Air Travel with Dummies

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How a team of engineers and mannequins is improving comfort and safety for passengers in airplanes

"This is it," says Byron Jones, professor of mechanical engineering, as he flips several switches. The large, darkened air cabin springs to life with warm electronic hums and the sound of air circulating overhead. Stubby nozzles above passenger seats begin forcefully blowing air downward. Portable lighting rigs illuminate the cabin and its silent, lifeless passengers.

This is a scale-model Boeing 767 passenger cabin. Kansas State University researchers use it as a laboratory to conduct ground-based air cabin research for the Federal Aviation Administration and the commercial air transportation industry.
Ground control
Despite having never left the ground, Kansas State University’s X-lab is already a center of research, by the FAA and as part of the agency’s Air Transportation Center of Excellence for Research in the Inertial Transport Environment, or RITE. Kansas State University co-leads the center with Auburn University and partners with Purdue University, Stanford University, Rose-Hulman and Boston Medical and Health Sciences at the lab, in a core sector of aeronautical research.

This $32,000 space for research lab was previously a showroom for a car dealership and later a children’s dance studio. For the past 12 years, though, the space has been used to conduct research ranging from how diseases spread throughout the cabin to what happens to body heat passengers release.

All are performed with the cabin crew of dummies — some of which sport markers and eyes, others of which contain a working jet engine.

“The space is divided into sections. One section houses large ventilators and ducts blowing air that way and at different concentrations so that researchers could visualize the air movement,” Jones said.

Researchers use this method to test for temperature fluctuations in the cabin as well as a variable for other studies.

Air combat
Using the passenger cabin’s airflow to ventilate or contaminate dummies, diseases and carbon dioxide is a common focus for the team.

Jignesh Arvind Patel, master’s student in mechanical engineering, is studying the effectiveness of the cabin’s ventilation system.

The FAA requires that the heated air and the carbon dioxide passengers generate during flight get mixed with the air from the cabin as soon as possible for contamination experiments. “If someone has a cold and they sneeze, you don’t want those germs to spread among the other passengers,” Patel said.

“Instead, you want to ventilate those germs as soon as possible so that they are removed from the equation.”

To study this, carbon dioxide is injected into the passen- ger cabin in the lab. The carbon dioxide rises to the steady state. Once it was steady, the researchers performed a test to determine how much of the carbon dioxide was removed. “It’s a bit of an extreme scenario with every passenger using a laptop at the same time,” Patel said. “This is ideally what we want because it means that the research is designed for maximum efficiency.”

Another project looked at whether passengers could be getting more than refreshments from the beverage cart. “We were really curious to see if someone on the plane can smell the beverage cart, how far can they detect it and how effectively transported?” Jones said. “Someone had done a mathematical equation that looked at disease dis- tribution on airplanes, but nobody had done experimental measurements on it.”

Researchers built a track down one of the cabin’s seating areas. A dummy was attached to a beverage cart and a electronic control system moved the two up and down, the aisle to mimic the attendant’s route. Carbon dioxide and smoke were released into the cabin, so researchers could visualize the air move- ment.

“We saw that there is so much motion in the cabin’s air from the ventilation system that even if someone smelled on the plane, it is not going to have a significant effect on how contaminants could travel,” Jones said. “There is almost none chance of germs getting a long ride.”

Since then, WSI, a big focus was put on national security and air travel. Researchers have also conducted experiments for air combat research. They have worked on national security and air travel. Researchers have also conducted experiments for air combat research.

We develop the experiment, then we develop the environment, we develop the experiment, then we test it and analyze the data from that experiment so we can make inferences. In the next year, we’re going to be doing a lot more of this. We’re looking at the effects of having a vaccine and a test, so that researchers could then develop the cabin comfort.

Engine safety
Shahin Nayyeri Amiri, instructor of civil engineering, works with a jet turbine engine in one of the lab’s small labs. He is looking at whether chemicals and toxic par- ticles in the plane’s fuel and oil can contaminate the passenger cabin or if one of the engines has a leak.

“There are several case studies in which passengers sued an airline because they reported smelling oil during the flight and then after the flight felt sick and had memory loss,” Nayyeri Amiri said. “These passengers reported that they could smell oil at the site of the leak. It’s something that’s hard to prove because you can’t see it, you can’t hear it, you can’t smell it.”

Airplanes do not have an air-conditioning system. The turbine engines that propel the plane also compress fresh air from outside the craft into the passenger cabin to cool it. If oil or fuel leaks into the engine as it’s compressing air, carbon and particles from those fluids can be released inside the passenger cabin, Nayyeri Amiri said.

To study the particles, Nayyeri Amiri relies on a turbine engine and an air simula- tion system. Many different engines have different concentrations through temperatures and pressure adjustments. Oil and fuel are then injected into the engine and Nayyeri Amiri looks at what happens during combustion.

While he cannot speak to the medical effects, Nayyeri Amiri and colleagues have published multiple studies on their findings about various particles and chemicals that are released.

“If an engine already has a leak, this kind of thing will not happen,” Nayyeri Amiri said. “But if there is something wrong with an engine, even a small amount of oil may leak out of it, and that could cause a problem.”

The FAA is working to develop sensor technology that can detect the source of a leak and automatically turn air compression off for the affected engine.