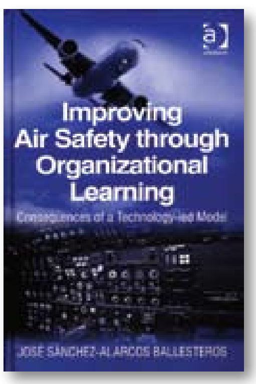
A NEW AVIATION SAFETY MODEL FOR ‘Organizational Learning’

Aviation has been blessed with effective ‘organizational learning’ to reduce accidents, but increasing aviation complexity and the need for greater efficiency may call for new directions.



BOOKS

Improving Air Safety Through Organizational Learning: Consequences of a Technology-Led Model

Ballesteros, José Sánchez-Alarcos. Aldershot, England, and Burlington, Vermont, U.S.: Ashgate, 2007. 188 pp. Figures, references, index.

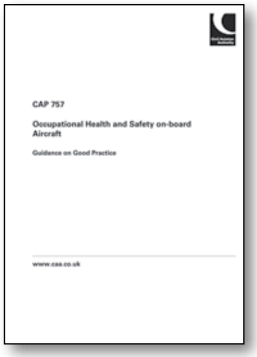
Sánchez-Alarcos, a non-professional pilot and business management consultant and teacher, says that aviation safety and business management models are essentially the same, except that aviation safety “has more pressure and, hence, it has been forced to advance further.” In seeking to apply his insight to business management, he was surprised to find that the application of the aviation safety model to business management met a lukewarm reception, but he found an enthusiastic audience in aviation, including at an International Civil Aviation Organization meeting where he presented his main findings.

Aviation is a high-risk activity, he says — not statistically, but in the sense that “reliability is a more pressing problem than that of efficiency.” The altitudes, speeds, routes, meteorological conditions and other factors involved in flying present risks that must be overcome by reliability.

The development of aviation risk management, which has driven significant improvement in accident rates, can be understood as a model of successful learning, Sánchez-Alarcos says. The model includes pressure from passengers, airlines and politicians, but aviation has been able to benefit from peripheral fields as well: “It has been possible to learn lessons from the military and space fields, useful for the design of new models of airplane, without incurring the costs and risks that a complete … development would represent.” In addition, he says, aviation learning is spurred by the “fluidity” of information in the field, with the results of technical improvements and accident investigations widely and quickly distributed.

This benign model that has served the industry so well is nevertheless threatened to some degree by two factors, Sánchez-Alarcos says: the need for *efficiency* and an increase in *complexity*.

“Once an acceptable level of reliability is reached, the pressures toward increased efficiency in operations can impose themselves,” he says. “As technology improves, the potential


CAP 757
Occupational Health and Safety on-board Aircraft
Guidance on Good Practice
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for safety increases, but this isn't fully used for improvements in safety. The demands of efficiency, that is, improvements in speed, altitude, maneuverability, fuel consumption, reduction in training cycles and the possibility of operating in any meteorological conditions, among others, are present. These demands claim for themselves part or all of the new technological capacity."

The growing complexity of aviation technology involves the problem of systemic risk, he says. With each increase in complexity, the possibility of cascading failure looms larger: "Functionally unrelated systems can be physically close and interact in unforeseen ways." He cites several accidents:

- "The detachment of an engine in an American Airlines DC-10 caused the retraction of the surfaces that provide lift at low speeds and, hence, the destruction of the airplane;
- "A grave failure in the pressurization system in a Japan Airlines Boeing 747 caused the total loss of hydraulic fluid, resulting in losing control of the airplane;
- "An explosion in the tail engine of a DC-10 airplane caused the loss of the hydraulic systems, with loss of conventional control; [and,]
- "A blow-out of a tire was the cause of the accident of a Concorde in Paris. It led to an engine failure and the perforation of a fuel tank. Furthermore, the nebulized fuel escaping from the perforated tank was ignited by the afterburner, starting fire. Finally, the fire and a second engine failure led to the total destruction of the airplane."

Sánchez-Alarcos sees the current model for aviation risk management as having reached a point of diminishing returns, paradoxically in part because it has worked so well. Noting that, after a dramatic improvement, accident levels have remained low but not notably improving for many years, he says, "The experts in quality could explain very well the reduction in improvement levels: when a system has reached a high level of perfection, marginal improvement has a growing cost. If the level reached is considered satisfactory, there would be a clear justification to not incur ever-increasing costs."

Acknowledging that the current risk management model, based on technological and regulatory improvement, has been useful, Sánchez-Alarcos suspects that for further improvement it might be necessary to find an alternative system. "The current situation allows an easy analogy with the functioning of an engine," he says. "More power can be extracted from an engine by introducing a turbocompressor and increasing pressure. When the overpressure is at its limits and even more power is wanted, the solution cannot consist of introducing even more pressure. Where safety is concerned, radical design changes are required, and this is the situation in commercial aviation."

The book examines how the learning model for aviation safety might evolve. Chapters include, "Explanation of the Reduction in the Rate of Learning in Complex Environments," "Organizational Learning in Air Safety: Lessons for the Future," "Meaning and Trust as Keys to Organizational Learning" and "The Future of Improvements in Air Safety."

REPORTS

Occupational Health and Safety On-Board Aircraft: Guidance on Good Practice

U.K. Civil Aviation Authority. Civil Aviation Publication (CAP) 757. August 2007. 36 pp. References. Available via the Internet at <www.caa.co.uk/docs/33/CAP 757.pdf> or from The Stationery Office.*

This updated CAP offers guidance to operators about protecting their on-board workforce, especially cabin crewmembers, from on-the-job injury. Chapters are devoted to "manual handling" — that is, manipulating objects by hand; "burns and scalds in the aircraft cabin"; "slips, trips and falls"; and "control of biohazards."

"Although this guidance is primarily designed for large transport aircraft types, many of the principles contained within it are equally applicable to other types of aircraft," the report says.

The most basic principles are included in a section titled "Overview of Risk Management." Risk management involves two phases, the report says: risk assessment and risk prevention.

Risk assessment, the report says, entails asking questions such as:

- "What are the hazards that arise from the activity, location or task?
- "Who or what can be harmed and how? [and,]
- "Are the risks being adequately controlled? If not, what more needs to be done, by whom, and by when?"

Prevention is said to include:

- "Combating risks at [the] source;
- "Developing a coherent overall prevention policy which covers technology, organization of work, working conditions, social relationships and the influence of factors relating to the working environment; [and,]
- "Giving appropriate training and instructions to staff."

Optical Radiation Transmittance of Aircraft Windscreens and Pilot Vision

Nakagawara, Van B.; Montgomery, Ron W.; Marshall, Wesley J. U.S. Federal Aviation Administration (FAA) Office of Aerospace Medicine. DOT/FAA/AM-07/20. Final report. July 2007. 17 pp. Figures, references. Available via the Internet at <www.faa.gov/library/reports/medical/oamtechreports/index.cfm> or from the National Technical Information Service.**

Optical radiation, including ultraviolet and infrared as well as the visible light spectrum, can have acute and chronic effects on eye tissues if exposure exceeds the eye's normal repair capabilities. Forms of possible degradation include conjunctivitis, which affects the eyelid membranes so that they become inflamed and cause discomfort; photokeratitis, an inflammation of the cornea tissue that results in an aversion to bright light, often accompanied by pain; and cataracts, a progressive clouding of the lens.

The FAA Civil Aerospace Medical Institute measured the transmittance properties of aircraft windscreens for both visible and invisible optical radiation. The sample windscreens included those made of multilayer composite — laminated — glass, from a McDonnell Douglas MD-88, an Airbus A320, a Boeing 727 and a 737, a Fokker 27, an ATR 42 and a Raytheon Hawker Horizon, and those of polycarbonate plastic, from a Beech Bonanza and a Cessna 182.

"This study found that, of the windscreens that were tested, the laminated glass commercial aircraft windscreens transmitted substantial UV [ultraviolet] radiation below 380 nm [nanometers], while the polycarbonate general aviation aircraft windscreens were more effective UV blockers," says the report.

Both types of windscreens blocked most of the UV-B radiation, which is more harmful than UV-A. "On the other hand, since pilots are repeatedly exposed to higher levels of both UV-A and UV-B than those found at sea level, and for long periods, the cumulative effects of UV exposure are still of concern," the report says. "For a pilot, hazardous exposure to naturally occurring UV and visible radiation is most likely to occur when flying over a thick cloud layer or a snow field with the sun at its zenith. Snow reflects 85 percent of visible and UV radiation, while clouds can reflect up to 80 percent.

"In such conditions, sunglasses with a closely fitting wrap-around frame design are best, since UV-blocking lenses are useless if radiation is allowed to enter the eye from the sides of the frame."

WEB SITES

Bureau d'Enquêtes et d'Analyses pour la Sécurité de l'Aviation Civile (BEA), <www.bea-fr.org>

The BEA is responsible for technical investigations of civil aviation accidents and incidents occurring on French territory and represents France in investigations conducted abroad. Its Web site is accessible in three languages — French, English and Spanish — with some unique and some identical information in each language.

BEA's searchable accident reports database contains more than 1,250 reports of accidents that occurred between 1968 and the most recent 2007 updates. Most reports are in French, with a few in English. Translated reports are identified as such. Reports are full-text and may include color photographs and other figures.

Several full-text safety studies are available. Examples include "Study of GPS Events," "Sea Search Operations" and "Flight Data Recorder Read-Out: Technical and Regulatory Aspects."

Select air transport incident reports that involved French operators or occurred in France are presented with the intent of "help[ing] to draw lessons that can prevent similar future events from happening with, perhaps, more dramatic consequences," says the BEA.

The Web site also contains general aviation reports having significant safety implications, annual statistical reports, and the newsletter, *REC Info* (2001–2007), produced by REC (Recueil d'Evénements Confidentiel), the confidential event reporting system.

Australian Society of Air Safety Investigators (ASASI), <www.asasi.org>

ASASI was formed, according to its Web site, "to better serve and represent the views of air safety investigators in Australia." One of the organization's contributions to air safety is co-hosting the Australia and New Zealand Societies of Air Safety Investigators conference; see this month's Safety Calendar (p. 7), listing for May 30–June 1.

PowerPoint presentations and papers presented at these events, 1997–2007, are available online at no cost and may be downloaded or printed. Topics addressed include accident investigation, data recovery and analysis, communication, human factors training, threat and error management, and other safety issues. ●

Sources

* The Stationery Office
P.O. Box 29
Norwich NR3 1GN
United Kingdom
Internet: <www.tso.uk/bookshop>

** National Technical Information Service
5385 Port Royal Road
Springfield, VA 22151
Internet: <www.ntis.gov>

— *Rick Darby and Patricia Setze*