MONITORING ATC OPERATIONAL SAFETY

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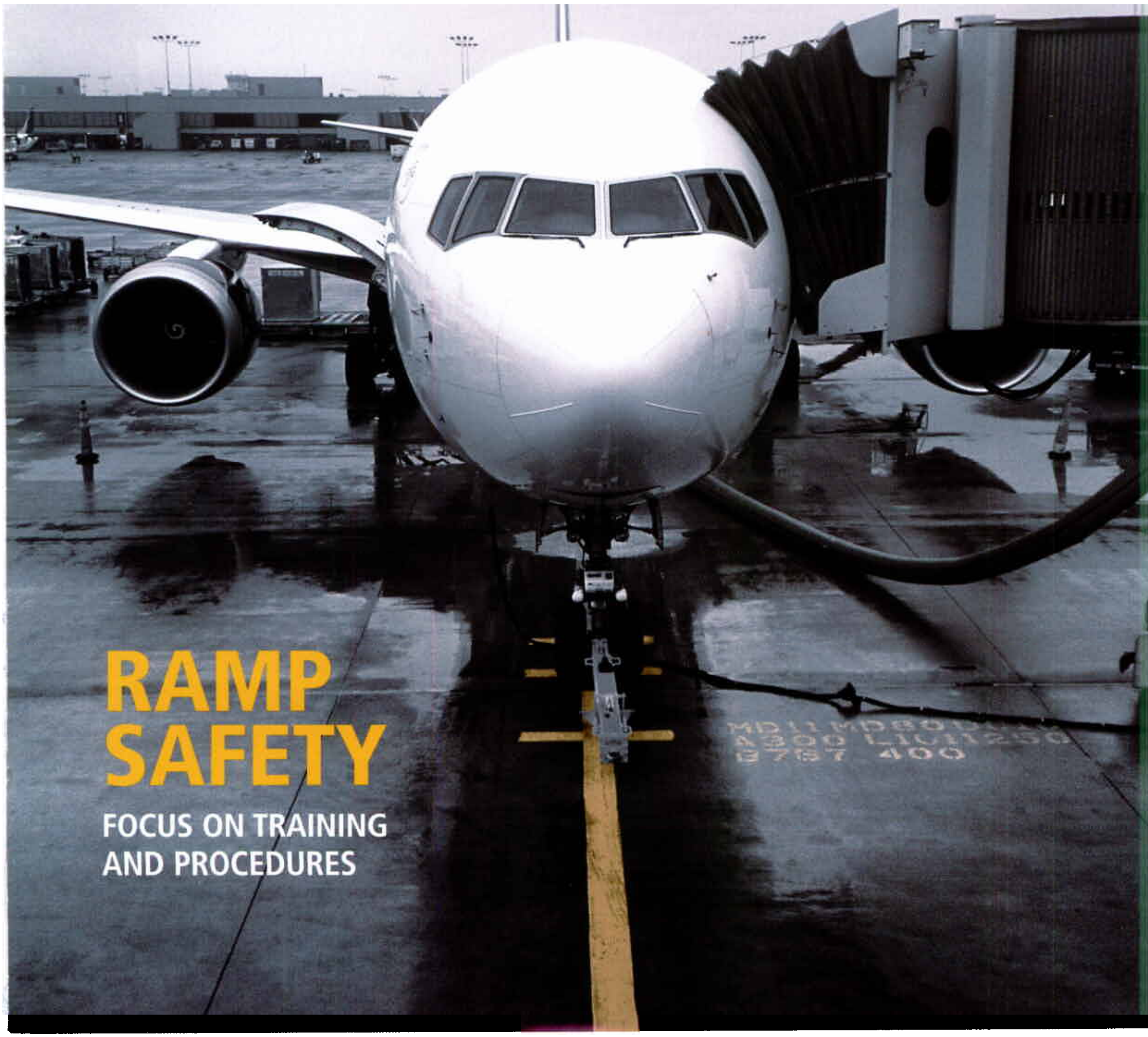

RAMP SAFETY

FOCUS ON TRAINING AND PROCEDURES

ICAO examining ways to monitor safety during normal ATS operations

One concept under consideration is an air traffic control safety data collection tool that would provide robust data on everyday threats to safety managers. Analysis of such data may help focus the safety change process on areas that require the most attention.

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ICAO is examining ways to apply a safety concept proven in flight operations to the monitoring of air traffic services (ATS) operations. The process involves collecting safety-related data from normal operations to identify safety threats that might not otherwise come to the attention of safety managers.

An informal action group* formed by ICAO in late 2003, with participation from ATS providers, regulators, system manufacturers and researchers, has begun developing guidance material that could be used by States in setting up programmes for monitoring safety in ATS operations. For now, the focus is on air traffic control (ATC) operations, but eventually the group may examine safety monitoring for other components of the ATS system, specifically the flight information service, alerting service, and air traffic advisory service.

One concept the ICAO group is now evaluating is an ATC safety data collection tool known as the normal operations safety survey (NOSS). As with the Line Operations Safety Audit (LOSA) programme that has been successfully implemented at a number of airlines for monitoring safety on the flight deck, NOSS would be based on a human factors tool known as the threat and error management (TEM) model.

While analysis of LOSA safety data has provided airlines with important insight into the threats and errors that flight crews have to manage in their day-to-day operations, LOSA could not be applied directly to the ATS environment because ATC operations differ significantly from flight operations. For one, the number of staff involved in an ATC operation can be much larger than the crew on a flight deck. However, the operating characteristics of the tool for ATC operations can be very similar to those of LOSA.

In its anticipated form, NOSS would entail over-the-shoulder observations during normal shifts and would not be allowed in any training situations. The programme would require joint sponsorship from management and the association representing air traffic controllers. All participation would be voluntary, and data collected would be de-identified and treated as confidential and non-disciplinary. NOSS would use a standard observation form, trained and calibrated observers, trusted data collection sites, and a data "cleaning" process. In addition, it would spell out targets for safety enhancement and provide feedback to participating controllers.

The idea behind NOSS is to furnish the ATC community with a means for providing robust data on threats to safety managers. Analysis of NOSS data, together with safety data from conventional sources, should make it possible to focus the safety change process on the areas that need attention the most. This is precisely what airlines have succeeded in doing by adopting LOSA.

As noted above, the ICAO study group has adopted a variation of the TEM model as the basis for NOSS. This is a conceptual framework for identifying threats and errors that must be managed by operational personnel. In the case of ATC operations, the model identifies "safety threats" as any factors external to the air traffic controller that increase

operating complexity. Threats diminish the margin of safety but must be handled by controllers as part of their normal work shift. Among examples of threats to safe ATC operations are the use of similar call signs, non-standard local procedures, system malfunctions and airspace restrictions. Different threats can characterize the aerodrome and radar environments.

In addition to dealing with threats on a daily basis, controllers also manage errors. Errors in this context are defined as actions or inactions by controllers that lead to deviations from organizational or controller intentions or expectations. An example of an error would be a controller's failure to rectify an incorrect read-back by a pilot.

The third component of the TEM model is the undesired state. In the ATC context, this is defined as an operational condition where errors by controllers place air traffic in a situation of unnecessary risk. As an example, an undesired state exists when an aircraft climbs or descends to a level other than the one the controller expects because the controller missed and did not rectify an incorrect read-back by a pilot. A list of possible undesired states in the ATC domain appears in the accompanying table.

Jim Jorgenson

The use of the TEM model is intended to make error management concepts explicit to air traffic controllers. Most important, however, the TEM model develops a conceptual awareness of threats. While the TEM model is already well known within the airline community, it is essential to introduce it to the worldwide ATC community as well. One way of achieving this is through the integration of the model into human performance training for air traffic controllers. In particular, team resource management (TRM) training programmes that ATS providers have in place appear to be an appropriate launching pad for this initiative. ICAO will initially support the global introduction of the TEM model in ATC operations through a circular on the subject that will be published in early 2005.

The usefulness of applying the TEM model to ATC operations can be illustrated by reviewing an actual loss-of-separation incident, in this instance involving a Boeing 747 and Piper Malibu heading towards the same navigation beacon after departing from separate airports. Aware that the Malibu's flight plan conflicted with several departures from the international airport, the approach controller failed to maintain separation between the aircraft after he forgot to instruct the Malibu to turn southwest some 3 nautical miles (NM) before reaching the beacon.

After noting the Malibu's flight plan conflict and its resolution, the approach controller became involved in handling other traffic. This required a phone call to the adjacent area control centre about a commuter aircraft which was operating on a non-standard routing, and whose flight path conflicted with a Boeing 737 inbound to the international airport. The second conflict was situated at the terminal control area (TMA) boundary, on the edge of the normal radar range on the approach controller's radar screen. To deal with this problem, the controller had to change the range of his radar screen and call up a different menu.

When he was contacted by the departing B747, the approach controller cleared the flight to continue on the standard instrument departure route while forgetting his initial plan to turn the Malibu before the navigation beacon. As a result, the departing aircraft and the Malibu would reach the beacon from opposite directions at approximately the same time and altitude. By the time the controller remembered the conflict and instructed the B747 to turn, it was too late to prevent a hazardous situation. Separation was reduced to 0.5 NM laterally and 370 feet vertically, and the outcome might have been a mid-air collision had the Boeing's pilots not responded to an airborne collision avoidance system (ACAS) warning in the cockpit.

A proposed programme for collecting safety data based on observing controllers at work would guarantee full confidentiality. All data collected would be de-identified and used solely to highlight safety enhancement targets.

This incident cannot be fully appreciated without some details about what transpired in the control room at the time it occurred. First, as a consequence of a problem the controller experienced while trying to input information about the Malibu into the computer system, the navigation beacon was not visible as a routing point in the radar label of the aircraft. Second, the coordination between the approach controller and adjacent area control centre involved a form of miscommunication: although both controllers were uncomfortable with the non-standard handling of the commuter aircraft and the B737, neither voiced his concern. Third, because of this latter situation, the approach controller was confronted with a new conflict at the TMA boundary requiring that he change the range of his radar screen and enter another menu for inputs in the system. This did not automatically turn back to the main menu later. As a consequence of this system design feature, when he attempted to make another input in the system for the B747, the range inadvertently changed in a manner that distorted the radar picture. Finally, distraction was a factor. Two visitors were in the control room at the invitation of the approach controller. However, a colleague who was disturbed by their presence ordered the visitors to leave in a very explicit way, a situation that the approach controller found embarrassing.

An analysis of the incident, applying the TEM model, highlights several threats and errors. The threats included two design features of the automated ATC system (leaving a menu page open after a selection has been made, and the difficulty in making the input for the Malibu routing) as well as the visitors to the control room. Among the errors identified are the miscommunication between the controllers, the failure to turn the Malibu as intended, and the input made by the approach controller resulting in an inadvertent range change of the radar picture. The consequence was an undesired state,

Configuration
Incorrect configuration - ATC system radar range selection (conflict pairs not discernible or outside range)
Incorrect configuration - aerodrome (runway lighting; navaids including ILS; stopbars; PAPI; etc.)

Ground Situations
Aircraft cleared towards wrong runway
Runway incursion (taxiing aircraft)
Aircraft cleared towards wrong taxiway / ramp

Instructions to Aircraft
Wrong altitude/level assigned
Late descent
Incorrect heading assigned
Late interception turn (e.g. for ILS approach)
Unnecessary weather penetration
Unauthorized airspace penetration
Speed restriction not cancelled

Runway Operations
No landing clearance given
Aircraft cleared for take off/landing with obstructed runway

Coordination
No coordination done
Coordination with wrong agency
Incomplete coordination (insufficient or incorrect details)

Examples of "undesired states" that can arise in ATC operations

an operational condition where both the B747 and the Malibu were flying to the same navigation beacon without any separation provisions in place.

One feature that makes the TEM model a powerful instrument for safety management is that even simple analyses like the one above provide ATC safety managers with information to initiate actions to improve safety, by focusing on the identified threats. Safety enhancements resulting from the example of this incident could include designing changes to the automated system (e.g. have the menu page return to the default after an input is made). Changes could also include having all waypoints required for the approach function available in the menu for the approach controller. Further safety changes could include a re-design of the airspace by creating segregated routes for traffic from the domestic airport and the international airport. Another possible safety enhancement might involve implementing a policy on visitor access to the control room.

The same model can of course be applied to normal ATC operations to proactively identify threats and errors and strategies for addressing them. But before NOSS observations can proceed, there are many issues, some of a technical nature, that need to be resolved.

One question concerns the number of observers that would be required for a NOSS session. In the LOSA programme, a single observer is all that is required, but this would probably be insufficient in the environment of an area control centre.

There also is a need for appropriate post-observation clarification between the observer and the controller. There may be situations where the NOSS observer is uncertain on how to interpret a specific traffic scenario, in which case a word from the controller could be helpful. Conversely, asking a controller to provide clarification during the session could be seen as interference with the "normal operations" context that NOSS is trying to capture. In further evaluating this, it should be kept in mind that the primary objective of LOSA and NOSS are to "capture" threats, not count errors. This is because safety management strategies are best directed against systemic threats rather than errors.

Questions may arise about the feasibility of providing external NOSS observers with the requisite amount of local ATC knowledge to guarantee the validity of their observations. Given that the primary objective of NOSS is to capture data about situations that increase the operational complexity of specific ATC units, it is important that NOSS observers have a solid background and operational experience in air traffic control.

The role of the regulator is another subject that needs to be addressed. In some States, for example, the ATS provider and the regulator belong to the same organization.

The issue of the data collection site and storage has significant legal liability implications. If an ATS provider decided to store NOSS data in-house, could it become publicly available under freedom of information legislation, compromising NOSS confidentiality? LOSA data is centrally stored and aggregated, guaranteeing its protection. A similar scheme will likely be necessary for NOSS.

The optimal duration of a NOSS observation session will require some thought. A typical LOSA observation covers all ground phases of flight as well as selected phases of the cruise element. Since phases are less readily identifiable in an ATC environment, it may be necessary to define a desirable time span for an observation session.

These and other issues will be discussed at the first formal meeting of the NOSS Study Group in Montreal in July 2004. A worldwide conference on TEM/NOSS, possibly as early as 2005, is also under consideration. □

*The informal action group has evolved into a formal study group known as the Normal Operations Safety Survey Study Group (NOSSG). NOSSG will convene its first meeting at ICAO headquarters in July 2004.

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