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[Wired Mag](#)
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## Airlines Try Smarter Boarding

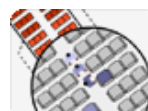
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02:00 AM May, 09, 2006

It's the announcement that every frequent flier dreads: "Ladies and gentlemen, we have a very full flight today. Please step out of the aisle and into your row as quickly as possible so that other passengers are able to reach their seats."

But the chaos of aircraft boarding may soon go the way of the 727. Several major airlines are working to develop more efficient ways to board an aircraft, using computer simulations to come up with mathematically proven -- if counterintuitive -- boarding models with names like the "rotating zone system" and the "reverse pyramid."

For cash-strapped airlines, improving the boarding process has become more than a customer service issue. "An airplane only generates revenue when it is in the air," explains David Swierenga, a former Air Transport Association of America economist and president of aviation consulting company AeroEcon. Swierenga says that by speeding "turnaround," an industry term for the amount of time an aircraft spends on the ground between flights, airlines can keep their planes in the air longer.



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"An airplane that spends an hour on the ground between flights might fly five trips a day," he explains. "Cut the turnaround time to 40 minutes, and maybe that same plane can complete six or seven flights a day." More flights mean more paying passengers, and ultimately, more revenue.

Many factors contribute to turnaround time, including baggage handling, refueling and aircraft cleaning. But a 1998 [Boeing study](#) shows that passenger boarding plays a significant role.

America West Airlines, which became US Airways after a [recent merger](#), has led the way in rethinking passenger boarding, working with engineers at Arizona State University to develop a system that speeds the process by reducing interference between passengers.

According to Tim Lindemann, US Airways' managing director of airport services, streamlining the boarding process was one part of a larger effort to reduce turnaround times at what was then America West. "We were looking at every possible way to shave time off the process," he says.

Convinced that there was a statistical solution to the problem, Lindemann approached Arizona State University's [industrial engineering department](#). "We have a great university in our backyard, and hoped they could help," he says. "The engineers there immediately understood

the problem we were trying to solve, because they had witnessed it themselves. They had been on our flights."

Professor René Villalobos and graduate student Menkes van den Briel began reviewing boarding systems used by other airlines. "The conventional wisdom was that boarding from back to front was most effective," says van den Briel. The engineers looked at an inside-out strategy that boards planes from window to aisle, and also examined a 2002 simulation study that claimed calling passengers individually by seat number was the fastest way to load an aircraft.

The two then developed a mathematical formula that measured the number of times passengers were likely to get in each other's way during boarding. "We knew that boarding time was negatively impacted by passengers interfering with one another," explains van den Briel. "So we built a model to calculate these incidents."

Villalobos and van den Briel looked at interference resulting from passengers obstructing the aisle, as well as that caused by seated passengers blocking a window or middle seat. They applied the equation to eight different boarding scenarios, looking at both front-to-back and outside-in systems. "Ultimately, the issue America West needed to address was time," explains van den Briel. "We figured a system that reduced interference between passengers would also cut boarding time."

Van den Briel then spent two days at Los Angeles International Airport, where America West was filming actual passengers as they boarded, positioning one camera on the Jetway and another inside the aircraft. He spent the next two weeks analyzing these tapes, clocking the times it took passengers to complete certain tasks. "You can't imagine how boring this was," he says, laughing.

He and Villalobos used this passenger data to build a computer-simulation model that validated the results of their analytical work. "The analytical model gave us the information we needed to design a new system," Villalobos explains, "but we needed a simulation that would allow us to test our method against others."

Story continued on [Page 2](#) »

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Villalobos and van den Briel presented America West with a boarding approach called the reverse pyramid that calls for simultaneously loading an aircraft from back to front and outside in. Window and middle passengers near the back of the plane board first; those with aisle seats near the front are called last. "Our research showed that this method created the fewest incidents of interference between passengers," Villalobos explains, "and was therefore the fastest."

US Airways' Lindemann says the airline has enjoyed significant improvements since implementing the reverse pyramid in 2003, including a 21 percent decrease in departure delays in the first three months following the system's launch, and a two-minute reduction in average boarding time.

Other carriers appear to have taken note. Last July, AirTran Airways launched a boarding system that the airline's Judy Graham-Weaver refers to as a rotating zone system. AirTran first seats the back five rows of the plane, then the front five, and continues rotating back-front-back until boarding is complete. Graham-Weaver says that this system is one reason AirTran enjoys turnaround times in the 20- to 30-minute range.

United Airlines is using a boarding strategy it calls "Wilma," which stands for "window-middle-aisle." This outside-in system boards all window passengers first, followed by those with middle seats and, finally, those seated in the aisle. Like the AirTran and US Airways systems, Wilma offers pre-boarding for first-class passengers, elite frequent fliers and those requiring extra assistance.

Southwest Airlines takes a low-tech approach to boarding, placing passengers into one of three groups based on their check-in time, and allowing them to take any open seat once their group is called. Representative Whitney Eichinger says that this method has served Southwest well since it began flying in 1971, and that the airline enjoys some of the quickest turnaround times in the industry.

Van den Briel says that while Southwest's open seating might seem like an invitation for chaos, it actually illustrates a tendency among passengers to self-organize when left to their own devices. "Passengers who are free to sit anywhere usually do a good job staying out of each other's way," he explains. "Without having studied it in detail, I would imagine that an open boarding model is faster than assigned seating."

Villalobos and van den Briel designed the reverse pyramid for single-aisle aircraft, but America West's merger with US Airways means that the airline now operates wide-body Airbus and Boeing planes. Villalobos believes the reverse pyramid can be modified to work successfully with these aircraft, but admits that bigger planes create additional opportunities for passenger interference. Lindemann says US Airways will roll out the reverse pyramid systemwide once the two carriers have adopted a single reservation system.

In 2007, Airbus will begin deliveries of its [A380 super jumbo](#), capable of seating up to 555 passengers. Airbus' Clay McConnell says that his company has addressed customer concerns about the time required to load the A380 by making all 16 of the aircraft's doors large enough to board passengers comfortably.

"An airline could simultaneously load the aircraft from two different gates," he says. "Or, they could board people from the back using stairs." McConnell says Airbus' research shows that the boarding process for an A380 will be only five minutes longer than that for a Boeing 747-400, despite the fact that the Airbus plane can carry up to 140 more passengers.

While the reverse pyramid was designed to address airplane boarding, its creators believe the model has other potential applications.

"Someone called and asked if it could be used to shorten the time it takes to evacuate a building," Villalobos says. "I told him it was something we could definitely look into."

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