Recovery from airline delays works best with future disruptions in mind

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Industrial and enterprise systems engineering professor Lavanya Marla and her colleagues developed a new approach to airline-disruption recovery that could save the industry millions of dollars. Credit: L. Brian Stauffer

Instead of responding to each flight delay as if it were an isolated event,

airlines should consider the likelihood of potential disruptions ahead, researchers report in the journal *Transportation Science*. They developed a new approach that allows airlines to respond to flight delays and cancelations while also incorporating information about likely disruptions later the same day.

Their model suggests this approach could reduce airline recovery costs by 1%-2%, potentially resulting in millions of dollars of savings a year, the researchers say.

Flight disruptions waste precious resources and cost airlines tens of billions of dollars a year, said study lead Lavanya Marla, a professor of industrial and enterprise systems engineering at the University of Illinois at Urbana-Champaign. Because most airports in the U.S. schedule flights to leave or depart every two minutes, delays at one or two major airports can propagate quickly through the system. While some timing buffers are built into the network to allow for minor delays, larger disruptions—for example, those stemming from a powerful weather system in one region of the country—tend to magnify problems across the network of airports as the day progresses.

Understanding these probabilities can help airlines respond to disruptions in a more realistic manner, Marla said.

"We are trying to introduce the idea that we should be reactive and proactive at the same time," she said.

For example, an airplane that is behind schedule could use more fuel to fly faster to make its destination on time, Marla said.

"But if I know that there is a high likelihood that the flight will experience a delay at the other end, I may decide not to waste a lot of money trying to speed it up," she said. "That way, I don't incur those

unnecessary costs."

Airlines can respond to disruptions in a number of ways. They can hold flights so that delayed passengers and crew members can make their connections. They can cancel flights to minimize disruptions elsewhere in the system. They can swap aircraft. They can switch the crew pairings for particular flights. They also can reroute aircraft or change their speed, flight pattern or elevation.

Some options are more disruptive or expensive than others, Marla said. With her colleagues, Alexandre Jacquillat, of the Massachusetts Institute of Technology, and U. of I. civil and environmental engineering graduate student Jane Lee, Marla developed the Stochastic Reactive and Proactive Disruption Management model, which uses estimates of potential future disruptions to choose the least costly options available. It often deliberately introduces flight-departure holds, which are less costly than speeding up the aircraft, canceling flights or swapping aircraft.

"We are going to trade a lot of these very costly measures for a number of strategically placed low-impact approaches," Marla said. "That may result in more delayed flights, but that's because I'm holding these flights deliberately so that my network connectivity is preserved."

The model is designed to minimize an airline's recovery costs, Marla said.

"A solution that's good for the airline might not be good for individual passengers," she said. "But reducing delays on the whole is good for passengers."

Future studies should incorporate data that also prioritizes the needs of airline crews and passengers, she said.

More information: Jane Lee et al. Dynamic Disruption Management in Airline Networks Under Airport Operating Uncertainty *Transportation Science* (2020) DOI: 10.1287/trsc.2020.0983

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