Committing to automation

Technologies influence hand-flying skills, ATC safety nets, airport moving maps and runway-debris detection.

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Complications often emerge when commercial air transport adopts new automated systems, several presenters said at Flight Safety Foundation's International Air Safety Seminar (IASS) Oct. 23–26 in Paris. Among examples cited were difficulties for airline pilots compelled to hand-fly transport jets in response to "automation exceptions," air traffic control (ATC) systems that generate unwarranted/nuisance short-term conflict alerts (STCAs) and runway surface radar that occasionally misreports the presence of debris that could cause foreign object damage (FOD).

Automation Exceptions

Flight crews accustomed to "glass" flight decks can counteract subtle degradation of their basic instrument flying skills by periodic hand-flying practice during line operations under approved conditions, said Capt. Dennis Landry of the Air Safety Committee and Northwest Airlines Master Executive Council of Air Line Pilots Association, International. "Exclusive use of automation during normal operations can result in degradation of the ability to precisely maneuver the aircraft without automation," Landry said in a proposal to the industry. Initial practice six times a month, then 15 to 30 minutes once or twice per month should be sufficient, he said.

Although flying without the autopilot, autothrottles and flight director — for example, during climb from 10,000 ft until entry into reduced vertical separation minimum airspace in visual meteorological conditions

Speakers from left, Landry, Bourdais and Patterson

Photos: Wayne Rosenkrans

— sharpens skills and "control feel" for takeoff and landing, the primary objective is to establish a practice regime of rule-based behaviors that helps pilots effectively allocate attention to flight-path issues. Landry defines automation exceptions as events that may compel pilots to revert to operating the airplane either without automation or contrary to automation-directed flight paths. These situations include "flight management and guidance computer systems or flight management systems that are not operationally stable or require pilots to create workarounds for system deficiencies [such as faulty software modifications]; go-arounds that are not flown as programmed; partial or full pitot-static system failures; traffic alert and collision avoidance system resolution advisories; precision radar monitor instrument approach system breakout maneuvers; [terrain awareness and warning system] escape maneuvers; 'slam dunk' [visual] approaches; abbreviated instrument approaches initiated from altitudes considerably above the normal descent profile; rapid-decompression descents; and ATC instructions requiring divergence from planned or assigned flight paths."

Correct action is essential if the flight crew confronts an automation exception, he said. Without awareness and practice, "blind over-reliance" on automation can generate subconscious complacency, reluctance or unwillingness to override guidance displayed by the flight director. "Disregarding or eliminating the automation … often presents the best, if not the only, option available," he said.

Landry said that the airline industry and regulators would have to conduct formal research and development, and create policies and guidance to establish the proposed practice regime.

Ground-Based Safety Nets

Nuisance STCAs have inhibited efforts by 60 European air traffic service providers to employ four ground-based "safety nets" — that is, system safety defenses based on automation — to reduce the risk of midair collisions, said Martin Griffin, ATC domain manager for Eurocontrol. In addition to STCA, the most mature safety net, others are the minimum safe altitude warning (MSAW), approach path monitor and airspace penetration warning systems. STCA has been mandated, and standardized implementation has been expedited as a pan-European safety objective for 2007–2011.

"The main challenge is to find the optimum balance for a particular local situation between minimizing the number of nuisance alerts and maximizing the warning time when tuning the different STCA parameters," Griffin said. "There is also a dire lack of training for controllers on STCA. This occurs because we have no standard for STCA or safety nets in Europe. Sometimes controllers didn't even realize that they had STCA functionality [or they] had it turned off." Other air traffic controllers have reset STCA parameters so that this radar software functions only as an ATC decision-support tool for routine operations. Particularly troubling from a 2004 survey of air traffic service providers were vague decision-making processes and lack of purpose regarding safety nets among ATC safety managers. "Safety nets come in almost 'automatically' when ATC systems are renewed or upgraded," Griffin said.

Some survey respondents suggested downlinking resolution advisories (RAs) from airborne collision avoidance systems (ACAS) to ATC facilities; Eurocontrol so far has verified the technical feasibility of doing this via data link but with an eight-second delay. Related studies were pending at the end of 2006. "While STCA and ACAS are typically expected to be complementary, dependent on conflict geometry, they sometimes necessarily operate in the same [five-second] time frame, which can be dangerous," Griffin said. "Controllers often are oblivious that an RA has been given to the pilot." Eurocontrol's Safety Nets Planning Implementation and Enhancements Task Force, which conducted an international workshop in October 2006, believes that safety net improvements can be achieved primarily through standardization by the end of 2008.

Airport Moving Maps

Automation that displays guidance to airline flight crews for precise all-weather taxiing was introduced in 2003 by a few airlines to help reduce runway incursions. This airport moving map technology will be standard on all-new airliners such as the Airbus A380 and Boeing 787, and will be available for retrofitting other types, said André Bourdais, an Airbus navigation engineer. Airport data for about 300 air

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carrier airports already are available. As with selection of appropriate automation modes/functions for flight-path control, however, airport moving maps require correct mode selections. After a mode has been selected, a range can be selected for a strategic or detailed view of the airplane's surroundings.

"Installations are either done as an additional mode on the [forward-facing] navigation display (ND) or as a function on the [side-facing] electronic flight bag (EFB)," Bourdais said. Airport moving maps are being designed as the "cornerstone" of coming software enhancements for display of taxi routing, collision avoidance and weather overlays, he added.

"[Improved situation awareness] is achieved by an adapted depiction of a digital airport map [an assembly of several geometrical figures (points, lines or polygons)] merged with aircraft current position and heading," he said. Any airport database compliant with recently adopted standards can generate accurate displays at any desired size or resolution, with intelligent decluttering that helps the flight crew view and interpret only the graphical objects, labels and symbols relevant to the immediate task. "Runway labels are made to always be visible on the map to promote maximum awareness so that pilots can anticipate arrival at intersections and know they are close to a runway," Bourdais said. "Smooth transitions [between different modes and ranges] ensure that pilots never lose visual contact during all taxiing phases."

When automatic dependent surveillance-broadcast (ADS-B) becomes available, upgraded airport moving maps probably also will enable flight crews to observe real-time movement of surrounding aircraft and vehicles, perform evasive maneuvers and receive ground-conflict resolution advisories. ATC clearances involving the airport surface also could be data-linked to the display.

Fine-Tuned Debris Alarm

In 2001, Vancouver (British Columbia, Canada) International Airport Authority and radar specialists at QinetiQ decided to adapt millimetric wave radar and automation to remotely detect debris as small as the cap of a ballpoint pen on paved surfaces. But the potential for false alarms — defined as "any time a FOD retrieval person responded to reported [debris] coordinates and found no debris" — was an early concern, said Brett Patterson, the airport's director of operations safety planning. False alarms have been caused by things such as hangar doors opening and helicopter rotor-blade scintillation. Two incidents involving debris on runways in 2000 — one involving large pieces of an Airbus A330 engine cowling and the other a large aluminum tube from a de Havilland Dash 8 — had convinced the authority to pursue a technologically advanced runway debris-detection method.

Investigators found that human factors reduce the effectiveness of conventional surface-inspection methods. These include individual attentiveness, variations in basic visual acuity, non-uniform visual sampling, inadequate sensitivity to visual contrasts and poor visibility of debris during nighttime and adverse conditions of all-weather operations in Vancouver. "[A] relatively small area of focus, coupled with the fact that the individual performing the runway check is in a moving vehicle, makes a comprehensive scan very difficult," Patterson said. Even adhering to the international recommendation to inspect each runway every six hours, Vancouver's runways are "known to be clear for only 0.5 percent of any 24-hour period."

In 2006, each of two parallel runways received two radar sensors positioned approximately one-third of the total runway length from each threshold. Called QinetiQ Tarsier, the system was in initial operating capability mode at the end of the year. Each sensor has power output equivalent to a mobile phone and has no effect on other airport systems. Employees in the airport operations center advise ATC and request runway closure only if a visual/audible alarm occurs. After debris removal, radar confirms that the runway is clear before reopening.

"FOD radar has consistently identified [runway debris] before pilots or airport personnel, even during daylight, and it provides responding personnel with the latitude and longitude coordinates of the [debris] to within 3.0 m [9.8 ft]," Patterson said. Short-term plans call for software versions that distinguish large versus small FOD-radar targets, improve record keeping and control the lens of a video camera at each radar sensor antenna tower — based solely on radar-generated position coordinates — to transmit sharp magnified video images for risk assessment. ●