Skills in Depth

For optimum performance, intangibles supplement technical expertise.

BOOKS

Safety at the Sharp End: A Guide to Non-Technical Skills

Flin, Rhona; O'Connor, Paul; Crichton, Margaret. Aldershot, England, and Burlington, Vermont, U.S.: Ashgate, 2008. 329 pp. Figures, tables, references, index.

Non-technical skills, in this book's context, are the cognitive and social skills that complement technique. In aviation, where engineering design and human technical proficiency are usually reliable, further safety enhancement often depends on improving non-technical skills.

The book is organized under seven headings: situation awareness, decision making, communication, teamwork, leadership, managing stress, and coping with fatigue.

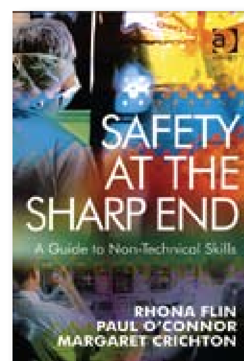
Decision making, frequently cited as a factor in accident reports, exemplifies a non-technical skill that is critically important in aviation safety. It can involve extremely complex situations, multiple sources of information, missing information, unexpected events, several simultaneous stimuli, past experience, time limitations, weighing the odds of possible outcomes, and many other factors for which no classroom or textbook can fully prepare an individual.

"Decision making in time-pressured, dynamic work environments has attracted the attention of psychologists specializing in the study of human performance. They discovered that classical (i.e., rational or normative) decision theory was of limited application to uncertain, time-pressured settings, where reaching a satisfactory solution to gain control of a problem tends to be the norm — as opposed to trying to reach an optimal or perfect solution."

Dynamic decision making, the kind that operators usually need to perform, can be looked at as a two-stage process: (1) situation assessment, or understanding what the problem is, and (2) choosing a course of action, or deciding what to do.

"The first step of the decision-making process is diagnosing the current situation," the authors say. "At this point, the decision maker, often with a team involved, builds a mental model to explain the situation encountered. … If the situation assessment is incorrect, then it is likely that the resulting decision and selected course of action that is taken in response will not be suitable."

A wrong assessment can result from a number of factors: "Cues in the situation may be misinterpreted, misdiagnosed or ignored, resulting in an incorrect mental picture being formed of the problem. Alternatively, risk levels may be miscalculated or the amount of available time may be misjudged."



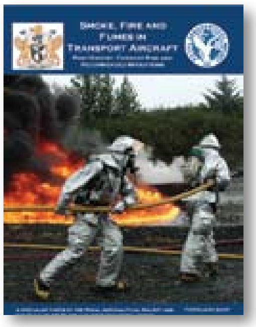
The authors cite a study by a psychologist team of pilots' decision making. "They have observed pilots flying in the simulator and have also examined reports of problem situations causing accidents and near-[collisions]," the authors say. The study showed that "the estimation of available time and level of risk during this situation assessment is critical, as this determines the type of decision method the pilot will then adopt. … Where there is very little time and high risk, pilots use faster strategies, such as applying a known rule. When there is more time (even with variable risk), they may opt for a slower but more rigorous choice method to compare and evaluate alternative courses of action.

"In terms of time estimation, studies from aviation … indicate that experienced practitioners tend to be more accurate with estimates of available time than less experienced colleagues, the latter tending to underestimate this. Experts tend also to be aware of more strategies that they can use to 'buy time' in a problem situation."

Choosing a response to the situation assessment involves four principal methods, the authors say: recognition-primed or intuitive, rule-based, comparison of options and creative.

"In the recognition-primed and rule-based methods, only one response option is considered at a time," the authors say. "In choice decision making, several possible courses of action are generated, then compared simultaneously. In the creative option, the situation is judged to be so unfamiliar that it requires a novel response.

"In some situations, doing nothing or waiting to see what happens may be the optimal course of action. … However, novices typically experience more stress and, as this appears to be relieved by taking action, they are less likely to wait and watch than experienced practitioners."



REPORTS

Smoke, Fire and Fumes in Transport Aircraft: Past History, Current Risk and Recommended Mitigations

Cox, John M. London: Royal Aeronautical Society and the Guild of Air Pilots and Navigators. February 2007. 64 pp. Photographs, appendixes. Available from the Royal Aeronautical Society.*

The danger of in-flight fire was demonstrated as long ago as during the reign of Louis XVI in France. In July 1785, Jean-François Pilâtre de Rozier's hydrogen balloon ignited and burned over the English Channel.

"The occurrence of smoke, fire or fumes aboard a commercial aircraft presents a potentially dangerous situation. Accident data show in-flight fire with the fourth highest number of onboard fatalities and the seventh highest category of accidents," says Cox. "In addition, data from recent years indicate the probability of passengers experiencing an in-flight smoke event is greater than one in 10,000. In the United States alone, one aircraft a day is diverted due to smoke."

This report examines in-flight smoke, fire and fumes (SFF) from multiple angles: originating locations aboard the aircraft, causation, patterns of propagation, detection, protection and barriers, regulations, maintenance, and pilot procedures.

"A review of the past incidents shows that in-flight fires have continued to occur despite the efforts of manufacturers, regulators and operators," Cox says. "Recently the [U.S.] Federal Aviation Administration (FAA) acknowledged that it is unlikely to 'eradicate all possible sources of ignition in fuel tanks,' and they also state, 'The examinations of large transport aircraft … revealed many anomalies in electrical wiring systems and their components, as well as contamination by dirt and debris.' This acknowledgement is important because it shows the need for multiple mitigations to contend with smoke/fire/fumes."

In-flight fire is particularly dangerous because it can do more than destroy areas directly affected by the heat, Cox says. It can also cause cascading failures of other systems: "The proximity of wires within wire bundles can cause seemingly unrelated systems to fail due to arcing and burning of wires within a single wire bundle. As shown in Swissair Flight 111, the shorting, arcing and burning of wire can cause melting and provide a conductive path for electric power to other wires." Flight 111, in 1998, involved a McDonnell Douglas MD-11 in which an in-flight fire led to loss of control, with 229 fatalities.

In a section headed "Location, Location, Location," Cox describes another threat multiplier in SFF — it is often difficult for pilots to discern where the fire is or, in some cases, to gain access to the space with a fire extinguisher. Thick smoke can hide the source of the fire, and fire extinguishers are most effective when aimed at the source or the base of the fire, Cox says.

Although donning protective equipment enables pilots to breathe even in heavy smoke conditions, it is no help for vision. It might seem natural under such stressful and "blind" conditions to open a window to vent smoke, but that can be counter-productive. "In cases of continuous smoke, no manufacturer suggests opening a window, because it can cause the fire to spread," Cox says. "Several serious in-flight fires show that the flight crews opened the window without improving the visibility significantly and, in some cases, it was made worse. An open window creates high wind noise, which prevents effective communication between crewmembers. The high noise level prevents checklist accomplishment and also prevents a crewmember from assisting the flying pilot during the landing with callouts (which may be vital in the limited visibility of a smoke-filled flight deck)."

SFF accident descriptions and scenarios make grim reading. Still, as Cox points out, regulators have progressed toward mitigation. In September 2005, for instance, flammability requirements for thermal acoustic insulation blankets were upgraded by the FAA, a result of work done at the FAA Technical Center on flammability testing and materials flammability resistance. In July 1986, the FAA issued advisory circular (AC) 25-9 to provide guidelines for certification tests of smoke detection, penetration, evacuation tests and flight manual emergency procedures.

"The final version of AC 25-9A was published on 6 January 1994," Cox says. "The revision from the original AC included recommendations for additional regulatory amendments for improved smoke clearance procedures, adherence to updated [U.S. Federal Aviation Regulations] Part 25 requirements, fire protection, lavatory fire protection, addition of a crew rest area smoke detector certification test, use of a helium smoke generator in testing and a paper-towel burn box smoke generator, but not continuous smoke in the flight deck testing." Cox believes that the lack of continuous smoke generation in testing cockpit smoke clearance — smoke production under current guidelines lasts three minutes — is insufficient.

His recommendations for further reducing the likelihood and severity of SFF are grouped under the categories of equipment design and airworthiness, protective equipment, maintenance, pilot procedures and flight crew training. Some recommendations include:

- "Improve the engineering and installation of wires so that the routing does not endanger, by proximity, any critical system wiring. Evaluate modifications using the same approval process for supplemental type certificate modification as for type certificates";
- "Install fire access ports or dedicated fire detection and suppression systems in inaccessible areas of aircraft";
- "Implement vision assurance technology for improved pilot visibility during continuous smoke in the flight deck";
- "Modify maintenance procedures to minimize the possibility of contamination of thermal acoustic insulation blankets";
- "Implement flight crew procedures for using autoflight systems to reduce pilot workload [in an SFF emergency]. There should, however, be provisions in the procedures for the failure or un-serviceability of the autoflight system";
- "Redesign all transport aircraft checklists pertaining to smoke/fire/fumes to be consistent with the Flight Safety Foundation smoke/fire/fume checklist template. Consider: memory items, prevention of checklist 'bottlenecks,' font size and type, where it should be found (quick reference handbook [QRH] or electronic), smoke removal, number of checklists for smoke/fire/fumes, and the length of the checklists"; and,
- "Ensure that flight crew training includes the proper use of a crash ax, the necessity of proper fire extinguisher operation including vertical orientation, the proper accomplishment (or abandonment) of checklists during simulated smoke/fire/fumes events, the importance of maintaining a smoke barrier during smoke/fire/fumes events and the ineffectiveness of, and potential problems with, opening a flight deck window during realistic line-oriented periodic flight training on a recurrent annual basis."

WEB SITES

NATA Safety 1st, <www.natasafety1st.org>

The National Air Transportation Association (NATA), a U.S. association representing aviation business service providers, calls itself "the voice of aviation business." Members include companies owning, operating and servicing aircraft; air taxi and commuter operators; and fractional ownership management companies.

NATA's Web site notes, "NATA has developed Safety 1st, an innovative line-service proficiency testing program that enhances safety by identifying the knowledge and skills required of professional aviation line-service personnel and assuring their competence through objective testing."

The NATA Safety 1st Web site contains a number of materials available to nonmembers that may be downloaded, printed or read online at no cost. Items include:

- More than 50 free safety posters online, which NATA encourages readers to print and use as safety reminders in their operations. Posters concern activities such as aircraft movement, teamwork, ground control, equipment usage and injury prevention;

- Two online safety newsletters, "Flitebag" (2005–present) and "eToolkit" (2004–present) provide industry and association news, plus articles on topics such as safety and complacency, ramp safety, operational best practices, safety management, and communications; and,

- A training resources list that includes a free three-page ramp safety quiz, a training presentation titled "Safety Guidelines for Non-Employees Working the Ramp for Special Events" and links to safety training materials at other Web sites.

The Safety 1st Web site can also be accessed from NATA's Internet home page: <www.nata.aero>.

NAV Canada, <www.navcanada.ca/>

NAV Canada, Canada's civil air navigation services provider, developed local area weather manuals for its flight information centers. Information initially used for internal training purposes is now available to the public.

Each weather manual comprises five chapters and describes the basics of meteorology, aviation weather hazards, weather patterns, seasonal weather and local effects, and airport climatology for six specific forecasting areas: British Columbia; Canadian Prairies; Ontario and Quebec; Atlantic Canada and Eastern Quebec; Yukon, Northwest Territories and Nunavut; and Nunavut and the Artic.

English and French manuals can be read online, downloaded or printed at no charge. Documents reflect geographical formations and terrain of the areas covered. Nevertheless, general information about ice formation, clouds, wind and other meteorological elements may be applicable in other regions of the world. Manuals contain simple graphics to illustrate weather effects on aviation. ●

Source

* Royal Aeronautical Society
4 Hamilton Place
London W1J 7BQ, United Kingdom
Internet: <raes@raes.org.uk>

— Rick Darby and Patricia Setze