

# Airlines and passengers save billions through crew planning

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Airlines avoid up to 80 percent of crew-related delays through advance planning, according to the authors of a Dartmouth College study on the commercial airline industry. The research explains the complex reality of crew scheduling and provides an inside look at the techniques used by airlines to absorb system delays.

While individual airlines use proprietary systems for crew planning, this is the first study that publicly describes how crew itineraries are developed. It is also the first open study of how airlines weigh planned costs and disruption costs when deciding crew schedules.

Understanding the rules and regulations that define how airlines work and that often compound frustrating delays for passengers is difficult. The analysis explains how positioning of flight crews attempts to ease travel disruptions while saving airlines and consumers billions of dollars.

"Airlines are among the world's most complex businesses," said Vikrant Vaze, an assistant professor of engineering at Dartmouth's Thayer School of Engineering. "Understanding the sophisticated planning systems used by airlines to schedule crews—as well as understanding how delays impact the air travel system—are both massive tasks, but such information can result in great savings for the airlines and the flying public."

Annual revenue and annual costs in the U.S. [airline industry](#) are each estimated to be around \$150 billion. On the expense side, crew costs are counted as the second-largest outlay. On average, it is estimated that crew expenses—including pilots and flight attendants—account for about one-third of total airline costs, or about \$45 billion, according to the U.S. Department of Transportation's Bureau of Transportation Statistics (BTS).

Calculations in the Dartmouth study demonstrate that sophisticated crew scheduling practices allow

airlines to avoid 60-80 percent of crew-related delays. While a dollar figure is not provided in the paper, rough estimates suggest that this amounts to savings of up to \$13 billion system-wide each year in terms of reduction in delay costs to airlines and consumers.

Researchers focused on four categories of operational factors related directly to pilot scheduling that affect the extent of the spread of delays: aircraft change, connection buffers, crew legality and crew swaps. These categories relate to the complex constellation of operational decisions, regulations and labor guidelines that guide real-time decision-making in the airline industry.

Among the regulations that airlines need to factor when determining crew schedules are: the amount of total flying time, sit time, rest time and the total time away from the crew base.

"While the industry's problems are easy to pick out, finding solutions to keep countless moving parts working efficiently is much more challenging," said Vaze, the senior researcher of the study.

According to this research, published in the journal [Transportation Science](#), airline delays are strongly impacted by decisions that are made to pair crews to a series of flights during the course of a work period. In order to better understand how crew delays amplify throughout the airline system, the researchers developed a model to estimate the proprietary crew itinerary generation algorithms used by airlines.

Once the research team could accurately estimate how airlines make crew pairing decisions, they were able to model how delays propagate throughout the airline system as a result of technical problems, poor weather, security issues and other disruptions.

The team analyzed a series of confidential crew

scheduling datasets from multiple major US airlines in order to confirm how well mathematical models used in the research estimate how the industry accounts for the cascading delays.

"This study answers often-asked questions about crew pairing and airline delays," said Keji Wei, a doctoral candidate at Dartmouth and lead author of the paper. "Understanding the extent, causes and impacts of the propagation of delays and disruptions is essential for developing methods to improve the overall aviation system performance."

Just under 80 percent of U.S. flights were delayed by 15 minutes or less in the first half of the current decade. According to the paper, public data does not include specific information on the number of [flight delays](#) caused by crew delays and disruptions.

Researchers expect the study will help airports, airlines and government agencies improve [delay](#)-mitigation techniques used throughout the industry.

"Accurate estimation of crew delays is critical for an overall understanding of aviation system performance and to inform government policy and air carrier decisions," said Vaze.

The study—that focuses on pilot schedules only—comes after a difficult period for some [airlines](#), including a high-profile incident in which a passenger was forcefully removed from a plane to provide room for transporting a [crew](#) member.

**More information:** Keji Wei et al, Modeling Crew Itineraries and Delays in the National Air Transportation System, *Transportation Science* (2018). [DOI: 10.1287/trsc.2018.0834](https://doi.org/10.1287/trsc.2018.0834)

Provided by Dartmouth College

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