero, it is important also to cultivate opportunities. Opportunities offset the risks and allow Boeing to replenish cost and schedule margins to ensure a healthy program. Opportunity Management also allows teams to improve technical performance and to add capabilities that increase the total product value for Boeing customers.

In Opportunity Management, the savings realized from successfully exploiting opportunities are used to build a time and budget buffer. Then when unexpected problems arise, as they often do when technological frontiers are expanded, this margin is available to help resolve them without upsetting the program's base. As the Growler program shows, Opportunity Management can even result in better performance than planned.

Opportunities abound when people go looking for them at program start. Better still, Opportunity Management encourages people to seek opportunities beyond the program's established baseline. This can mean securing additional business in existing markets or opening up entirely new markets.

"Opportunity Management played a big role in our flying and delivering early and staying within budget. It let us identify and go capture potential benefits, including many that were beyond our program's defined scope."

– Mike Gibbons

For example, when new components are being developed to replace obsolete ones, there are usually opportunities to design them for even greater affordability, reliability, and future growth. Maybe new systems that have added capabilities the customer will appreciate and value can be integrated into existing aircraft. Maybe products and services can be envisioned that customers don't yet know they need and thus haven't asked for.

Although the Growler program arose before Opportunity Management was systemized, it offers a good example of a business opportunity successfully exploited. When the U.S. Navy needed to replace its aging Vietnam-era EA-6B Prowler electronic warfare airplanes, Boeing proposed exploring the F/A-18F Super Hornet airframe as the basis for a new-generation airborne electronic attack fleet.

The resulting EA-18G meets Boeing growth goals by delivering greater value to the customer on two fronts. It has entirely new capabilities. The Growler can keep up with strike aircraft, and it can also communicate while actively suppressing enemy air defenses. Another value is the Growler's extensive commonality with the Navy's F/A-18 fleet. That yields lasting benefits through spares-part provisioning and other fleetwide economies.

"We pushed the envelope effectively on the Growler and it worked out awfully well for us," concludes Gibbons. "Although this was a development program, almost any Boeing team can benefit from Opportunity Management. This broadly applicable process promises to be a valuable tool for achieving gains under the Lean+ initiative."

The EA-18G Growler represents a business opportunity successfully exploited. Proposed as a successor to the Vietnam-era EA-6B Prowler, it is delivering greater value to the customer by providing commonality with the existing F/A-18 carrier fleet and through its ability to communicate while suppressing enemy air defenses.

Risk and reward

In the past, engineering teams that spotted opportunities elsewhere often couldn't pursue them beyond their own immediate organizations. Opportunity Management changes this. It has a built-in mechanism for realizing profound benefits through broad, objective analysis and collective buy-in.

Of course, there is uncertainty in opportunity as there is in risk. Opportunity Management addresses this uncertainty by encouraging everyone to target and capture potential improvements. The result is a more balanced, effective, and ultimately successful path to attaining program goals.

"When you focus just on the risk side of the equation, people naturally tend to become risk-averse," says F/A-18 Risk Manager Jim Warren, a key architect of Opportunity Management. "That's not what we want; instead, we need people to take calculated and intelligent risks. Opportunity Management helps by giving us a positive way to improve our plans and products; we're not just trying to avoid problems and train wrecks."

When a risk is not mitigated, the consequences can range from mild to serious. By contrast, there are few if any reminders of squandered opportunities. Perhaps for this reason, Opportunity Management is not immediately intuitive to some aerospace engineers. However, once the process is explained or witnessed in action, it quickly wins converts.

Both Integrated Defense Systems and Boeing Commercial Airplanes provide approved Boeing Process Instructions for implementing Opportunity Management, and training is available. Several programs are already using the process.

One is the P-8A Poseidon anti-submarine and anti-surface warfare aircraft that Boeing is developing for the U.S. Navy. Based on the Next-Generation 737, the multimission P-8A will also perform intelligence, surveillance and reconnaissance duties.

Vice President Bob Feldmann leads the Poseidon program. In his previous role as vice president of F/A-18 programs, he directed the Growler's development and saw firsthand what Opportunity Management can do. When he relocated from St. Louis to Seattle to take up his new duties on the P-8, he brought it with him.

"In a company committed to maximizing value, we value every opportunity," Feldmann says. "Opportunity Management lets us do this. But we're not very practiced at it yet, so unique and sustained management commitment is essential to its successful implementation."

Word is spreading fast about this remarkable new tool – both about its growing success and direct applicability under Lean+. In Feldmann's view, it is only a matter of time before engineers across the enterprise begin assessing opportunities as readily as they do risks. ■

Progressive evolution

The evolving Development Process Excellence Initiative is shifting focus to better serve Boeing's growth and productivity goals. **by William Cole**

Progress leads to change, and change can lead to further progress. That's the strategy the Development Process Excellence (DPE) Initiative is following as it progressively evolves from a focus on improving Boeing's R&D yield and program management efficiency to a focus on helping establish standard processes, systems and training for the enterprise.

When the DPE Initiative was first established, it was focused on three key areas, explains DPE Initiative leader John Pricco:

Enterprise Technology – focused on finding ways to maximize the yield of Boeing's technology investments and the readiness of technology needed for development programs.

Lab and Test Assets – focused on determining a maximally efficient set of internal and external test resources consistent with ensuring top program performance.

Product Development and Large-scale Systems Integration – focused on improving the efficiency and effectiveness of development programs by identifying and applying best practices and lessons learned, as well as establishing more standard processes, and systems and training across the enterprise.

"Progress in each of these areas has led to positive changes in the company as well as changes within the Initiative itself," says Pricco. "Effort in all three areas has been either totally or partially woven into the fabric of the company, where further progress can be made."

The Enterprise Technology task has been transitioned to the role of the Chief Technology Officer (CTO), the Lab and Test Assets task has been transitioned to the Lean+ Initiative, and a major aspect of the Product Development and Large-scale Systems Integration task has been transitioned to the business units."

"As a result of all that positive change, the focus of the DPE Initiative is narrowing on a key foundational element for streamlining the Program Management, Engineering, Operations and Supplier Management functions of the company – standard processes, systems and training," says Pricco.

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John Pricco: "Standardization will allow us to more easily move work to people rather than people to work. Programs will have access to the right engineering talent at the right time with the right technology."

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Summary of progress

Since January 2006, the various DPE Initiative teams have been working to make real progress. For example, the Initiative's Enterprise Technology team conducted benchmarking studies to determine how best to increase the yield of R&D across the enterprise. The result was a proposal to institutionalize the role of the Chief Technology Officer as leader of an enterprise team to develop an Enterprise Technology Strategy. This role of the CTO has since been formalized to lead the Enterprise Technology Board in developing and implementing an Enterprise Technology Strategy. As a result, this element of the Initiative was completely transitioned to the CTO for further implementation and advancement.

During this time, the Lab and Test Assets team was conducting its own studies on how to make more efficient use of Boeing's assets both internally and externally. Members of the team toured the company to look at how little-used or unused assets could be consolidated and which could be improved and used more efficiently. Using lean principles, the team has helped to shape common processes for regional test-equipment management and has closed various little-used or unused lab and test assets and developed plans for further improvement. Because of this lean approach, this element recently moved to the Lean+ Initiative allowing it to more effectively pursue its goals.

Meanwhile, the Product Development and Large-scale Systems Integration and Development team has been conducting benchmarking studies with regard to Boeing development programs and how to run them more efficiently and effectively. Much of this benchmarking effort has been completed. Also in support of this element – as well as in support of the various functions at EO&T – an enterprise team was formed to analyze how best to identify and implement common processes and systems for these enterprise functions.

With this element nearly complete, it was decided that the DPE Initiative would continue to play an important enterprise role by helping the business units establish common processes, systems and training that are consistent with a single enterprise architecture and with as much cross-enterprise commonality as possible. And it will continue to play the same role in helping the enterprise Engineering, Operations and Supplier Management functions achieve the same goal.

The new focus of the Initiative

"The DPE Initiative is an important part of Boeing's journey toward more growth and productivity," says John Tracy, senior vice president of Engineering, Operations & Technology and Boeing CTO.

"Our overall goal, along with the other three Initiatives, is to continue to help Boeing to become more competitive," he says. "We can best do that by focusing our attention on a critical element of business success – promoting real efficiencies by having everyone speak the same technical language and work together through standardized and common processes, systems and training."

Pricco says the Initiative has already made progress in working with the business and functional leaders and ultimately will resolve a long-standing challenge associated with having a varied set of processes, systems, and training for accomplishing the company's work.

He says the Initiative has already logged some notable achievements. The Initiative's Executive Steering Team is already reviewing the status of developing business unit plans and their approaches to long-range business planning. The Initiative is also working to ensure a consolidated enterprise view and assessing whether business unit plans and consolidations are consistent with enterprise standard solutions.

Main changes to the Development Process Excellence Initiative

- The Enterprise Technology Team has been transitioned to the CTO organization.
- The Lab and Test Assets team has been moved into the Lean+ Initiative.
- The DPE Product Development/Large-scale Systems Integration best practices study will be completed.
- The Initiative is now focused on planning and implementation of Engineering, Operations & Technology's common processes, systems and training.

"This will engage functions and business units to provide standard service-ready solutions for improved program performance," Pricco says. "A standard set of processes, systems and training will allow programs to plan, execute, monitor, manage, and control more effectively. This standardization will lead to strengthened program performance through improved functional integration and discipline. Because of the strategic importance of this standardization endeavor, an accelerated approach has already begun with funding allocated to several projects."

In addition, he says, "Standardization will allow us to more easily move work to people rather than people to work. Programs will have access to the right engineering talent at the right time with the right technology. Operations will be improved by efficient "design-anywhere, build-anywhere" processes, systems, and training, and by the availability of production data where it's needed, when it's needed. Boeing will increase its ability to buy anywhere, using common processes and integrated systems, thereby lowering costs, improving quality and efficiency, and speaking to suppliers with one voice.

Pricco points out that all of us have an opportunity to make a contribution. "Employees can help," he says, "by looking within their functions and helping to review, capture, and classify processes, systems, and training that are redundant, obsolete or nonstandard. That will help us in our effort to migrate to a streamlined set of common processes, systems, and training courses. Standardized processes, systems and training will promote best practices, Lean principles, ISO and other common Initiatives.

"Enterprisewide, standardized processes, systems and training will facilitate the movement of work across the enterprise to where it's best performed and foster an IT environment that is agile, adaptive, and flexible. It will essentially allow us to work together globally as one team, 24 hours a day, 7 days a week

"This and the simplification and streamlining of our systems will ultimately benefit Boeing customers and enhance our competitive edge." ■

John Pricco | at a glance

Current position: vice president Development Process Excellence initiative, Engineering, Operations & Technology.

History: Assumed leadership of the DPE Initiative in November 2006. Prior to that was director of Engineering for the 747/767/777 programs, 777 chief project engineer and director of Customer Engineering for Boeing Commercial Airplanes. Held various management positions in Boeing's Aircraft Systems and Interiors organization. Joined Boeing in 1981 as a liaison engineer after completing an engineering internship.

Education: Bachelor of science degree in mechanical engineering from Washington State University, a master's in business administration from the University of Washington and completed the Seattle University Executive Leadership Program.

Organizations: Board member of Snohomish County Junior Achievement 2003 through 2006; member of Gonzaga Engineering Advisory Council from 2003 through 2007; Auction co-chair for Work Opportunities (an organization providing job training and support for the disabled) in 2005 and 2006; Executive Focal for Washington State University; Advisory Board member for WSU Engineering department.

John Pricco: "We must remain adaptable to shifting circumstances and conditions."

Programs such as the Airborne Laser (ABL) – military aircraft based on commercial platforms – will benefit from common processes and systems. The ABL is based on a modified version of the 747-400F.

Delivering results

Boeing's success depends on employees contributing directly to the bottom line. Across the company, they are adding value by producing results. **by William Cole**

Natasha Zaninovic

The C-17 has touched the life of Natasha Zaninovic in more ways than one. She grew up in Tuzla, Bosnia, where the C-17 later delivered supplies during the conflict there. But she was also an engineer in Los Angeles working for another company when the C-17 contract was awarded. "That was an exciting time for engineers in the area," she says. "And I knew I wanted to be a part of it." Over the years, as a mechanical engineer and senior manager for C-17 wing design in Long Beach, Calif., she's helped to make the C-17 more affordable for the U.S. Air Force and international customers.

"The whole process of working with a good team every day to find design and manufacturing solutions is very satisfying," she says. "Boeing is the best."

Gone are the days when employees simply followed instructions and were cautious about showing creativity and initiative.

Today, in their engineering cubicles, at their meetings with suppliers in the field, and on the shop floor employees at all levels are working creatively to help Boeing to grow and become more productive. They are closely following Boeing's financial performance, looking at and learning about trends in the industry, taking advantage of training programs and collaborating with their workmates and colleagues to work more efficiently.

"Today's employees are very sophisticated," says Mike Denton, vice president of Engineering for Boeing Commercial Aircraft and head of the Enterprise Engineering function. "They know that we help ourselves if we help to position Boeing for the future. They have made the connection between working more efficiently and producing results. What's more, they have realized that you don't have to be a manager to live by the leadership attributes, which drive our efforts toward productivity and growth."

All of us can play a role in mapping out a strategy for our team – or chart a course – no matter how small the group, says Denton. Setting high expectations, inspiring others and finding a way are part and parcel of most team efforts. And living the Boeing values has taken on new meaning over the last three years.

Now, more than ever, employees are delivering results, says Denton. Here are some examples of employees who are excited about their work and the future of the company:

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Arlene Moore

When she's assembling parts onto the F/A-18 Super Hornet in St. Louis, Arlene Moore treats the aircraft as if her daughter's life depended on it – and it does. "I have a real interest in protecting our men and women in uniform," says Moore, a sheet metal assembler and riveter, or SMAR, "because my 20-year-old daughter is one of them. She's in the Navy and will be serving on an aircraft carrier soon. So it's up to me to make sure that everything fits perfectly." Moore often goes the extra step to help others. She's heavily involved in diversity activities and even learned sign language to act as an interpreter for some hearing-impaired employees on the shop floor. She says, "I'm fascinated by the way people will find a way to communicate no matter what."

Thao Nguyen

Arriving at Boeing was the achievement of a lifetime for Thao Nguyen. Determined to succeed when he arrived in the United States from Vietnam in 1975, he worked as a dishwasher, janitor and then in a mill to support his family. At the same time he attended school to improve his skills. His diligence paid off. He landed a job at Boeing in 1980 as a mechanic on the 737 Classic flight deck. Now, he leads a team of five people who install flight control rigging on the 737 moving line in Renton, Wash. “It’s exciting,” says Nguyen, who enthusiastically embraces Boeing’s lean initiatives and the assembly line’s nine-step installation process plan. “It’s in everybody’s interest to help Boeing to succeed,” he says. “What’s more, I have an excellent team of people who are very supportive of me and the company.”

Jian-Juei Wang

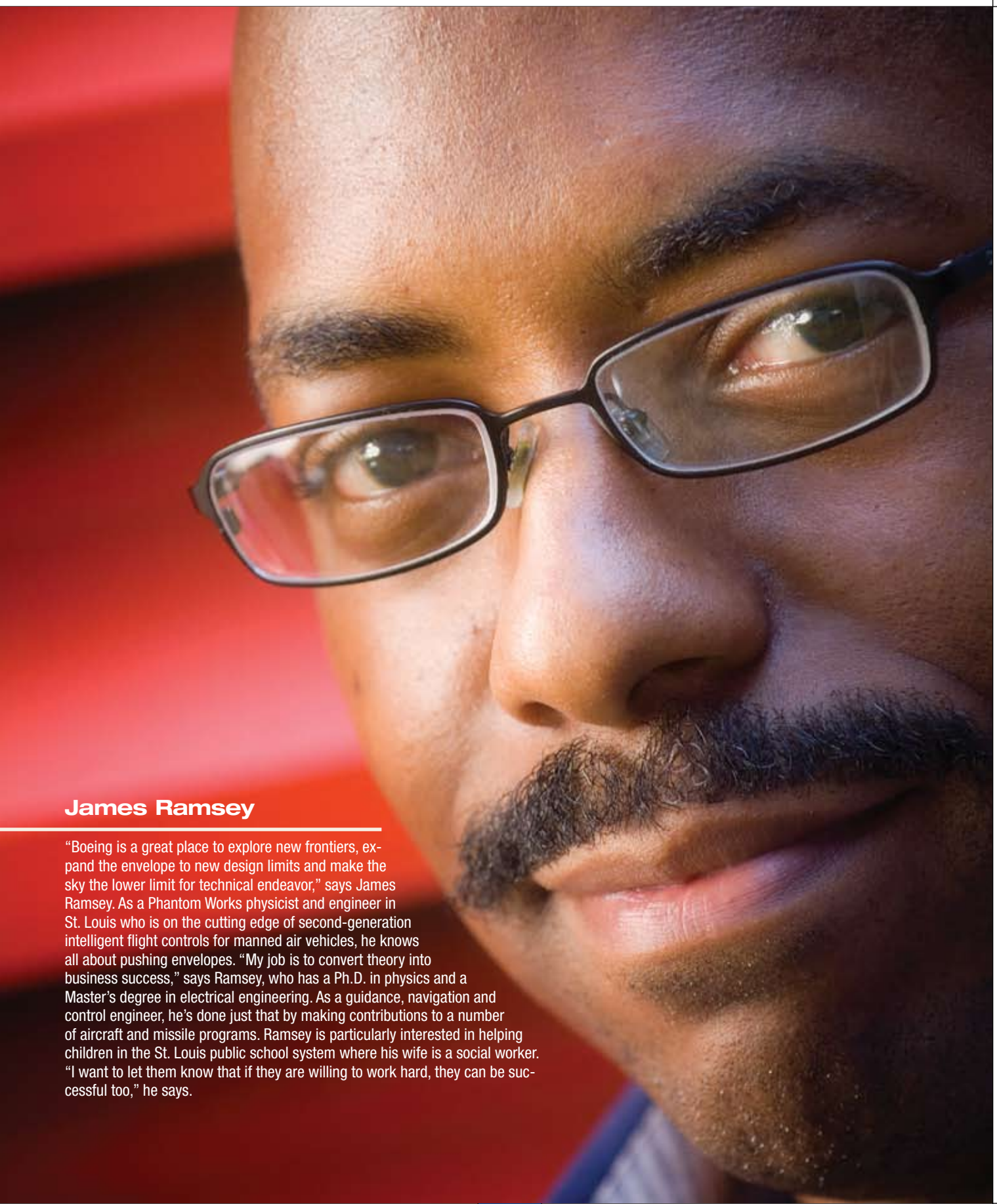
Aerospace metals and composites are designed to endure the most brutal of conditions. But should either of them need to be analyzed before or after damage repair, who do you call? Jian-Juei Wang for one. He's a Phantom Works' structures engineer in Huntington Beach, Calif., who specializes in the analysis of bonded composite repair of both composites and metals that have both military and commercial applications. His analysis tool has been implemented on the Common Structures Workstation and is now being used by engineers across the enterprise, including those on the 787 program. "That's very satisfying," he says. Born and raised in Taiwan, Wang is now a devoted U.S. citizen. "Where else could you get a teaching scholarship for your doctorate and master's degree?" he asks. "Only in America."

David N. Loffing

Born in Ohio – not far from where the Wright brothers worked on their revolutionary flying machine – engineer David Loffing was recently presented with an aerospace challenge almost as daunting as theirs. He was asked to take the design of the 747 wing, developed in the 1960s, and bring it into the 21st century. The new wing is being redesigned for the 747-8, a stretched version of the 747-400 capable of flying 467 passengers up to 8,000 nautical miles or 295,200 pounds of freight for 4,475 nautical miles. Loffing is leading an interdisciplinary team in Everett, Wash., managing the wing and empennage configuration. "It's truly an amazing piece of engineering," he says, "being done by some of the best engineers in the world. I have loved airplanes for as long as I can remember. This is just an awesome experience."

Mary-Louise “Missy” Aykent

She’s a director of Process Excellence who wants to give the mechanic on the F/A-18 assembly line, for example, all the information he or she needs on a monitor – in the right format and just in time. Missy Aykent’s overarching goal is to make life easier for the production, quality, supplier management and supplier quality people. She’s building a common processes strategy for Integrated Defense Systems and collaborating with Commercial Airplanes as part of an Engineering, Operations & Technology strategy. “Ultimately we’ll have a common set of processes, systems and tools that are easier to use, easier to maintain and that will free us to work in a common language,” says Aykent, based in St. Louis. “We’re driving change, helping people to look to the future. That’s what’s fun about my work.”



James Ramsey

"Boeing is a great place to explore new frontiers, expand the envelope to new design limits and make the sky the lower limit for technical endeavor," says James Ramsey. As a Phantom Works physicist and engineer in St. Louis who is on the cutting edge of second-generation intelligent flight controls for manned air vehicles, he knows all about pushing envelopes. "My job is to convert theory into business success," says Ramsey, who has a Ph.D. in physics and a Master's degree in electrical engineering. As a guidance, navigation and control engineer, he's done just that by making contributions to a number of aircraft and missile programs. Ramsey is particularly interested in helping children in the St. Louis public school system where his wife is a social worker. "I want to let them know that if they are willing to work hard, they can be successful too," he says.

Julio Navarro

He's an expert in radio frequency circuits and antennas. Over 20 years, he has helped Boeing develop new communications and radar phased array products used in missiles, satellites and unmanned aerial vehicles. He's the holder of 12 patents relating to low-cost phased array antennas, an Associate Technical Fellow and a Ph.D. who's authored some 30 technical articles and a textbook. Yet Julio Navarro, whose dad was a machinist, still finds time to talk to young Hispanics and other minority students about careers in engineering. "I was blessed with an opportunity when I had little knowledge and experience, says Navarro, who works on miniaturized circuits and antenna systems in Renton, Wash. "Now its time to help others follow their dreams in the same way I did. Someone once said choose a profession you love and you'll never have to work a day in your life."

Marianne Wilkinson

The flying public depends on Marianne Wilkinson in a big way. Her job as a stress engineer with New Airplane Product Development at Commercial Airplanes is to analyze the structural performance of parts that go into airplanes. “We are trying to get the most out of every part that goes into our aircraft,” says Wilkinson, who with her team in Everett, Wash., tirelessly conducts test after test in pursuit of performance perfection. “We’re looking for optimum weight, strength and integrity,” she says. “It’s a huge responsibility,” Wilkinson knew she wanted a career in math and science and almost became a teacher. But she was so inspired by the female Boeing engineer who interviewed her about a job that she decided that aerospace was the perfect choice. She says now: “I’ve learned more in the past 11 years than at any other time in my life.”

Engineering brain drain?

As the aerospace business picks up, a shortage of engineers throughout the industry is looming. **by Louise Wilkinson**

As the aerospace industry grows and the engineering population shrinks, top aerospace companies such as Boeing are looking at how they can address a potential shortage of aerospace engineers in the coming years.

Several factors are contributing to this potential shortage.

First, there has been a steady decline in the number of engineering graduates in the United States since its peak in the mid-1980s.

According to a recent study by *Aviation Week & Space Technology* magazine, the United States is turning out only about 110,000 engineers a year compared with China's 600,000 a year and India's 350,000 a year.

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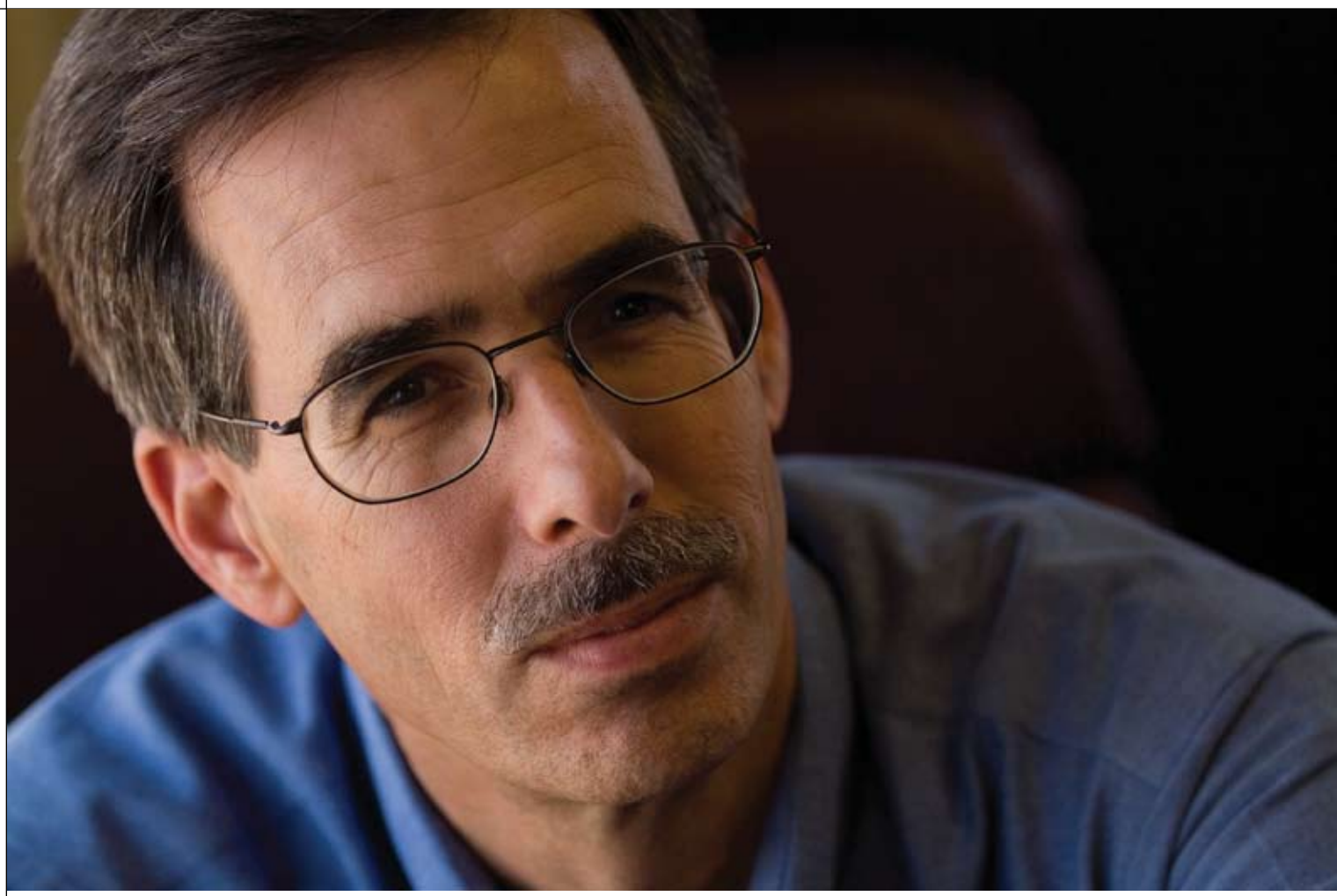
Deborah Limb, director of Payloads and Structures Engineering for Boeing Commercial Airplanes, says engineering derives strength from diversity. "It should be dynamic teamwork," she says, "bringing people from different cultures and backgrounds and achieving something more than any one of them could do alone."



John Tracy, senior vice president of Engineering, Operations & Technology and Chief Technology Officer.

"Engineering is our lifeblood. It is at the heart of everything we do. We need to find ways to fill the engineering pipeline and then draw from the best of the best."

– John Tracy

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In addition, fewer students at engineering schools are opting for aerospace careers, favoring high-paying high-tech careers in other fields instead.

According to the *Aviation Week* study, just seven percent of the students interviewed at 15 top engineering schools expect to pursue a career in aerospace and defense.

And finally, a large number of baby boomers that comprise the current engineering work force are expected to retire during the next few years, reducing the ranks by about 25 percent. At Boeing, the percentage of the engineering work force that is eligible for retirement today is expected to double over the next five years.

John Tracy, senior vice president of Engineering, Operations & Technology (EO&T) and Chief Technology Officer, says, "Engineering is our lifeblood.

It is at the heart of everything we do. We need to find ways to fill the engineering pipeline and then draw from the best of the best."

And the aerospace industry is not the only one concerned. Recognizing the critical role that aerospace engineers play in the U.S. economy and national security, Congress in 2005 passed a bill creating a federal task force to work with state governments and the private sector to identify and promote ways to revitalize the aerospace work force.

For its part, Boeing is encouraging more segments of the population to enter technical disciplines and urging those people to enter aerospace engineering.

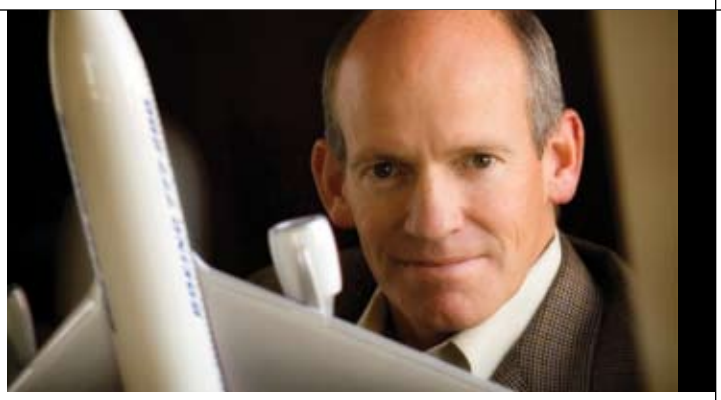
Nan Bouchard, vice president of Engineering & Mission Assurance for IDS and team leader with Mike Denton of the Enterprise Engineering function within EO&T.

"At Boeing, women are increasingly taking on key engineering roles with major management and technical responsibilities. Boeing is working hard to hire new engineers – men and women – and to retain those eligible for retirement."

– Nan Bouchard

Finding a way

"We have got to find ways to inspire students at all levels and from all backgrounds and cultures to become more interested in math and science and to pursue degrees in engineering," Tracy says. "By increasing the diversity of our work force, we can better meet our growth requirements and also meet them in a way that enhances our ability to provide more creative and competitive solutions."



Mike Denton, vice president of Engineering for Boeing Commercial Airplanes and who leads the Enterprise Engineering function of EO&T with Nan Bouchard.

"Women represent 50 percent of the population but only 11 percent of engineers in the aerospace industry."

– Mike Denton

Boeing has been involved in a number of activities to meet these challenges. These include:

- Diversity councils
- Affinity groups (see article page 50)
- External technical affiliations focused on diversity
- The university executive focal program
- University scholarship programs
- Primary & secondary school outreach programs

While Boeing is working hard to increase engineering representation among all minority and non-minority groups, women represent a particularly large under-represented population.

"Women comprise 50 percent of the population, yet they represent only 11 percent of the engineering population in the industry," says Mike Denton, vice president of Engineering for BCA and head of the Enterprise Engineering function within EO&T. "If we can interest more women in engineering as well as more minorities, we would be making a big step forward. We know we can do better, because about 18 percent of today's engineering graduates are women. Similarly, the graduation rate of minorities is also higher than our current representation rate."

"At Boeing, women are increasingly taking on key engineering roles with major management and technical responsibilities," says Nan Bouchard, vice president of Engineering & Mission Assurance for IDS and team leader with Mike Denton of the Enterprise Engineering function within EO&T.

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Julie-Ellen Acosta: "It doesn't hurt to be passionate about engineering in front of your children. We must be role models."

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In interviewing Bouchard and several other woman engineers at Boeing, *Challenge* learned that there are abundant opportunities for women who choose a technical career. The women also discuss what inspired them to become engineers, how they are doing in their careers, and what advice they have for other women just starting out.

Early interest

All of these engineers recognized their passion for science early, and many had strong family influences that made mechanical and mathematical curiosity a part of everyday life.

Julie-Ellen Acosta, now vice president of Leadership Development for Boeing and before that vice president of AeroStructures, Manufacturing and Support Technologies for Phantom Works, grew up wanting to know how things worked. Engineering flowed in her blood and filled her young days. "My grandfather designed machinery in his basement. The kids would clean the parts as he made them. Our tiny fingers were perfect for winding the armatures on motors. I was only four or five, but I was fearless about tearing things apart and trying to put them together again." Acosta felt totally comfortable in the grimy environment of a machine shop, and dirt never dampened her fascination with her summer job installing telephones, crawling under and over the roofs of houses.

Deborah Limb, now director of Payloads and Structures Engineering for Boeing Commercial Airplanes, also enjoyed taking things apart as a child. She was recently the director of the Fuselage and Interiors team for the 787 and led the international team responsible for the design, build and support of the 787 fuselage. "Wired to be an engineer," she took the whole family's bikes apart and rebuilt them so they would perform better. And hers was a family of five. Limb's father was an engineer at Boeing for 29 years, and he "talked about science and math at the dinner table – asking the equation for this or that, or making you recite laws of physics." Limb has another unusual entrée to the world of mechanics and mathematics: "I play the drums, and they are very mathematical in a way. When you play drums, you use all four of your limbs with beats that are linked and yet separate." Structures have always fascinated her, and when she walks into a building, she looks at how things are connected, the load paths and what holds it up.

Helene Michael is the vice president of 737 Manufacturing for BCA. She grew up in Sweden in a rural environment "tied to nature and the outdoors and to the physical things of building, designing and seeing how things work." Involved in many team sports, she found it "almost identical to doing business – defining what you want to accomplish and knowing that you can't do it yourself. Defeats and victories also apply to work on a daily basis."

Michael spent her first two years in agricultural engineering in Montana before she switched to mechanical engineering. She always kept a hands-on relationship with her work; she learned to weld and machine anything she designed – to understand what was possible and what the limitations were.

Nan Bouchard did not take things apart or put them together. "I'm not a naturally handy person – I don't build my own com-

PHOTO BY MARIAN LOCKHART

Dianne Chong: "Things are changing for men as well. Now there is an opportunity for us all to be included and our ideas heard and valued."

Helene Michael: "Young girls have a very traditional view of what it is to be an engineer, they don't see the variety and breadth." She suggests two-week shadowing internships when girls are 13 and 14, the age "when interest in math and science seems to diminish."

puters or fix things," she says. "My degree is in chemical engineering." Bouchard turned to engineering because she enjoyed math and science and was looking for a stable career. Today, she has functional management responsibility for the IDS engineering processes, engineering tools, and the 32,000-person engineering team, as well as co-leading the enterprise engineering function for Boeing.

Pam Drew's father was an engineer with the space program, and Drew says she was hugely inspired by the technical feats of Apollo and Skylab, accomplished in NASA's heyday. She remembers watching the first man walk on the moon: "It was an enormous deal. My mother made me a special white dress with blue polka dots, and a cape – just for that event."

Now Drew is vice president and general manager of Integrated Defense and Security Solutions, part of the Advanced Systems group in IDS. She looks at markets for Boeing technologies and helped to land the contract for SBInet, a huge Homeland Security program for securing all 6,000 miles of the United States' northern and southern borders through a virtual sensor network.

Drew has never forgotten her roots. While her mother was a secretary, her aunt was a nurse named Nancy Drew (she thought her aunt had written "all of those wonderful books"). Drew aspired to be a nurse until one day her father asked why she couldn't be a doctor. She went on to study biology and chemistry. She later discovered her fascination with computer science, when the field was still in its early stages.

All eight women described families particularly supportive of their scientific interests.

> "If we want to retain these women engineers, we have to understand what makes them tick, what interests them. How do we best do that? Through mentoring."
>
> – Helene Michael

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The critical teen and college years

During adolescence, many girls lose interest in science and math. While these women maintained their interests in math and science, their lives were not without challenges. All described grueling academic curriculums and long hours of study.

Shelley Lavender is the program manager for the F/A-18E/F Navy aircraft and is responsible for all aspects of development, production and performance of the Super Hornet. During her freshman year at the University of Illinois, she called home complaining about missing all the campus parties because she had to study so much more than her sorority sisters. Her mom said, "Think long term. If you sacrifice now, you will be able to do what you love." Lavender says it was well worth it; she not only learned "this technical stuff," she learned how to study.

Dianne Chong, director of Material & Process Technology for BCA, started out in pre-med but moved into bioengineering and then materials engineering. Her family was supportive of her career aspirations from childhood, and she mulled over the possibility that Asian families tend to have clearer expectations for daughters' success in math and science. She had a passion and confidence that prevented her from becoming discouraged despite the hard work. However, in her role as executive focal for the University of Illinois, Chong observed a much higher attrition rate for women in engineering than for men.

Mary Jayne Adriaans, head of the test program and the chief flight-test engineer on the A160 Hummingbird, an autonomous helicopter being developed by Advanced Systems at Integrated Defense Systems, said that only 10 percent of her physics class in college was female, and in graduate school the percentage dropped even further.

She has a Ph.D. in physics but loves the engineering side of "building, testing, and getting something to work." In her doctoral program, she was the only woman in a class of 15. It was a bit like having a class full of brothers, she says now.

Current Boeing experience

All eight women – confident and successful – spoke about Boeing's current commitment to a culture of inclusion. They feel the company values their perspectives and their contributions.

All of these women love the work they do at Boeing, Bouchard finds lots of opportunities to work with great people who share a common mission. "It's an environment where you continue learning and help solve technical challenges on important programs," she says. Limb travels all over the world and meets people from different cultures. She gets great satisfaction out of seeing a team complete a project successfully, "something far more than any individual could achieve." Her 787 team designed a new way of making commercial jetliners for the future – one-piece composite fuselage barrels. They've overcome an old paradigm, and they used a global-partner model, involving men and women from all over the world. Adriaans loves the excitement of solving problems on things that fly. The excitement of flight-testing a new-configuration helicopter is "hard to beat," she says. She has the freedom to do a job that she enjoys doing. "To me, that is a luxury. Not everyone gets that opportunity." Drew says "Boeing is one of the most inspirational companies on the planet. One of the reasons I chose Boeing is that it is the intersection of three major transformational forces: transportation, communications and computing. We have done some of the most advanced computing to create advanced products." Lavender talked of "being able to do something that is really important."

Why, then, aren't more women clamoring to become engineers?

Pam Drew: "Boeing is one of the most inspirational companies on the planet. One of the reasons I chose Boeing is that it is the intersection of three transformational forces – transportation, communications and computing."

What can we do?

The problem, according to most of the women interviewed, has to do with perception. Bouchard suggests that many forms of engineering are seen as "uncool and unfriendly," and many women who are good at math and science tend to gravitate to other fields such as medicine, finance or architecture. Bouchard supports efforts to reach out to students and teachers to "put math and science on their radar screen as a possibility for the future – that 'engineering is something I can do, and make a good living doing it.'"

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The one and only Helen Holcombe

Above: Helen Holcombe, hard at work at the old Boeing headquarters now preserved as the Red Barn at the Seattle Museum of Flight.

Right: Helen Holcombe in later years.

Helen Holcombe, born in Kalamazoo, Mich., Dec. 5, 1892, made Boeing history – she became the first woman member of the company's engineering division. She started as a draftsman in September, 1917, working on Model C trainers for the Navy.

She was the only woman working in the attic of a building at Boeing's Plant 1, later known as the Red Barn, now restored and on view at The Museum of Flight in Seattle. Her job was to copy blueprints and hand the drawings to a carpenter who built the specified parts. James C. Foley, Boeing directing engineer, hired her after asking her to duplicate a blueprint he sent her in response to her application for work.

"We will be in a position to have you come with us when our new office building is completed, which will be in three or four weeks," Foley wrote on Aug. 8, 1917.

Holcombe represented contradictions apparent in 1917. That year, Jeanette Pickering Rankin of Montana became the first woman elected to Congress, serving as women picketing the White House for the right to vote were being thrown in jail. Women would not get to vote until after Aug. 26, 1920, when the 19th amendment to the Constitution took effect.

Holcombe graduated from the University of Wisconsin, having studied mathematics and music, and later moved to Seattle. By the middle of 1918, she was among 335 people on the Boeing payroll building the trainers for service in World War I. When the war ended, most were laid off. By the end of 1919, payroll was down to 67.

Holcombe escaped the layoff and by 1920 was still the only woman in a group of 20 in the engineering division, working on DH-4B observation planes and the BB-L6 passenger plane. There is a record of her riding as a passenger with pilot Claude Berlin for a 35-minute flight in an unspecified Boeing biplane on May 1, 1919.

She left Boeing for a couple of years to study architecture at the University of Washington, but was back at the drafting table by 1922, when she served as secretary of the Boeing Aircraft Club. The club sponsored soccer matches and social events and sent notes to families in times of crisis and triumph. In a way, it was a forerunner of today's Employee Services.

Holcombe left the company in 1925 to begin her career as an architect, returning to drafting only during World War II at a Seattle shipyard. According to her sister-in-law, Ellie Holcombe, Helen designed a dozen or more buildings in the Seattle area. One was her own home in West Seattle. In 1975, her health required that she move to her nephew's home in Oregon.

Holcombe died Sept. 21, 1984, at the age of 92.

by Eve Dumovich

Mary Jayne Adriaans: During her doctoral program, she was the only woman in a class of 15. But it was worth it. "I have the freedom to do a job I enjoy doing," she says. "To me, that is a luxury. Not everyone gets that opportunity."

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Lavender examined role models and how girls play as children. "How often as a child do you play engineering?" Lavender says girls need to relate engineering to their lives, and women engineers can be role models who can say, "Here's what life could be like if you do this. I've done it, and it is fun and very rewarding."

Limb agrees. "Young women need to see that engineering isn't calculating equations all day. It is dynamic teamwork, bringing together people from different cultures and backgrounds and achieving something more than any of those individuals could do alone."

Michael says some women have a very traditional view of what it is to be an engineer. "They don't see the variety and breadth." She suggests two-week shadowing internships when girls are 13 and 14, the age "when interest in math and science seems to diminish."

Acosta suggests parents start early: "Get your children to play with toys that promote mechanical skills. Involve children at an early age in activities that help promote creativity, puzzle solving and learning. It doesn't hurt to be passionate about engineering in front of your kids. Two of Acosta's four children have graduated with Aeronautical Engineering degrees, and she speculates that the other two will end up going down the engineering path. She participated in career fairs in Wichita, Kan., where she once worked as an engineer, helping grade- and middle-school students build bridges and rockets to get them excited about engineering. "We have to see this as part of our community effort. We must be role models."

Chong mentors and counsels young women. She suggests working with school counselors to make sure they have the information and materials to help girls make wise choices. Chong speaks at Historically Black Colleges and Universities, noting that her being a woman of color helps young African American, Hispanic and Asian women see themselves in engineering roles.

Attracting and retaining women engineers at Boeing

All eight engineers agree that Boeing is going in the right direction. Limb says we should "keep progressing by doing what we are doing. As we grow the company, and new blood comes in, we are transforming."

Lavender notes that "if you look at the Leadership Model and the Boeing values, it's all about a culture of inclusion. Women want to be included, want their thoughts and ideas heard and valued – just like male engineers. So what we're doing now – valuing diversity, engaging and valuing everyone – will retain everyone."

Communication is the key for Michael. "If we want to retain these women engineers, we have to understand what makes them tick, what interests them. How do we best do that? Through mentoring." Michael also notes that "providing better work-life balance would help. Young people today put a greater priority on their personal life, and what will this mean for us as a business as we move forward?"

Bouchard says there are perceptions about the nature of the aerospace industry that must be overcome: "People think defense companies have a command-and-control culture, and that they're male-dominated. We need to overcome that perception." Bouchard encourages "continuing conversation between managers and teams to make sure people are engaged, have an opportunity to grow, and change assignments when they need to." She concludes: "The products we make are tremendous. They are a great entry card" that inspires people to work at Boeing. "Then we strive to give our employees opportunities to work on challenging programs and develop their careers."

The face of engineering has changed dramatically at Boeing in the last 20 years. There are more women in prominent leadership positions. And they are helping to make the company more creative, more diverse, more inclusive of all perspectives and ideas, and more in tune with a healthy balance of work and family.

Shelley Lavender: When she called her mom from college to complain about having to study so much, her mom said, "Think long-term. If you sacrifice now, you will be able to do what you love."

Not only are women benefiting and enjoying their work as engineers more, but so, too, are men.

Mike Denton agrees with Bouchard that stereotypes about engineering being a job for men only should be dispelled. "In the future, white males will be a minority in the work force. We have to attract and retain women and minority engineers to get the talent we need to succeed," he says.

> "If you look at the Leadership Model and the Boeing values, it's all about a culture of inclusion. Women want to be included."
>
> – Shelley Lavender

Bouchard and Denton say that Boeing is working hard to hire new engineers and retain those who are eligible for retirement. In order to retain potential retirees, Boeing is trying to do what it does with new hires – give them challenging, interesting work to keep them engaged and working for Boeing.

Dianne Easley, vice president of Human Resources for EO&T, says: "All of us here know that Boeing is a great place to work. We have to take that message to the universities, educational and cultural institutions across the globe. We have to convince students that this company offers them tremendous opportunity and that this is where they can build a strong future. And once we succeed in hiring the best engineers, we have to make sure that there is sufficient challenge and opportunity available to keep them at Boeing."

Now the challenge is to spread the word that Boeing is a great place to work – for all employees. ■

Getting it down PAT

Need advice on a process improvement or tool standardization? Process Action Teams are everywhere at Boeing and able to provide a ready solution.

by Daryl Stephenson

The most powerful tool you can use to help Boeing implement common systems and processes and spread best practices is on your desk. It's the telephone.

Use it to call any one of 19 Boeing Operations Process Action Teams (PATs) and you'll tap the skills of hundreds of experts across the company. These Boeing ninjas are ready to move at a moment's notice in pursuit of excellence.

PHOTO BY JASON BARRAS

Members of the Industrial Engineering Process Action Team inspect the tie wrap process on an MV-22-to-CV-22 modification aircraft in the Philadelphia Modification Center. From left are John Crutchfield, IDS senior manager in Industrial Engineering from St. Louis and deputy leader of the Industrial Engineering PAT; Joe McCann, IDS senior manager in Industrial Engineering from Philadelphia; and Dwight Miller, BCA director of Program Planning and Control from Seattle and leader of the Industrial Engineering PAT.

Structure and Join Process Action Team members examine a 737 wing component as they discuss how to improve the process to integrate the component into the wing assembly. From left are Marty Chamberlin, BCA director of 737 wing manufacturing; Hoyt Bonar, BCA senior manager, wings manufacturing; Tim Boyton, BCA team leader, 737 wings; and Kyle Duncan, IDS Puget Sound director of Operations and leader of the Structure and Join PAT.

If a problem with commodities, assemblies or support is increasing costs for your site or your program, these experts will pool their skills to solve it. The solution could involve adopting a best practice, or importing people or tools from a program or site anywhere in the company.

"The Process Action Teams function almost like support people at a 1-800 number," says Steve Detter, who leads coordination and staff support for the Boeing Operations Leadership Team. "They may not have all the answers, but they know where to go. They can pull in personnel from other functions to help out a program."

For example, the Composites PAT, led by John Triplett, has a core team of 18 representatives from eight sites. But it draws on an extended network. Almost 200 composites experts from Engineering, airplane programs, Industrial Participation, and Business Management are on call for specific action.

"What's unusual about this network is that it bridges boundaries between commercial, military, technology development and aerospace programs," Triplett says. "It is similar to a legislative body in that it represents all constituents."

In addition, Triplett says, "We've got our database of subject-matter experts broken up into processes. So when a caller says, 'Hey, I need a mechanic to do a repair,' we search the database by rework repair and it spits out the names of the experts across Boeing that we can draw on. Because of the network we've established, we can get a quick turnaround on solutions."

Other PATs work in a similar way.

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"You can call me, and tell me what the issue is." says Dwight Miller, who leads the Industrial Engineering PAT. "I'll get the team together, we'll look for the right skills and attributes and experience profiles, and we will all strive to support a struggling program or function."

Miller's team includes representatives from 14 Boeing sites across the United States, and draws on the talents of 1,300 industrial engineers. "Having that many engineers who are experienced in various applications is a huge advantage for Boeing," Miller says. "It's a tremendous piece of leverage to be able to bring that much diversity of thought and application to any issue just by making a phone call."

The extended networks that PATs bring to bear on solving problems not only cross the lines of business units and functional organizations, they also reinforce the idea that help is at hand.

"The PATs change Boeing from a large, very complex, geographically dispersed operation to a small, intimate operation

> "I think the ultimate value of the PATs is really in their technical excellence and their deep knowledge and understanding of commodities, processes and skills. You get a broad understanding of the whole business by constantly sharing, constantly visiting sites, constantly looking at the way each of us does the work.
>
> – Dwight Miller

in which we can truly make productivity enhancements, have a great teaming environment, and freely share ideas," says Kyle Duncan, leader of the Structure/Join Process Action Team. "It's almost like the principle of six degrees of separation, which says that through just six people, you could reach virtually everybody in the world. At Boeing, you make one phone call, and with maybe three connections you can find the answer to just about any problem you have."

Those kinds of results build strong bonds that last, says Jack Jones, who leads the Field and Ramp Process Action Team. "Because of the PAT I'm on, I know people now in the field and ramp world, as well as other PAT and Task teams, that I otherwise would never have had the opportunity to meet or work with," he says. "Because I know these people personally, I don't hesitate to pick up the phone and dial a number. When the person on the other end is someone you have established a personal working relationship with, it really facilitates our opportunity to deliver results. The people-to-people interaction is one of the most powerful elements of what the PATs have opened up."

Providing enterprisewide solutions to programs in need is just one value that Process Action Teams provide the company. Their main focus is to spread and replicate best practices far and wide, and to help establish common systems and processes.

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PATs' progress:

Process Action Teams were born in the late 1990s. They were formed at the behest of the Boeing Operations Council, which wanted companywide teams to identify best practices, especially ones that produce significant savings, and spread those practices throughout the company.

Created at about the same time were four Task Teams. Their job has been to coordinate activities among the Process Action Teams, especially in the areas of common processes and command media.

Although it's not possible to cover all 19 teams in the context of this story, the teams profiled here are four of the earliest and most successful. They provide good snapshots of what the PATs do, the challenges they've overcome, and the value they provide to Boeing.

John Van Gels, vice president of Operations and Supplier Management for Integrated Defense Systems and chairman of the Boeing Operations Leadership Team, the current successor to the Operations Council.

> "The Process Action Teams (PATs) have been around a long time. Their focus has always been to generate best practices, ideas and systems – then work the issues together and share data. Now they are working on replicating good ideas throughout the company."
>
> – John Van Gels

Composites PAT

Team leader: John Triplett, Boeing Commercial Airplanes.

Formed: 1998.

Membership: A core team of 18 people that includes leaders from Boeing composites fabrication facilities and representatives from Global Partners and from Materials & Process Technology. The core team draws on a network of 200 composites experts from Engineering, airplane programs, Industrial Participation, and Business Management.

Original mission: Asset utilization. The team assessed the capabilities and capacities of Boeing composites facilities to help determine their strategic value.

Expanded mission today: Be the company's single best source of information for all things related to composites fabrication. Act as a composites consulting firm within the company, at no cost. With an increased demand for composites stemming from the 787 program, the team today conducts many assessments that are focused on developing more composites capacity for future applications.

Most significant accomplishments: Sharing best practices and producing cost savings of $244 million from 1998 through August 2007. Currently, the team is providing significant support to the 787 program.

Biggest challenges: Obtaining consistent participation by the sites and the technology organizations. Because PATs are not official organizations with operating budgets, participation is based on perceived benefit to the sponsoring organizations.

Example of the team's value: In 2007, the Composites PAT network supplied almost 100 people from Boeing composites organizations to support 787 partners. The team has placed 22 emergent hardware packages, which represent thousands of composite parts, at Boeing sites. Most of the people working on these hardware packages are in Integrated Defense Systems.

Field and Ramp PAT

Team leader: Jack Jones, Boeing Commercial Airplanes.

Formed: 1998.

Membership: Includes representatives from every Boeing field and ramp operation. The major ones are Renton, Everett, Boeing Field Flight Test, and Boeing Field Delivery Center in Washington; Wichita, Kan.; St. Louis; Long Beach, Calif.; San Antonio; Mesa, Ariz.; Patuxent River, Md.; and Philadelphia.

Original mission: Sharing of best practices.

Expanded mission today: Focus on Lean, Lean+, and Employee Involvement.

Most significant accomplishments: Consolidation of hundreds of field and ramp processes in an effort to standardize practices and processes across Boeing. The team also is reducing the number of computing systems that field and ramp employees use.

Biggest challenges: Expanding appreciation for the Process Action Team. Members sometimes have difficulty balancing everyday work responsibilities with their service on the PAT.

Example of the team's value: Came to the aid of the Wichita site, unable to paint a tanker aircraft because its paint facility was being modified. The team found another facility where the job could be done quickly. The team also facilitated the move of field and ramp people from Wichita and St. Louis to Seattle to meet an emergency need on the 777 program.

Structure and Join PAT

Team leader: Kyle Duncan, Integrated Defense Systems.

Formed: 1999.

Membership: Leaders from BCA, IDS and Phantom Works who are part of the manufacture or development of structural assembly and join products. Representatives from every Boeing site that performs structure and join assembly – IDS in Puget Sound, BCA in Renton, Everett and Auburn, Washington; and IDS in St. Louis, Southern California, Philadelphia, Mesa, Ariz., and San Antonio.

Original mission: Capture savings through a sharing of best practices.

Expanded mission today: Coming up with a standard set of common Information Technology systems and command media to facilitate structure and join assembly.

Most significant accomplishments: Documented cost savings or cost avoidances of $242 million since 1999. The team has also created a high-performing network of experts in structure and join assembly.

Biggest challenges: Carving out time to work team initiatives, meeting face-to-face as a team, and taking on more responsibility without a dedicated budget or full-time support.

Example of team's value: Mini Accelerated Improvement Workshops in which team members from host sites would identify processes or products that needed improvement. The Structure and Join PAT would brainstorm solutions and share best practices with site representatives.

Industrial Engineering PAT

Team leader: Dwight Miller, Boeing Commercial Airplanes.

Formed: 1999.

Membership: Representatives from 14 Boeing sites across the United States, including IDS Seattle; BCA Seattle; IDS sites in Long Beach, Huntington Beach, and El Segundo, Calif.; Mesa, Ariz.; Wichita, Kan.; St. Louis; Philadelphia; Huntsville, Ala.; Macon, Ga.; and San Antonio. Team draws on extended network of 1,300 industrial engineers across Boeing.

Original mission: Assess skills and competencies of industrial engineers across Boeing to determine centers of excellence. The team also worked to bring different IE cultures together.

Expanded mission today: Detailed implementation of standardized processes for all Boeing industrial engineers. The team also is establishing common classifications and common training requirements for industrial engineers.

Most significant accomplishments: Helping Boeing industrial engineers view themselves as a unified group with a shared vision. Team has completed assessments of capacity, tools, equipment, skills and training. The team's goal is to produce an environment in which industrial engineers would be able to move from program to program and site to site and "hit the ground running and be as efficient as possible right out of the chute," says leader Dwight Miller.

Biggest challenges: There is not yet a standard set of computing systems tools for industrial engineers to use across the company. The team would also like to find better ways to communicate what it has learned to the shop floor.

Example of team's value: In 2000, the team met for three days in Macon to develop and articulate their vision for industrial engineering. That vision, put into action, has helped build a world-class industrial engineering team with experts across Boeing to support all programs.

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The PATs are composed of representatives from both Commercial Airplanes and Integrated Defense Systems, so they are adept at finding commonalities between the two major business units. PATs know how to meet cost-reduction challenges and ensure functional discipline to establish reasonable program targets.

Jack Jones is Boeing Commercial Airplanes director of Everett Field Operations and Delivery and leader of the Field and Ramp Process Action Team.

The PATs work on these issues all of the time, not just when they're on call. Since the PATs were first formed in 1998 and 1999, their roles have expanded.

"When we started, we studied how we were using our assets in composites manufacturing in an effort to reduce our footprint," says Composites PAT leader Triplett. "But since then, with the exception of the 787, the issue for composites has changed from too much capacity to too little. As a result, we are now developing additional capacity for future applications. So now our team is expected to have expertise in what the industry is doing, prioritizing technologies, managing intellectual property, and setting composites strategy," he says.

"During the past 18 months, we've been putting a big emphasis on common systems and processes, as well as sharing best practices, which we've always done," says Structure and Join team leader Duncan. "We're looking for a standard set of common systems (mainly Information Technology systems) as well as command media to facilitate structures/join work for Boeing."

Standardization is also a major focus of the Industrial Engineering PAT, says team leader Miller. "We're doing a lot of work in standards. We're building common competencies and finding general agreement on common classifications for each one of our jobs," he says. "We're getting close to having common training for our folks, and we're really sharing more across the company about what it takes for industrial engineers to be technically competent."

One reason the PATs are doing more is that they have a good track record, particularly in saving the company money, says Detter. Through September 2007, the cumulative savings since 1998 reached $1.3 billion. In 2007 (January through September), cost savings from the PATs totaled $372.12 million.

"I think the ultimate value of the PATs is really in their technical excellence and their deep knowledge and understanding of commodities, processes and skills," says Miller. "You get a broad understanding of the whole business by constantly sharing, constantly visiting sites, constantly looking at the way each of us does the work. It's a huge benefit." ■

Boeing Process Action Teams (PATs)

Executive sponsor: Barbara O'Dell, Commercial Airplanes vice president of manufacturing

PAT staff support: Steve Detter, Integrated Defense Systems
Mark Sanders, Commercial Airplanes

Commodities PATs:
- Composites, led by John Triplett, BCA
- Machining and Advanced Metal Structures, Jenette Ramos, BCA
- Electrical and Electronics, Dan Watt, IDS
- Chemical Processing Standards, Tom Deem, BCA
- Tubes and Ducts, Dave Ball, BCA
- Tooling, Frank Foeller, IDS

Assembly PATs:
- Structure and Join, led by Kyle Duncan, IDS
- System/Integration/Test, Don McGlothlin, IDS
- Field and Ramp, Jack Jones, BCA

Support PATs:
- Tool Services, led by Bob Rhine, IDS
- Industrial Engineering, Dwight Miller, BCA
- Lean, Jay Martinson, IDS
- Manufacturing Engineering, Tom Spiegel, IDS
- Production Control and Material Management, Dave Thole, IDS
- Distribution, Bob Norris, IDS
- Metrology, Vicki Dunlop, BCA
- Procurement, Stan Adachi, IDS
- Environment, Health and Safety, Doug Briggs, BCA
- Common Quality, Processes & Systems, Greg Singleton, BCA, and Kristy Heffernan, IDS

Task Teams

- Technology Prioritization, Don Fudge, BCA
- University and Associated Relations, Howard Appelman, IDS
- IT Steering Team, Nancy Bailey, Engineering, Operations & Technology IT
- Process Steering Team, Missy Aykent, IDS, and Mark Sanders, BCA

Cumulative savings to Boeing:
1998 to September 2007 – $1.3 billion
January to September 2007 – $372.12 million

Members of the Composites Process Action Team check a 787 composite fuselage test article being prepared for fabrication on the advanced fiber placement machine at the Composite Fabrication and Assembly Center in Seattle. From left are Greg Dill, the PAT's fabrication team leader for 787 Barrel Development; Brian Wieker, leader of the Composite Fabrication and Assembly Center; and John Triplett, the PAT team leader.

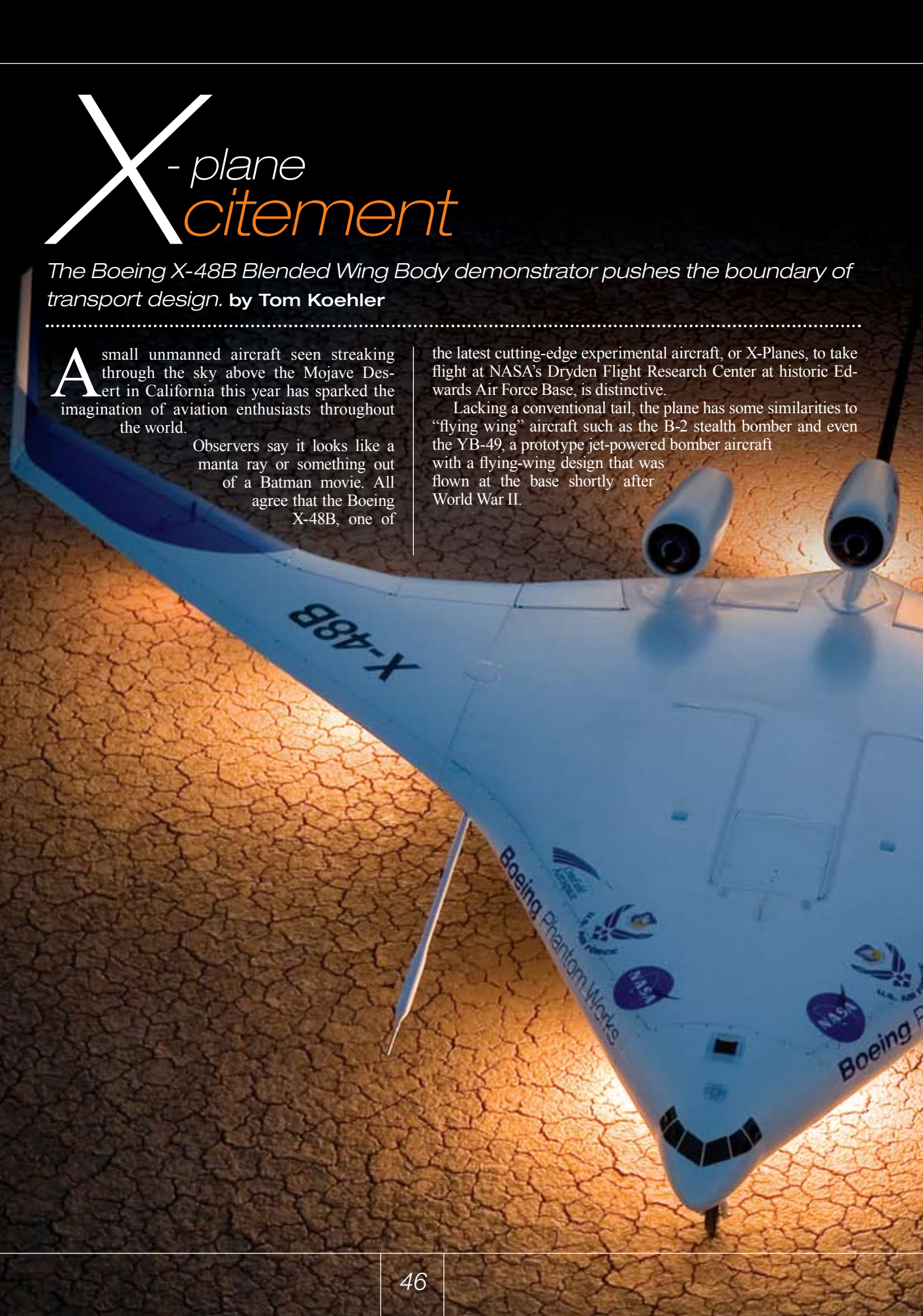
X-plane citement

The Boeing X-48B Blended Wing Body demonstrator pushes the boundary of transport design. **by Tom Koehler**

A small unmanned aircraft seen streaking through the sky above the Mojave Desert in California this year has sparked the imagination of aviation enthusiasts throughout the world.

Observers say it looks like a manta ray or something out of a Batman movie. All agree that the Boeing X-48B, one of the latest cutting-edge experimental aircraft, or X-Planes, to take flight at NASA's Dryden Flight Research Center at historic Edwards Air Force Base, is distinctive.

Lacking a conventional tail, the plane has some similarities to "flying wing" aircraft such as the B-2 stealth bomber and even the YB-49, a prototype jet-powered bomber aircraft with a flying-wing design that was flown at the base shortly after World War II.



Several notable aerospace achievements have taken place at the site including Chuck Yeager's famous flight breaking the sound barrier in the X-1, test flights of the X-15 rocket research airplane at altitudes of up to 50 miles and the first landings of the Space Shuttle. Today, much of the buzz centers on what Boeing and NASA researchers affectionately refer to as "Skyray 48."

Blended wing body concept

A team of 20 Phantom Works engineers and technicians, working closely with NASA and in cooperation with the U.S. Air Force Research Laboratory, is using the X-48B as a research platform to explore and validate the structural, aerodynamic and operational advantages of a concept called the "blended wing body," or BWB. With a 21-foot wingspan, the 500-pound remotely piloted plane is an 8.5 percent scale model of a heavy-lift, subsonic airplane with a 240-foot wingspan that possibly could be developed in the next 15 to 20 years for military applications.

"While Boeing constantly explores and applies innovative technologies to enhance its current and next-generation products, the X-48B is a good example of how we also look much farther into the future at revolutionary concepts that promise even greater breakthroughs in flight," says Bob Krieger, who recently announced his retirement as Boeing chief technology officer and president of Phantom Works at the end of 2007.

The Boeing advanced R&D team believes the BWB concept will offer the potential someday of much more fuel-efficient and quieter airplanes.

"We were challenged by NASA early in the 1990s to see if we could find a better configuration for a subsonic transport than the conventional tube-and-wing," says Bob Liebeck, a Boeing Senior Technical Fellow and Phantom Works' BWB research program manager. "Our team came up with this BWB concept, and our studies early on showed the potential for a remarkable reduction in fuel use of about 20 to 30 percent compared with a conventional transport on the same mission.

"Initially, the potential for reduced fuel use was attractive enough in itself. But we subsequently learned that because the engines in the design mount high on the back of the aircraft, the BWB also offers the potential for a 50-decibel reduction in cumulative noise around airports during takeoff and landing," Liebeck says.

Unlike the traditional airplane design in which a tube-like fuselage is fitted with wings, the BWB merges the fuselage with the wing. The result is a cross between a conventional aircraft and a flying wing such as the B-2.

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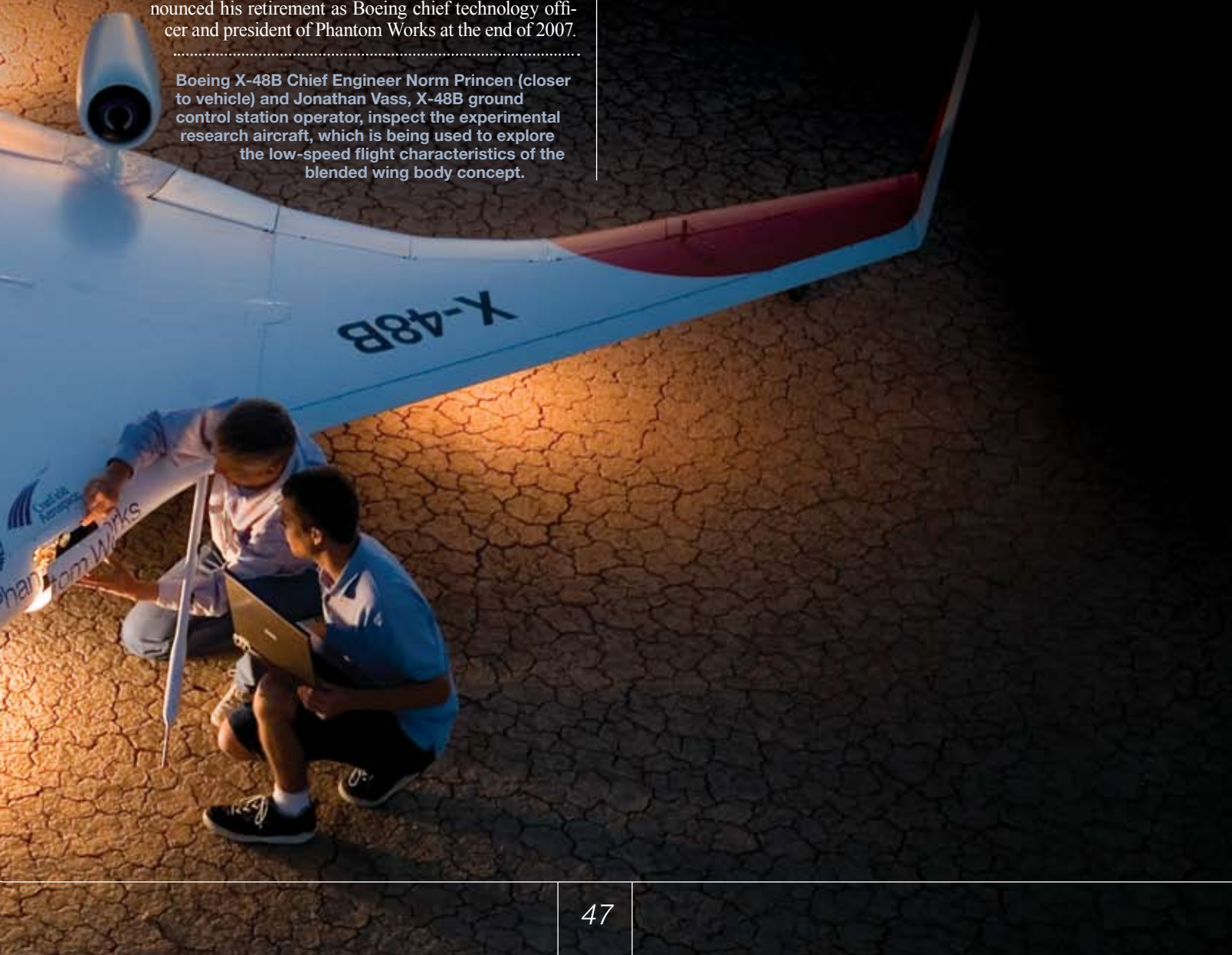

Boeing X-48B Chief Engineer Norm Princen (closer to vehicle) and Jonathan Vass, X-48B ground control station operator, inspect the experimental research aircraft, which is being used to explore the low-speed flight characteristics of the blended wing body concept.

Members of the Boeing X-48B research team include (kneeling, from left) Terry Von Klein, flight controls lead; Norm Princen, X-48B chief engineer; Norm Howell, project pilot; Tom Gurbach, director of Integrated Defense Systems Advanced Global Mobility Systems; and (standing, from left) Dave Hyde, simulation lead; Mike Kisska, project manager; Bob Liebeck, BWB program manager; Derrell Brown, BWB chief engineer; and Bill Vargo, BWB business operations.

Skyray 48's
successful first flight

Calm excitement filled the ground control station. Engineers peered intently at their computer screens as the pilot, sitting next to them, flexed his fingers over the controls. Outside, the ground crew tending the aircraft put away their equipment and stepped away from the aircraft. Preparations for the first flight of the unmanned X-48B blended wing body research aircraft were complete.

Years of research, design, construction, and wind-tunnel and ground tests coalesced into this one moment.

Radios crackled. "Tower, Skyray 48 in position, lake bed runway 23. Request clearance for takeoff …"

"Skyray 48 roger. Main base winds 220 at 6. Report airborne, lakebed 23 …"

"Wilco."

"Five, four, three, two, one, brakes …"

Quickly, the manta ray-shaped aircraft rolled down the dry lake bed runway. It trailed a plume of dust as it picked up speed, its three small jet engines whining. With an excitement that comes only from an aircraft's first flight, everyone watched as the triangular red, white and

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The blending of the wing into a wide, flat, tailless fuselage helps to get additional lift with less drag than an airplane with a circular fuselage generates.

Fay Collier, head of the Subsonic Fixed Wing Project with NASA's Fundamental Aeronautics Program, confirms that NASA has been interested in the BWB concept for some time. "The design offers a number of potential benefits – increased volume for carrying capacity, efficient aerodynamics for reduced fuel burn and, possibly, significant reductions in noise due to propulsion integration options," Collier says.

Flight-control research

Aviation pioneer Jack Northrop began experimenting with flying wings as long ago as the 1920s, and the U.S. military showed strong interest in the concept toward the end of and just after World War II. Several experimental prototypes were built. However, because the design lacks a tail for stability, it was prone to control problems. Flying it was a difficult challenge for even the most experienced pilot.

A YB-49 flying-wing prototype crashed at what was then called Muroc Air Force Base in 1948, killing the crew, including U.S. Air Force test pilot Glen Edwards. A year later, the high-desert base by the side of a large dry lake was renamed after Edwards.

What's different today, according to the Boeing and NASA research team, is technology. Advanced flight-control computing systems including high-bandwidth control actuators can aid the pilot in managing the many required control surfaces on the trailing edge of the wing that are needed to compensate for the missing conventional tail rudder. The X-48B has 20 control surfaces on the trailing edge, including ailerons and elevons, as well as rudders on the winglets. The outer pair of control surfaces open like clam shells to act as speed brakes.

Over the past 10 years, Boeing and NASA have compiled a great deal of aerodynamic information on the BWB design from computer modeling simulations, as well as from wind-tunnel testing. This data has been used to develop sophisticated flight-control software. A major goal of the X-48B flight research program has been to test and validate the data and the flight-control system, and gather more-detailed information, especially on the stability characteristics of the BWB design during takeoff, landing and other low-speed flight.

Bob Liebeck, Boeing BWB program manager: "The BWB concept offers potential for more fuel-efficient and quieter airplanes."

"We want to fully understand the aerodynamics of the BWB design, all the way up to and beyond stall, so that we can learn how to fly a BWB as safely as any other large transport aircraft with a conventional tail," says Boeing X-48B Chief Engineer Norm Princen.

Built in accordance with Boeing requirements by Cranfield Aerospace, Ltd., in the United Kingdom, the X-48B has been intricately constructed with advanced composite materials to ensure that it has the proportionate mass distribution of a full-sized airplane. Engineers describe this as "dynamic scaling" – and it is an important requirement for obtaining realistic flight-test data.

Cranfield Aerospace also built the ground-control station in which Boeing experimental test pilot Norm Howell, who usually flies C-17s, uses conventional aircraft controls and instrumentation while looking at a monitor fed by a forward-looking camera on the aircraft.

blue X-48B leapt into the air. "Skyray 48's airborne," Boeing pilot Norm Howell called, matter-of-factly.

And with that, at 8:42 a.m. on July 20, 2007, a significant milestone in the history of blended wing body research was passed at NASA's Dryden Flight Research Center at Edwards Air Force Base, Calif. Against the backdrop of a pristine blue sky, the X-48B climbed to an altitude of 7,500 feet, circled back and landed 31 minutes later.

Afterward, several members of the Boeing team reflected on the accomplishment.

Bob Liebeck, Phantom Works BWB research program manager, who began developing the BWB concept in 1990, was near the takeoff location for the first flight.

"As the engines were started, I briefly reflected on how special this experience was – to stand on Muroc Dry Lake with all its aviation history, and watch an airplane I helped to create make its first flight," Liebeck says. "And the takeoff was more moving than I imagined – the thing flies! We had done it."

In his 46 years at Boeing, Liebeck, a Senior Technical Fellow and a recipient of many aerospace awards, has served as program manager on several advanced-concept airplane programs, some of which culminated in successful flight vehicles. But, he says, the feeling at the time of X-48B's first flight was "irreplaceable."

Howell, a Boeing C-17 test pilot who has flown F-4Gs in Iraq, says the airplane handled as predicted by flight simulations. "I am very pleased with how the vehicle is handling," he says. "It does handle like a conventional large transport airplane, such as a C-17. My hat is off to the engineering team."

"First flight is a monumental achievement for any program, manned or unmanned," says Boeing X-48B Project Manager Mike Kisska. "I thought about how this program is staffed with an exceptional group of professionals and how privileged I've been to work with each of them. All that work, all those late nights, all the things that make coming to work difficult at times and challenging – it all pays off in that one moment when you see air underneath the wheels of that aircraft."

For Boeing X-48B Chief Engineer Norm Princen, the real impact of first flight did not sink in until several days later. "That's when I realized what we had really accomplished," he says. "I was on cloud nine for the entire week. We still have a lot of work to do to prove that the blended wing body concept is as safe and reliable as current transport aircraft. But this was a huge step towards that goal."

Three model gas-turbine engines, each with 50 pounds of thrust, power the flight test vehicle, which was designed to fly at altitudes up to 10,000 feet and speeds up to 120 knots. A second vehicle, which was used during wind-tunnel testing in 2006 at the Old Dominion University NASA Langley Full-Scale Tunnel in Virginia, is available as a backup.

In addition to hosting the X-48B flight-test research activities, NASA Dryden is providing engineering and technical support – expertise garnered from years of operating cutting-edge air vehicles, including many X-Planes. NASA also provides critical telemetry and command-and-control communications during flights, as well as T-34 chase aircraft support.

Norm Howell, X-48B project pilot: "My hat is off to the engineering team."

Six flight tests were conducted during July and August. As many as 25 more flights are planned this year and early next year to gather additional data in the low-speed flight regimes. Later, the X-48B may be used to test the BWB's low-noise characteristics and possibly its handling characteristics at much higher speeds.

Potential BWB applications

"We believe the BWB concept does hold tremendous promise for the future of military aviation as a multipurpose military platform in 15 to 20 years," says Darryl Davis, president of Integrated Defense Systems Advanced Systems.

"It has the potential to do many jobs for the Air Force including aerial refueling and the transporting of cargo, as well as serving as a regional or strategic bomber, or a persistent intelligence, surveillance and reconnaissance platform," Davis says. "By using a common platform for these missions, the Air Force could reduce its logistics footprint and associated costs. And the BWB's aerodynamic efficiencies would reduce fuel consumption, operating costs and dependency on foreign energy sources."

Tasked with transitioning new programs into the IDS business areas, IDS Advanced Systems is closely monitoring Phantom Works' BWB research, Davis says. As the research progresses, IDS will work with potential military customers to move the BWB concept forward.

Boeing Commercial Airplanes product development engineers also have looked at the BWB concept as one of many proposed unconventional configurations for future commercial airplanes. Although these engineers are monitoring the progress of Phantom Works' BWB research and are keeping their minds open to new technology and market developments, they do not envision commercial BWB applications for at least 20 years.

Next steps

Boeing and NASA researchers have been pleased with the results of the X-48B flight testing. They say that the flight data closely correlates with data previously gathered during wind-tunnel testing. But they view current testing as just the beginning of what they hope will be a larger effort someday to build a full-sized, manned BWB vehicle.

"We would like to see a manned aircraft eventually come out of this program, and we want to make sure that it is safe for flight," says Mike Kisska, Boeing X-48B project manager. ■

A culture of inclusion

A diverse work force contributes to improved business performance through openness, inclusiveness and leadership. **by Rebecca Crichton**

Virginia (Ying-Hsing) Ling, an information architect in Renton, Wash., is a Taiwanese-American and a member of the Engineering, Operations & Technology Diversity Council: "It's human nature to want to be accepted and to be able to contribute," she says.

When Boeing leaders talk about diversity and inclusion, they mean business – in more ways than one. At all levels of the enterprise, diversity and inclusion are recognized as critical to Boeing's success in the global marketplace. And Boeing employees are working in unison to help produce that success.

Employees working together – not in separated, individual efforts – is the key to diversity's tremendous potential for improving productivity and growth, says Jim McNerney, Boeing chairman, president and CEO.

"The culture that drives business performance is exactly the same culture that drives diversity, ethics and integrity – all of which work together, mutually reinforcing each other," he says.

As Joyce Tucker, vice president of Global Diversity and Employee Rights, says: "Diversity is good business and it's good for business. Focusing all our diversity on the business challenges of our company gives Boeing a competitive advantage."

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Tucker said strides have been made in the five years since the Integrated Diversity and EEO Compliance Strategy was designed and implemented. "This strategy was created by a cross-section of people from around the enterprise," she says. "The five goals are the same ones we started with and we're on our way to meeting them. But in the end, the success of the strategy depends on each and every Boeing employee working together to create the environment that values the different background and perspectives that each of them brings to the workplace. This is truly diversity at work."

Joyce Tucker, vice president of Global Diversity and Employee Rights: "Diversity gives Boeing a competitive advantage."

Tapping employee energy

Most employees get involved in diversity efforts through Affinity Groups and Diversity Councils. But it's only when they come together that their efforts pay off.

Affinity groups are employee associations whose members share a common interest, such as race, gender, or culture. The groups are designed to further personal and professional development, promote diversity, meet new people, enjoy social activities, and network.

Diversity councils are a blend of managers and non-managers. They focus on facilitating implementation of a business unit's diversity plan and on improving engagement, providing learning and leadership opportunities, and increasing communication.

Both groups cultivate activities that allow employees to increase their own diversity awareness and share it with others. They allow employees to develop professionally, to participate in training and education, and to reach out to others at Boeing and in their own communities.

A good example is Brandon Polingyumptewa, a supply chain analyst with Integrated Defense Systems in Mesa, Ariz. He is a Hopi Indian from northeastern Arizona and president of the Boeing American Indian Society in Mesa. Polingyumptewa belongs to all the affinity groups in his area and is also on the diversity council for the Mesa site. His appreciation of the importance of grass roots reflects his Native American culture: "For a tree to grow to its fullest potential, the seed must be nurtured and allowed to grow, but the roots must be strong . . . if the roots are strong, the tree will be strong. The Boeing Company plants the seeds of diversity by offering courses and the opportunities to expand its employees, both professionally and personally, and as the seed matures and develops, an environment of diversity and inclusion begins to materialize."

"People bring with them diverse backgrounds, experiences, perspectives and ways of solving problems," Joyce Tucker says. That applies to Katie Blanton, a procurement agent with BCA Global Partners in Puget Sound and a member of the newly formed Global Partners Diversity Council. Blanton worked as a Boeing intern in college and joined the company full-time in July 2006. She thinks about her culture from a generational perspective. "I discovered that the different generations think differently and offer different values. My generation values getting things done. People see us as hard workers and are somewhat surprised by how much we take on and what a good job we do. By giving us more opportunity to show what we can do we will prove it. We will prove to be valuable assets for higher-level decision making."

Belonging to a diversity council provides Virginia Ling with a place where she knows her contributions are appreciated. Ling is Taiwanese American and works as an integration architect for Boeing Commercial Airplanes Architecture in Everett, Wash. A member of the Engineering, Operations & Technology (EO&T) council, she believes that "people on the council become change agents to allow others to understand the importance of diversity. They do a good job of explaining that it is not just about abiding by the law. It is human nature to want to be accepted and be able to contribute. The council activities can help build that awareness."

Building community, expanding opportunity

Boeing affinity groups also provide primary ways for employees to connect with others who share their interests and gain a leadership foothold. Boeing Women in Leadership (BWIL) in St. Louis sponsors a popular monthly Breakfast of Champions that attracts many employees, especially new hires. Leaders from the St. Louis area discuss their career paths and share strategies and stories about how they succeeded. St. Louis BWIL president Stephanie Wojcik believes that her organization provides learning and leadership opportunities to people who wouldn't necessarily have them in their regular jobs. Wojcik, who works on the St. Louis Engineering Operations staff, notes that gaining management experience is often a Catch-22. "All K-manager positions ask for leadership experience. How would you get that before becoming a manager? Well, you can lead a committee at BWIL to get that experience. Now, you can say you've developed and acquired leadership skills."

Joyce Tucker appreciates the value that affinity groups bring. "This is about each individual Boeing employee recognizing that the culture of inclusion is all of our responsibilities. By signing up for affinity groups and diversity councils, people are saying: 'I want to be part of the inclusion movement at Boeing.'"

That is borne out by Ed Martinez, IT project manager, Computing and Network Organizations support, and a member of the Boeing Hispanic Employees Network in Puget Sound. "At our meetings we welcome all people who have interests in our group. When people first arrive they don't know there are support groups they can join and be part of. New employees of no matter what background have a need for support. The affinity group can provide some comfort and support for them. They find themselves more included and comfortable."

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Unsolicited learning

Sam Morgan may be blind, but his disability has brought him some unexpected benefits

Sam Morgan, a technical team lead in St. Louis, is legally blind as a result of a degenerative condition. But he regards his disability positively. "If I hadn't had this loss of vision, I wouldn't have had the same experiences," he says. "I keep learning new ways of doing things."

As he gradually began to lose his sight, Sam Morgan could have resigned himself to a world of darkness. Instead, he began to see the light – an awareness of himself and his work colleagues that had hitherto escaped him.

"I am a more diverse person for having lost my sight," he says. "I'm more open to other people's opinions and their ideas and their assistance."

He is also able to help others with similar disabilities, and that gives him satisfaction.

Morgan, a systems design and integration specialist and technical team lead with Computing and Network Operations at Engineering, Operations & Technology in St. Louis, is disabled and does not fall within the usual description of a minority.

Physical Ability is one of the internal dimensions depicted on the Diversity Blueprint often seen in Boeing buildings. But unlike diversity markers that are with us from birth – gender, ethnicity, race and age – physical ability can change suddenly or gradually throughout our lives. That was the case for Morgan, who was told he was going blind at age 23. He was diagnosed with a 'textbook case' of retinitis pigmentosa, a degenerative condition for which there is no cure.

Morgan has adapted well to his condition. Using a white cane, he is able to negotiate seemingly effortlessly through the complicated labyrinth of hallways, stairs and elevators in his St. Louis office building. And he says that being blind has actually brought him some blessings.

"I now recognize the value of others who help me all the time, even though I still like doing things myself," he says. "I was somewhat arrogant before, but now I have learned that more heads are better than one. My role as team lead is delegation – I'm Mr. Teflon – I pass jobs on to people. 'Automate and delegate' are my mottos. I want to work myself out of a job; that's part of automation."

Morgan's disability has helped others with similar problems. He shares the adaptive equipment at his desk with others. He has a flatbed scanner and a device that performs optical character recognition, turning it into text and then announcing whatever is on the page or meeting notice.

"If I hadn't had this loss of vision, I wouldn't have the same experiences," he says. "I keep learning new ways of doing things."

Rick Stephens:
Diversity and the bottom line

Rick Stephens, senior vice president of Human Resources and Administration: "It's not about the specifics of what I believe. It's about what I am able to bring to the table."

Whenever Rick Stephens meets with groups inside and outside Boeing, he usually cuts to the chase with a simple question: "What kind of value can you bring to our company?"

"It's essential to have the right heart, and the right soul, and the right ideas, and the right mind," he will tell audiences that include such groups as his fellow Native Americans. He challenges everyone to ask: How will you use your skills and talents to help us achieve our business goals?

For Stephens, senior vice president of Human Resources and Administration, diversity is about talent, value and the business – the bottom line.

"This is not about the specifics of what I believe," he explains "It's about what I am able to bring to the table. It's all about what I call the value proposition. When people focus on value, it's a great start because now we are speaking the same language.

"Of course, it's people who create our products," he says. "So naturally we want the very best people so we can continue to create the best products and be a leader in our markets. Taking the best of industry and bringing it into Boeing is fundamental to our strategy.

"Diversity of thought is really driven by our backgrounds, by our perspectives," says Stephens, a member of the Pala band of Mission Indians and a former tribal chairman. "What we're striving for is to create an environment where people are all focused on the same objectives, meeting customer expectations, meeting shareholder expectations and meeting employee expectations. When you get all those aligned and you have people who are bringing their different perspectives, you always come up with the best solution that wins in a competitive marketplace."

Value is important not only to the company, he points out, but to the very people who are providing it. "People want to work where they are valued," he says. "And they'll feel valued if they're looked at not because of their gender, their race, their religion, or the color of skin. It will really be driven by the value they bring to be able to support the business objectives."

It's the role of leadership, he says, to create the right environment where everyone has an opportunity bring their capabilities to the table.

The power of creative thought and passionate energy are the twin drivers of business success, he says. "The value that employees bring is really their minds – their critical, complex creative thinking. They also bring their hearts, which is their passion for doing things. And when you get those two connected, and you have the right environment, we create the right solutions for making us globally competitive."

And he makes no distinctions for himself. "I'm proud to be a Native American," he says. "But I have to bring value to Boeing. I have to draw from my background, my education, and my skills and abilities to help Boeing be successful."

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Managing diversity

When Boeing Chief Financial Officer James Bell says that diversity is not just a Human Resources issue, he is not discounting the importance of HR in furthering diversity and inclusion. Sandy Rufkahr, director of Phantom Works HR, created the new EO&T Diversity Council, which developed a diversity plan for the EO&T organization. She was impressed by the motivation and knowledge of the council members. "I've never seen a group so passionate about anything," she says. Rufkahr has a particular appreciation for how seriously Boeing is committed to diversity. A friend working in a governmental department revealed that her organization didn't collect diversity metrics. "They didn't track how many females and minorities they had. Boeing does a wonderful job at this. We track women and minorities. We target and recruit from minority colleges."

Ron Morinishi: "Treating people the same isn't enough. We need to be sensitive to the backgrounds and cultures of others."

Victor Hill: "Diversity is a necessity, not a luxury. Cultural isolation limits potential." Every person, every idea brings about global solutions, he says.

Souzane Tacawy recently stepped up to the challenge of increasing the number of women employed at the Long Beach, Calif., site. As regional director for Electronics and Avionics Testing at IDS in Southern California, she was asked to draft a plan to reverse the underutilization of female employees.

"When we started looking at the data, we discovered we didn't have females in lower levels, so when a requisition opened up internally, there were no women at those levels who could apply. We had to build a pool to get more women, and we needed to partner with external groups to get the word out to increase that pool." They gave plotted charts from the last five years to hiring managers to show how they could make a difference. It worked: The Long Beach site has been in the green for utilization of women since 2005.

Tacawy adds, "Our commitment to inclusion has resulted in better business for us in terms of motivated and engaged employees. Women and minority employees are encouraged when they see employees like them progressing at all levels in the organization. It motivates them to focus on performance to ensure that they, too, can move up."

She notes that the majority of Long Beach employees participating in the Boeing employee survey said diversity was valued in their work group, that the ideas and opinions of all employees mattered. "That clearly motivates the employees to bring more ideas forward, which results in better organizational performance."

One result was that in 2007, a reorganization created opportunities in the region. "There was a good pool of women and minorities especially from Long Beach," she says. Three women, including her, were promoted to M-level manager positions. Another two were promoted to E-series positions.

"The others promoted along with me were all highly talented people who were given an opportunity to show that they help Boeing to succeed," she says. "Recognizing them was clearly a good business proposition."

The opposite of exclusion

Asking people what inclusion means to them elicits stories of personal discovery. People know what it feels like to be excluded. And when the environment changes to one of inclusion, the result is deep appreciation and sense of commitment.

Gerald Stanley, a systems engineer on the Space Shuttle at Kennedy Space Center in Florida, knows what inclusion has meant for him. "It's when everybody is valued for who they are, no matter what their background, ethnicity, religion or culture."

Stanley is vice president of the Florida chapter of BEAGLES, the Boeing Employees Association of Gays, Lesbians and Friends. "I was reluctant to reveal my own sexual preference in the past. I turned 40 two years ago and I have heard many jokes and innuendos. I was tired of hearing them. Since I came out, that kind of thing doesn't happen in front of me, but it still happens."

Stanley also wants to help make it easy for others, especially new hires. "We need to protect employees from harassment and make this an attractive place to work. It has to be safe and comfortable for African Americans, gays and lesbians, and others to work for Boeing. "

Brian Lee, who has a Korean heritage, struggled with his identity.

A project manager on the 787 Program, Lee actively began exploring his Korean roots in college. "I look Korean and think American," he says.

A member of the new Global Partners Diversity Council and BAAPA, the Boeing Asian-American Professional Association, Lee says "You want to be part of the mainstream, but because of how you look, you think you don't fit."

He went to Korea to work as an engineering intern, to learn the language – and the culture. Embedded in many Asian languages, for example, is respect for elders and positions of authority.

"The way I speak with my dad is different from how I speak to other people," says Lee. "Another world opens up to us when we learn the language."

Jesus Elizondo, an IDS Production Controls manager in St. Louis and co-lead of the diversity council for St. Louis Operations and Supplier Management, says, "With the diversity message we're changing our perspective of how we do business for the future. I learned a long time ago that working with people allows you to drive success."

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One way of leading

"Everyone can be a leader of diversity and inclusion," Joyce Tucker often says.

Victor Hill, a function manager for Spacecraft Products Manufacturing Support and Material Requirements Planning at the Satellite Development Center in El Segundo, Calif., set out to prove it. After attending the Global Diversity Summit in California, Hill spoke about it at his Toastmasters club.

"I learned that diversity is a necessity, not a luxury, and that cultural isolation limits potential," he says. "If we include everyone, we include every idea possible for global solutions."

Hill says: "Inclusion to me is the creation of ideas for improvement, implementation of those ideas, and the measurement of success. It is inviting others to share openly and without fear of retaliation or disrespect. I believe that we can learn from almost everyone we meet. And we learn not only from success but from failure as well."

Hustle and flowdown

Commitment by senior leaders to diversity drives the message down. Employee involvement spreads the message. And managers play a major role in the consistent modeling and demonstration of diversity awareness for employees.

When Ron Morinishi moved to St. Louis two years ago, he realized it was culturally different from California, where he was reared and worked for many years. Morinishi, a manager in Phantom Works' Systems and Subsystems Technology area, belongs to the EO&T diversity council and is the head of the local St. Louis EO&T Diversity Council. He is also a member of the Boeing Asian-American Professional Association.

> "The understanding and practice of diversity and inclusion should be viewed as a critical leadership skill."
> – Ron Morinishi

"People think it's enough to treat people the same," he says. "If they do that, then it's okay. I try to preach that isn't enough. We need to be sensitive to others' background and cultures and use that to enhance our daily work."

Morinishi believes understanding and practice of diversity and inclusion should be viewed as a critical leadership skill and part of everybody's job, especially managers.

"They have to learn it, practice it and teach it to others," he says.

Joyce Tucker agrees. "We're having conversations about how to reach out and access all the talent that's available to us in our recruiting," she says. "We want potential employees to know that Boeing is an open and inclusive environment. A culture that values diverse employees will be the kind of culture that will attract talented people who can work effectively with others to achieve the goals of our company.

"Recognizing, leveraging and bringing together the unique contributions that all employees offer to the workplace makes Boeing one company and a great place to work." ■

Brandon Polingyumptewa: Like a tree, he says, Boeing needs strong roots. "Boeing plants the seeds of diversity by offering courses and the opportunities to expand its employees, both professionally and personally."

Gerald Stanley: "It has to be safe and comfortable for African Americans, gays and lesbians, and others to work for Boeing."

Jesus Elizondo: "With the diversity message, we're changing our perspective of how we do business for the future."

Carla Williams:
Getting involved

Carla Williams, Black Engineer of the Year for 2007: "Inclusion means being listened to and having your opinions valued."

Carla Williams believes in going outside the box – even outside of Boeing – to get involved.

It took her work with children and other programs at Boeing-sponsored external events to discover a wealth of expertise within her own company.

Williams, who works with the support program office on the Mobile User Objective System at Integrated Defense Systems in El Segundo, Calif., donates her time to a variety of volunteer activities, including teaching children about math at the Boeing Summer Science Camp in Huntington Beach, Calif.

"It is important for them to see that there are women in science and engineering," she says. Williams is past president of the Huntington Beach Boeing Black Employees Association and has volunteered with the Black Engineer of the Year (BEYA) organization for three years. In addition to its conference recognizing people in the industry, the BEYA organization also holds a conference for college students, encouraging them to continue their education and go to work for companies like Boeing.

Recently, Williams won the national 2007 Black Engineer of the Year award, accepting it in Baltimore at the annual BEYA conference. "When I was involved with BEYA, I realized there were many recognized experts on my same campus in California, and I hadn't known them. As a result of meeting those people at Baltimore, I set up an event at Boeing with people right on our own campus."

Williams recognizes the importance of grass-roots efforts for deepening diversity and inclusion. "The grass-roots movement gets at the heart of what interests people," she says. "People are interested in what they would like to improve for themselves, how they'd like to initiate change and how they'd like to help others."

She strongly believes in the power of inclusion. "Inclusion means having a seat at the table," she says. "It means being listened to and having your opinions valued. It also means being afforded the same opportunities as everyone else."

PHOTO BY TONY ROMERO

Hispanic Engineer National Achievement Award winners Maria Caldwell and Joseph Gallego.

Boeing's reputation for technical excellence increases every year. In 2007, many Boeing employees were recognized by their peers in engineering groups, professional associations, and learned societies for outstanding work in a variety of fields. The Boeing Company can be proud of its technical breadth and cultural diversity, says John Tracy, senior vice president of Engineering, Operations & Technology. The strong emphasis put on personal and professional achievement and excellence permeates the global enterprise. The diverse award winners for 2007 listed here represent the future of Boeing technology leadership.

American Institute of Aeronautics and Astronautics

Kevin Leath – Associate Fellow
Ted E. Goetz – Associate Fellow
Tim W. Propp – Associate Fellow (retired)
William J. Bezdek – Associate Fellow
Mathew L. Rueger – Associate Fellow
Eugene H. Kopp – Associate Fellow (retired)
Ying Teng – Associate Fellow
Timothy Bressler – Associate Fellow
Paul J. Moorehead – Associate Fellow (retired)
Russell J. Enns – Associate Fellow
Michael Mohaghegh – Sustained Services Award
Frederick Roos – Sustained Services Award
Peter Y. Cheng – 1st Place Membership Award (Large Category)
Kumar Bhatia – Fellow
Rick Stephens – Fellow
David G. Miller – de Florez Award for Flight Simulation

Asian American Corporate Achievement Award

Jason Hatakeyama – Asian American Engineer of the Year
Joan Wada – Asian American Engineer of the Year

American Helicopter Society

Manned/Unmanned Common Architecture Program Team – Grover E. Bell Award

American Indian Science and Engineering Society

Gary M. Bishop – Executive Excellence Award

American Society of Civil Engineers

Edward L. Gervais – Robert Horonjeff Award for Outstanding Achievement in Air Transportation Engineering

American Society of Engineers of Indian Origin

Arun Ayyagari – Engineering Excellence Overall Winner
Purvi Bodawala – Woman Engineer Overall Winner
Puja Gupta – Young Engineer Recognition
Naveed Hussain – Outstanding Achievement Overall Winner
Paul Sikand – Service Excellence Recognition

American Society for Quality

C-17 Globemaster Stuffed Tailcone Team – Gold winner in International Team Excellence Competition
C-17 Globemaster OBIGGS II Team – Silver winner in International Team Excellence Competition
C-17 Globemaster Integration Team – Silver winner in International Team Excellence Competition

Black Engineer of the Year

Joan Robinson-Berry – Career Achievement in Industry
James Bell – Most Influential Blacks in Business & Technology
Norma Clayton – Most Influential Blacks in Business & Technology
Sam Jenkins – Most Influential Blacks in Business & Technology
Jim Wigfall – Most Influential Blacks in Business & Technology
Darrell Warner – Most Influential Blacks in Business & Technology
Regina Austin – Modern Day Technology Leadership Winner
Kaiana Carter – Modern Day Technology Leadership Winner
Patrick Cazeau – Modern Day Technology Leadership Winner
Charles Coleman – Modern Day Technology Leadership Winner
Jarrett Datcher – Modern Day Technology Leadership Winner
Wanda Davis – Modern Day Technology Leadership Winner
Ronald Gayfield – Modern Day Technology Leadership Winner
Janet Makori – Modern Day Technology Leadership Winner
Latronia Ryan – Modern Day Technology Leadership Winner
Carla Williams – Modern Day Technology Leadership Winner
Dorothy Williams – 2007 Special Recognition

Career Communications Group

The Boeing Company – No. 1 in top supporters of black engineering schools for 2007

Hispanic Engineer National Achievement Awards Conference

Blanca Padilla – Role Model of the week
Joseph Gallegos – Information Technology, Hardware Award
Maria Cardwell – Luminary Award

Information Resources Management Association

Medhi Ghods – Fellow

Institute of Electrical and Electronics Engineers (IEEE)

IEEE Spectrum magazine (February 2007 edition)
The Boeing Company – No. 1 in U.S. patents in aerospace, defense industry

International Federation of Automatic Control

Kevin Wise – American Automatic Control Council Control Engineering Practice Award

Institute of Industrial Engineers

Susan Chandy – E-Week New Faces of Engineering 2007
Dwight Miller – Society for Engineering & Management Systems Management Award

National Society of Black Engineers

Sandra Jeffcoat – Golden Torch Award for Lifetime Achievement

Organization of Chinese Americans

Dev Banerjee – Asian American Corporate Achievement Award

Precision Strike Association

The Small Diameter Bomb industry team – 2007 William J. Perry Award

Royal Aeronautical Society

Fellowship
Nannette Bouchard
Marlin Dailey
Pat Finneran
Atul Jain
Dinesh Keskar
Roger A. Krone
James Leonard
John Lockard
Dennis O'Donoghue
Philippe Spalart

Society for the Advancement of Material and Process Engineering

Jayant Patel – SAMPE Fellow

Society of Automotive Engineers

Jayant Patel – SAE Fellow and Forrest McFarland Award
Cindy Chou – SAE International's Rumbaugh Outstanding Student Leader Award
John DeRosia – Bill Agnew Award for Outstanding A World in Motion (AWIM) Volunteer
Gordon L. Allen – 2007 Thomas H. Speller Award
Dr. Branko Sarh – 2007 Forest R. McFarland Award

SAE International AeroTech 2007

Joy Cassady – 2006 SAE Engineering Meetings Board Outstanding Oral Presentation
Susan Larson – 2006 SAE Engineering Meetings Board Outstanding Oral Presentation
Ishaque S. Mehdi – 2006 Aerospace Chair Award
Christopher M. Severns – Charles M. Manly Memorial Medal, 2006 Recipient
Nikhilesh Sheth – 2006 SAE Technical Standards Board Outstanding Contribution Award
Sharanpal (Paul) S. Sikand – Marvin Whitlock Award, 2006 Recipient
Robert J. Manelski – Marvin Whitlock Award, 2005 Recipient
Mark D. Scott – 2005 SAE Technical Standards Board Outstanding Contribution Award
Nikhilesh Sheth – Franklin W. Kolk Air Transportation Progress Award, 2005 Recipient
Matt Travis – 2005 Arch T. Colwell Merit Award

Society of Hispanic Professional Engineers

Erik M. Gutierrez – Promising Engineer Award

Society of Manufacturing Engineers

Carolyn Corvi – 2006 Eli Whitney Productivity Award

Society of Experimental Test Pilots

Doug Benjamin– Iven C. Kincheloe Award
Joseph Felock – Iven C. Kincheloe Award

Society of Women Engineers

Sandra L. Postel – Upward Mobility Award

Women in Aerospace

Marlene Nelsen – Lifetime Achievement Award

Women of Color in Technology

Judy Chen – Technical Innovation Award
Gail Meredith – Special Recognition Award
Denise Bolar – Technology All-Star
Toni Brown – Technology All-Star
Cynthia Cavalli – Technology All-Star
Camillie Geiger – Technology All-Star
Janice Greene – Technology All-Star
Carol-Sue Hipsher – Technology All-Star
Felicia Martin-Parham – Technology All-Star
Anena Metoyer – Technology All-Star
Marsha Morris – Technology All-Star
Jen-Mei Shih – Technology All-Star
Pamela Wall-Dover – Technology All-Star
Li-Chen Chang – Technology Rising Star
Nancy Diaz – Technology Rising Star
Christine Goo – Technology Rising Star
Shivaun Jones – Technology Rising Star
Teniel Jones – Technology Rising Star
Maida Lopez – Technology Rising Star
Anita Ravi – Technology Rising Star
Adenike Soyombo – Technology Rising Star
Gina Yip – Technology Rising Star

Winners previously recognized by the Boeing Women of Color newletter

Sandra Jeffcoat – Golden Torch Award for Lifetime Achievement (Society of Black Engineers)
Anne Kao – Research Leadership Award
Carolyn Nichols – Career Achievement Award
Barbara Wilson – Professional Achievement Award

PHOTO BY JUANITO HOLANDEZ

Robert A. DiChiara receives an award from Martha Ries, vice president of Intellectual Property Management.

The top Boeing inventors for 2007 are "pioneers upon a new science and industry," says Martha Ries, vice president of Intellectual Property Management, echoing the sentiment of company founder Bill Boeing.

"In that tradition, our Boeing inventors stand as models of innovative accomplishment, as hallmarks of technical excellence," Ries says. "They provide the means for Boeing to exceed our customers' expectations through the delivery of products and services of unparalleled quality, efficiency and affordability."

Intellectual Property Management (IPM) – a crucial component of Engineering, Operations & Technology, which protects and leverages Boeing intellectual property – presents the annual Special Invention Awards in the Northwest, Midwest and Southwest regions. In 2007, a total of 94 innovators were responsible for more than 25 newly patented inventions selected as winners from a pool of more than a thousand inventions.

The Special Invention Program offers monetary awards as well as recognition to Boeing employees who create and patent an invention.

Bob Krieger, who recently announced his retirement as Boeing chief technology officer and president of Phantom Works at the end of 2007, says it takes thousands of technologies and processes to design and build an airplane, weapon system, spacecraft, or networked system.

He told the Midwest group of winning inventors in St. Louis: "It's essential for Boeing to keep ahead of the competition in every one of these areas. I commend your creativity. You are defining the future of aerospace through innovation.

"All of these inventions bear the hallmark of creativity and innovation, the lifeblood of our company. Without such advances, we would become average, immobilized, and lose our leadership position in the world. By solving real problems and enabling our products and services to achieve extreme affordability and breakthrough performance, you are keeping us on the cutting edge, with technologies that will continue to change the way we live, work, and travel."

Midwest Region

Triple Purpose Lay-Up Tool
Dwight L. Engwall
John F. Costello

Methods and Apparatus for Testing and Diagnosis of Weapon Control Systems
Leonard James
William J. Ebert
Aaron L. Eggemeyer
Richard E. Meyer
Bobby J. Wilson

Route Search Planner and Sensor Scan Planner
Shirley N. Cheng
Ted L. Johnson
Michael G. Neff

Naturally Integrated Engineering Architecture
Monica M. Allen
James P. Hodge
Kyle I. Roberts
Kenneth H. Vaughan
Craig S. Warren
Michael A. Wirth

Systems and Methods for Performing Load Analysis
Scott W. Stevenson
Bruce D. Shimel
Dean H. Wette

iGPS
William J. Bencze
Robert W. Brumley
Clark E. Cohen
Barton G. Ferrell
Gregory M. Gutt
Brent M. Ledvina
Mark L. Psiaki
David A. Whelan

Intellibus
Robert L. Calkins
Philip J Ellerbrock
Robert L. Grant
Chris Noll
Mark D. Rogers
Marshall Watts
Joseph P. Winkelmann

Northwest Region

Managing Changes in Aircraft Maintenance Data
Kurt J. Vandermolen

Overhead Lattice Support Structure
Phillip Bobzien
Robert Dowdell
Michael D. Jacoby

Aircraft Engine Thrust Mount
Kent W. Dunstan

System, Method, and Computer Program Product for Accessing Electronic Information
William J. Ahl
Joseph F. Floyd
Roger L. Guay
Stephen P. Miller
David A. Okrent
Binoy V. Varughese

Chevron/Segmented Exhaust Nozzles for Jet Engine Noise Reduction
Ronald L. Balzer
Leonard J. Hebert
Vinod G. Mengle

Side Loading Automated Closet
Jeffrey D. Farnsworth

Controlled Atmospheric Pressure Resin Infusion
Dennis J. Hanks
Robert D. Hawkins
Andrew E. Modin
Jack A. Woods

Mobile Platform Distributed Data Load Management System
David Allen
Bijan Honari
Bruce Pollock
Mary Ann T. Nakasone
John Sims

E-Fixture
Lee McNeil
Douglas Ostgaard
Ramanlal Patel

Aerospace Vehicle Yaw Generating Systems and Associated Methods
Henry Beaufrere
Jeff S. Harrigan

Method and Apparatus for Removing and Replacing Components of an Airplane
Tim George
Michael W. Sievers

Southwest Region

Method for Determining Attitude of an Object
Thomas P. Weismuller

High Speed Monolithic Microwave Integrated Circuit Quadrature Phase Shift Keying and Quadrature Amplitude Modulation Modulators
Remy O. Hiramoto
Kurt W. Loheit
Suzanne E. Richards

Isoelectronic Surfactant Suppression of Threading Dislocations in Metamorphic Epitaxial Layers, and Isoelectronic Surfactant Induced Sublattice Disordering in Optoelectronic Devices
Peter C. Colter
James H. Ermer
Christopher M. Fetzer
Richard R. King

Shielded System with a Housing Having a High Atomic Number Metal Coating Applied by Thermal Spray Technique
Edward J. Coker
Michael G. Prlina

Thermal Insulation System Employing Oxide Ceramic Matrix Composites
Robert A. DiChiara Jr.

Closed-Loop Wavefront Sensor Using Field Programmable Gate Array
Jean J. Dolne
Paul J. Menicucci
Harold B. Schall

Systems and Methods of Recording Events Onboard a Vehicle
Ralph S. Perez
Luigi P. Righi
Joseph F. Sunio
Mark A. Talbot

Hingeless Flapper Valve for Flow Control
John L. Bowers
Sham S. Hariram
Jayant D. Patel
Sharanpal S. Sikand

Systems and Methods for Refueling Spacecraft
Craig Christy

Rigid Insulation and Method of Producing Same
Vann Heng
Maryann Santos
Karrie A. Hinkle

Multijunction Photovoltaic Cell with Thin 1st (top) Subcell and Thick 2nd Subcell of Same or Similar Semiconductor Material Tunnel Junction Connecting Subcells
Richard R. King
David E. Joslin
Nasser H. Karam

PORTRAIT

Systems Design and Manufacturing Demonstration Wing Team

The future is here for our team. We just created the wings for Boeing airplanes that have yet to be imagined. We've been working on an exciting advanced technology wing program in conjunction with the U.S. Navy. We pooled some of the best talents of Phantom Works and the Advanced Systems unit of Integrated Defense Systems to design a hybrid demonstration wing made of advanced composites and metals. The goal was to reduce traditional manufacturing and assembly costs by 25 percent. We not only reached that objective, but we also achieved efficiency and quality breakthroughs in our autoclave fabrication of composites, additive manufacturing of metallic components, and advanced assembly technologies. We are proud to be working as a one-company team on the kind of technologies that other people only dream about. We were asked to find a way. And we did.

From left to right

Don Drouin
Technology Integrator,
Advanced Systems, IDS

Jim Piszar
Manufacturing Engineer, Phantom Works

Tim Tyahla
Project Manager,
Phantom Works

Dave Heck
Design Engineer and Associate
Technical Fellow, Phantom Works

Robin Wippich-Dienhart
Strength Engineer,
Phantom Works