

## Air transportation

2003 was a year of continuing challenges for air transportation, principally in terms of security and profitability. Many airlines continued to face complex economic challenges. Passenger levels were down significantly from early 2001 because of the global economic downturn, terrorist actions, the war in Iraq, and SARS (severe acute respiratory syndrome).

However, the cyclical nature of the air transportation industry suggests that demand will eventually rebound and then continue to grow. So while airlines struggled to sustain themselves through this difficult period, the FAA and NASA continued their efforts to re-design the U.S. national airspace system to ensure that it can meet future capacity demands while enhancing safety. Across the Atlantic, the European Community began funding new research initiatives to improve the capacity and safety of their air transportation system. In the Middle East, the U.S. military greatly expanded the scope of its cargo airlift operations.

### Airline challenges

The airline industry had a difficult year, characterized by low revenue and low yield for most carriers. While passenger loads were up relative to 2002, they were still significantly lower than in the boom years prior to 2001. This year marked the capture of an unprecedented market share by low-cost carriers, who now transport more than 25% of passengers in the domestic market. Major airlines, facing competition from low-cost carriers in high-yield markets, continued to cut their costs aggressively through measures such as reductions in labor costs and increased reliance on information technology for the marketing and sale of tickets. Other cost-cutting measures include self-service passenger check-in facilities and the introduction of regional jets into markets that can no longer support larger aircraft.

*Water vapor condensation visualization shows wing-flap wake vortex core.*



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Both of the largest domestic carriers contemplated bankruptcy, with United Airlines ultimately filing for bankruptcy protection under Chapter 11. Major airlines continued the trend of contracting with regional airlines to provide feeder routes to their larger airport operations. Delta Air Lines pursued an alternative approach, launching Song, its low-fare subsidiary, in June. Conversely, regional operator Atlantic Coast Airlines initiated plans in August to end its profitable role as a United Express carrier and become an independent low-fare airline.

### Safety initiatives

The FAA released a roadmap for the development of air traffic procedures that pilots can use with on-board technology for more accurate and predictable navigation. The agency's Required Navigation Performance program provides a high degree of precision, enabling greater safety in approaches to airports.

Small aircraft suffer the greatest number of accidents per miles flown. This is particularly true in areas such as Alaska, where mountains, snow, and frequent fog contribute to hazardous conditions. To increase small aircraft safety, the FAA is implementing the Capstone program to increase pilots' situational awareness via integrated displays of weather, satellite-based navigation, data link communications, and positions of other aircraft for avoidance. The first commercial flight of a Capstone-equipped aircraft occurred in March, as the FAA demonstrated Phase II of the Capstone program in Alaska.

Limited visibility is one of the greatest contributing factors in fatal aircraft crashes. NASA is collaborating with industry to help create a revolutionary synthetic-vision-based cockpit display system for preventing such accidents. Data from GPS combined with accurate terrain databases will be used to generate a dynamic 3D synthetic view on a cockpit display to assist pilots flying under reduced visibility conditions.

To enhance pilot training, Alaska Airlines integrated its databases in the Flight Operations Div. and the Safety Div. Data mining has been used to design annual recurrent pilot training. The result is targeted training based on empirical performance data that indicate areas where training is needed most.

### Initiatives to increase capacity

NASA and the FAA have proposed a research plan to address separation requirements for wake vortex avoidance. These safety requirements have the undesirable side effect of reducing airport arrival rates during instrument meteorological conditions (IMC), thereby decreasing

system capacity. The NASA-FAA research plan includes near-term solutions, such as modification of the 2,500-ft separation standard for independent operations on closely spaced parallel runways during IMC; midterm solutions such as use of weather-sensitive procedures to account for crosswinds; and far-term solutions, such as a dynamic wake-avoidance tool to optimize in-trail spacing based on weather conditions. Successful implementation will require knowledge about the safety level of new technologies and procedures. A primary objective of the overall research plan is to estimate safety levels related to wake vortex encounters.

NASA's Advanced Air Transportation Technologies project continued working toward the goal of improving the capacity of transport aircraft operations in the national airspace system by developing a suite of decision support tools to assist air traffic controllers:

- The Direct-To Tool (D2) is a radar controller tool capable of providing rapid-update tactical conflict information, time-saving (wind-favorable) direct-route advisories, and a highly dynamic interactive trial planning function. All D2 functionalities are designed to be fully integrated with the radar (R-Side) controller's primary traffic display. A series of high-fidelity controller-in-the-loop simulations conducted this year at the FAA Technical Center demonstrated the suitability and potential benefit of D2 for the R-Side controller position at en-route traffic control centers.

- The En-route Descent Advisor (EDA) is a tool designed to help controllers efficiently guide aircraft that are subject to arrival metering during high-demand periods. A recent human-in-the-loop simulation, conducted at NASA-Ames with FAA controllers, indicated that EDA has the potential to increase throughput and efficiency while reducing controller workload. Simulation results will be used to refine design requirements aimed at developing EDA as an operational controller tool.

- Regional metering (RM), an extension of the Multi-Center Traffic Management Advisor, proposes to use time-based metering to achieve conformance with arrival and en-route constraints. Fast-time simulations of the RM concept conducted earlier this year indicated the potential for greater efficiency—in terms of reduced delays and reduced number of controller actions—than the currently used miles-in-trail operations.

### European research

To achieve the objectives described in the report "European Aeronautics—A Vision for 2020,"



*A C-17 Globemaster III undergoes loading operations at an overseas "hub" location while another returns from an Operation Iraqi Freedom mission. Photo by Capt. Ravi Chaudhary, USAF.*

the Advisory Council for Aeronautics Research in Europe (ACARE) released requests for proposals this year. Established in mid-2001, ACARE has prepared a strategic research agenda (SRA) to provide a framework for potential solutions and a research/technology roadmap for realizing the vision described in the report.

The research areas and scope for aeronautics, consistent with the SRA and funded at 840 million (\$992 million), are: strengthening competitiveness of the manufacturing industry; improving environmental impact regarding emission and noise; improving aircraft safety and security; and increasing the operational capacity and safety of the air transportation system.

### U.S. military air transportation

This year Operation Iraqi Freedom marked a critical expansion of the "hub-and-spoke" concept of military airlift operations previously applied during Operation Enduring Freedom in Afghanistan. The first phase in this method of air mobility was the transatlantic shuttle of C-5, C-17, and civil aircraft from U.S. military bases to hub locations in Europe. After arrival at European bases, cargo was transferred to C-141, C-17, and C-130 aircraft for theater tactical delivery into austere airfields (spoke locations). At these spoke locations, airmen quickly transitioned from standard Eurocontrol operations to the fluid environment of tactical airlift. Aircrews conducted operations almost exclusively at night, using night-vision goggles and specialized tactics geared toward mitigation of threats from hostile forces.

Operation Iraqi Freedom nearly doubled the throughput of cargo at hub-and-spoke locations. On June 8, Charleston AFB, S.C., recorded a single-day throughput of 842 tons of cargo, approximately equal to a single month of airlift activity recorded during Operation Enduring Freedom. For Air Mobility Command as a whole, hub-and-spoke operations for the two military operations became the second-largest military airlift effort in aviation history, surpassed only by the Berlin Airlift. ▲