

# Fine line

Boeing's 777 has always been an efficient airplane. Now its assembly line is operating more efficiently, too.

by Eric Fetters-Walp and photos by Bob Ferguson

For more than a decade, the 777 had been produced in “slant line” formation at the final assembly line in Everett, Wash., with airplanes parked wing to wing in stationary positions, the once-traditional manufacturing method for all Boeing models.

It worked well enough. But the successful 737 moving assembly line in Renton, Wash., showed there were production gains that could be realized using a moving line of jets parked nose to tail.

“It wasn’t broken,” said Kim Pastega, Commercial Airplanes director of 777 manufacturing, of the old way the line had operated, “but it really is about growth and productivity. We believe we have a competitive advantage the way we build airplanes here today.”

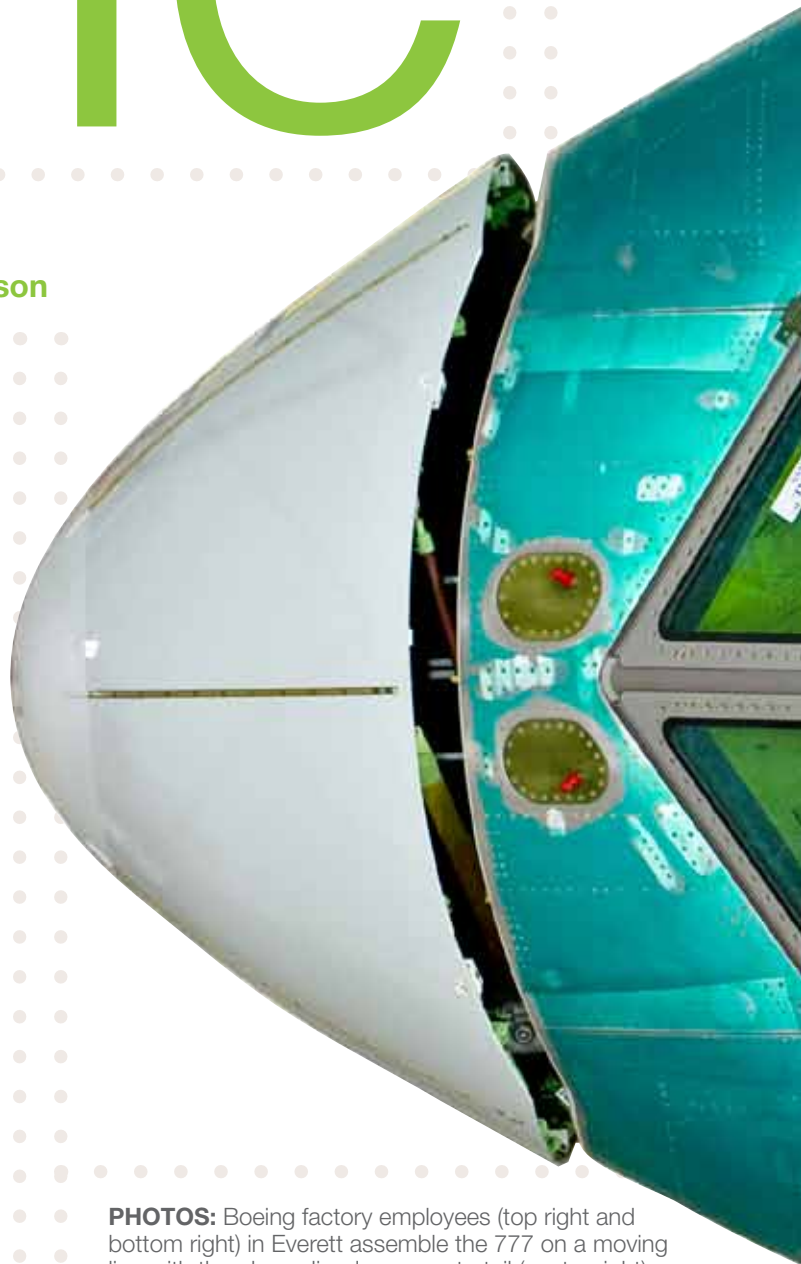
The transition has been a lengthy one. Boeing first started portions of the 777 moving line in 2006, after several years of planning. But progress toward making the entire final assembly line ready to move was interrupted by the introduction of the 777 Freighter in 2008.

During planning and preparation, 777 managers looked at lessons learned on the 737 program, which launched its moving line in 2002. “That really gave us a great foundation to learn from,” said Larry Loftis, 777 vice president and general manager, who also was a director for the 737 line when it was transformed.

Since the 777 program’s moving line officially started up on Jan. 12, it has moved an average of 1.6 to 1.8 inches (4.1 to 4.6 centimeters) per minute. That has reduced the 777 final assembly process—the time it takes between the arrival of initial fuselage sections into systems installation to the day the completed jetliner rolls out the factory doors—from 26 days to 17 days, Loftis said.

The moving assembly line idea has been replicated worldwide in large manufacturing processes since Henry Ford introduced it to the automotive world a century ago. Boeing became the first commercial airframe manufacturer to use the concept in building jetliners, starting with its 717 production line in Long Beach, Calif., in 2000. Boeing found the moving line helped to reduce assembly time and also cut costs by incorporating Lean+ principles into production processes.

Boeing’s moving lines are different from many moving production lines in the size and complexity of the product being



**PHOTOS:** Boeing factory employees (top right and bottom right) in Everett assemble the 777 on a moving line with the planes lined up nose to tail (center right) rather than in the traditional slant positions. The moving line, which officially started up in early January, has dramatically reduced the time it takes to assemble a 777—from 26 days to about 17 days.



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– Kim Pastega, Commercial Airplanes director of 777 manufacturing



assembled. The 777 line is believed to be the most extensive moving production line used to build a commercial airplane. A new, empty 777 weighs 366,940 pounds (166,441 kilograms) and includes about 3 million parts.

“What makes the 777 line unique was taking a baseline plan and adopting it on a scale and magnitude that’s never been done before,” Pastega said. “It absolutely needs every single person engaged to help with the implementation.”

Before planning for the line’s startup could begin, 777 employees spent significant time looking at how parts flowed to airplanes under construction and how the former production system worked, Loftis said. With that done, switching to a moving line required coordinating not only the assembly and tooling crews but also everyone else from suppliers to the employees who maintain the tugs that move the airplanes along the line, said Gary McCulley, director of 777 Final Assembly.

The transition also required that line employees learn a new system, Loftis said. The new system requires flexibility. “Change is always hard. The system is designed to highlight any problems, so you have to fix them rather than just live with them. The process forces you to look at all waste and get rid of it,” he said.

Recurring problems that crop up in the assembly process gain faster attention now, said Steve Hall, Production manager for 777 Final Assembly. That’s because when encountering a serious problem, an employee can halt the moving line.

“It’s real visible if you’re not moving,” Hall said. “There’s a sense of urgency when there’s a problem.”

So far, Hall said, a “handful” of major issues have been identified during transition to the moving line. Those are being addressed as phase 2 of the moving line is implemented, he said. The goal is to be at phase 3—full implementation of the moving line—by the end of summer.

That should be possible, Loftis said, given the enthusiasm Boeing workers have shown since the moving line started in January. The 777 assembly teams—many of which have adopted nicknames—track their performance on the line, a process aided by new large display screens hanging in the Everett factory.

“We’ve had some great successes with our employees helping us implement this,” Loftis said.

Pastega agreed, saying early doubts about the change largely have subsided. “I think our team really understands this is all about the value and competitiveness of the 777.”

Hall has worked on the program since 1994, before the 777’s first flight. From his office area overlooking the 777 line, he said he’s happy the new assembly strategy for the long-successful airplane program is in motion. “It’s gratifying to see the effort and the collaboration that’s gone into that,” Hall said.

“It takes a whole family to make that airplane go down the line.” ■

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## 4 of a different kind

All models of the 777 are assembled on the moving line, underscoring the stability of the new production system. Indeed, just recently, all four models—a 777 Freighter, 777-200ER (Extended Range), 777-200LR (Long Range) and a 777-300ER—were being assembled simultaneously.

The four variants have successfully moved down the line twice now without major hiccups in production, said Matt West, 777 Business Operations manager. “There



are significant configuration differences between these models, including fuselage structure, wing and systems ... These eight airplanes went through the factory build process flawlessly.”

As of mid-March, customers had ordered 1,117 Boeing 777s, of which 845 had been delivered. The 777 entered passenger service in 1995.

– Eric Fetters-Walp

**PHOTOS:** The tailcone of the 777 fuselage is shown in the background. One of the moving line’s most crucial points is Final Body Join, where the forward and aft fuselage sections are put together with the wing/body assembly (below left). The 777 moving line can be stopped at any time by one of the employees if there is a serious problem. A large display screen in the 777 bay (bottom right) helps employees track their performance and the progress of planes in final assembly.



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