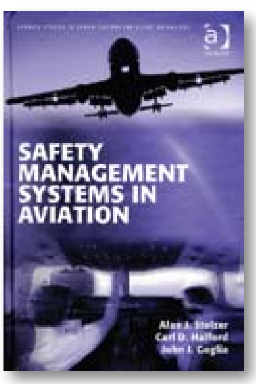
Designing Failure Out

Safety management systems offer a powerful combination of concepts, tools and methods.



BOOKS

Safety Management Systems in Aviation

Stolzer, Alan J.; Halford, Carl D.; Goglia, John J. Aldershot, England, and Burlington, Vermont, U.S.: Ashgate. 321 pp. Figures, tables, index.

It is now widely recognized that for the aviation industry to move beyond its already generally remarkable safety record, and seek the Holy Grail — *zero* serious accidents — the new paradigm will need to be based on foresight rather than reaction and on systemic rather than case-by-case risk reduction. Accordingly, thinkers and practitioners have turned to development of the safety management system (SMS) concept.

The term has become almost ubiquitous in aviation safety circles. Yet, SMS principles and processes are complex — this thorough book leaves no doubt on that score — and not always easy to grasp intuitively or intellectually.

The authors sum up the underlying idea: "SMSs provide organizations with a powerful framework of safety philosophy, tools and methodologies that improve their ability to understand, construct and manage proactive safety systems."

In contrast to what they call the "fly-crash-fix-fly approach" that dominated the safety improvement environment for most of the industry's history, the authors say, "Today we realize that it is much more productive to engineer a system in which, to the extent possible, causes of failure have been *designed out*." Accomplishing that requires "a working understanding of hazard identification, risk management, system theory, human factors engineering, organizational culture, quality engineering and management, quantitative methods, and decision theory." No wonder SMS doesn't yield up its meanings quickly.

The complexity of SMS can be gleaned from the authors' discussion of risk management systems. Noting that traditionally, risk was defined as the severity of an event multiplied by its likelihood, they say:

"Even the best safety analyses a few decades ago were forensic in nature. Note that [the traditional] definition of risk is also. The two measures on which this traditional calculation of risk is based both depend on an analysis of undesired events. Moreover, the data from which these calculations are drawn are historical. For example, suppose a hard landing occurs. A forensic approach to risk analysis would have the safety department look into the various safety databases maintained by the airline, and review the 'hard landing' reports on file."

From there, the safety specialists would create a matrix of the likelihood of such occurrences correlated with their severity. Based on that, most operators would determine appropriate mitigation and allowable time lines for corrective and preventive action, as well as assigning priorities based on relative risks of different kinds of occurrences.

"This analytic approach applied to understanding undesired events is a great improvement over that utilized in the past," the authors say. "However, this traditional 'severity *x* likelihood = risk' calculation is by its very nature backward-looking, and does not by itself capture the essence of SMS. An SMS also accomplishes risk analysis at the *constituent element* level of a system, where hazards are identified. In its most sophisticated form, risk analysis is based on model building, in which estimates of the range of potential severities, possible likelihoods and measures of the effectiveness of those controls put in place to mitigate hazards are allowed to interact with each other over and over in scenario-modeling software, with the result being a prediction of the most probable outcome of events."

The "four pillars" of SMS are designated by the U.S. Federal Aviation Administration in Advisory Circular 120-92, *Introduction to Safety Management Systems for Air Operators*, as policy, risk management, safety assurance and safety promotion. While this "orthodox disquisition" is conceptually sound, the authors say, "the SMS practitioner needs an in-depth understanding of the fundamentals, a comprehension deep enough to be able to enter any organization, at any level, and recognize the elements of a successful SMS as they might exist, in many different forms. Throughout this book, we will use every opportunity we can to take apart SMS and lay the components out on the table in front of us — examining those pieces in detail, and then putting it all back together only to take it apart in a different way. … Just as any complex system can be viewed from a variety of perspectives, each contributing to our understanding of the whole, deconstruction of the components of SMS can help us assure that we have a solid grasp of the discipline."

Conceptualizing and diagramming the SMS process, which the book aims to accomplish, doesn't exhaust the subject, however. There is still room for intuitive understanding.

"Recognizing a vibrant SMS is similar to distinguishing great art — you know it when you see it," the authors say. "Verification of the existence of an SMS is not presently accomplished (nor probably should it ever be) by merely the achievement of having eight of 10 boxes checked on the 'Is There an SMS Here?' form. SMS is far more organic and integral to the fabric of an organization … . But once you are an SMS practitioner yourself, spend a short time visiting an organization with a mature program, and you'll know, because safety management is everywhere you look."

REPORTS

Analyzing Vehicle Operator Deviations

Scarborough, Alfretia; Bailey, Larry; Pounds, Julia. U.S. Federal Aviation Administration (FAA) Office of Aerospace Medicine. DOT/FAA/AM-08/17. Final report. July 2008. 40 pp. Figures, tables, references, appendixes. Available via the Internet at <www.faa.gov/library/reports/medical/oamtechreports/2000s/media/200817.pdf> or from the National Technical Information Service.*

Runway incursions involve not only aircraft, but ground vehicles as well. A vehicle operator deviation (VOD) occurs when a vehicle operator crosses an airport movement area — a taxiway or runway — without authorization from air traffic control.

"In this report, we present the results of an analytical study that examined the types of VODs that occur and recommend a process for improving the manner in which VOD investigations are conducted," the report says.

VODs can be analyzed according to a taxonomy called JANUS-GRO. "The goals of JANUS-GRO were to provide a common human factors framework for identifying human factors trends through better VOD reporting, designing VOD mitigation strategies and evaluating the success of VOD reduction efforts," the report says. JANUS-GRO consists of two broad error categories: factors directly related to vehicle operator performance and factors that contribute indirectly to vehicle operator performance. The first category consists of the task being performed, the mental processes involved and the vehicle operator's compliance with procedures; the second includes factors such as airport configuration, the amount of ground traffic, weather and noise.

VODs are supposed to be reported on FAA Form 8020-24, which records facts such as what happened, the location, the vehicle and aircraft, environmental conditions, information about the ground vehicle operator and pilots, and how the incident was detected. "Based on the information provided in Form 8020-24, we developed a directed model depicting the causal sequence of human factors associated with committing a VOD," the authors say. "We wished to move beyond simply describing VODs to forming predictive models that could serve as exemplars for designing improved VOD mitigation strategies."

A number of hypotheses were developed for testing, such as: "VOD types associated with the failure to follow signals, signs, markings and lighting are more likely related to maintenance and environmental contextual conditions compared to any other VOD type." The hypotheses were correlated with items from the reporting forms for 229 VODs.

Using logistic regression and other statistical analysis techniques, researchers found that "a lack of knowledge associated with the airport layout was instrumental in vehicle operators who completed driver training but became lost and/or were unable to locate the route they were instructed to follow. Knowing this, an airport operations manager could evaluate the airport's vehicle operator training program to determine whether improvements need to be made in how vehicle operators learn the airport layout and/or how they develop driving competencies for operating on and off the movement area."

The researchers found that vehicle operators are not always contacted to learn why they committed a VOD. "Instead, the causal factors are sometimes inferred by reviewing and/or interpreting the vehicle operator's behavior," the report says. "For example, if a vehicle operator committed a VOD as a result of a failure to follow movement area procedures, it may have been inferred that the vehicle operator lacked the knowledge about movement area procedures. However, the VOD may instead have occurred because the vehicle operator was distracted due to thinking about the task that he/she was going to perform after arriving at the destination. Without conducting an interview with the vehicle operator, there is no way to know for certain why the vehicle operator did not follow movement area procedures."

Lack of pertinent information seriously hampers efforts to reduce VODs, according to the researchers. "Our results illustrated that of all the information recorded on the current VOD reporting forms, less than 4 percent [was] associated with the vehicle operator's performance, such as task descriptions, noncompliance issues and mental processes," the report says. It suggests that the JANUS-GRO framework can be a step forward in improving reporting and investigation.

WEB SITES

Aircraft Icing Research Alliance, <icingalliance.org>

Aircraft Icing Research Alliance (AIRA), a partnership of Canadian and U.S. government agencies, says, "Aircraft icing is the most critical natural hazard affecting the safe operation of aircraft in the northern hemisphere." The Web site says that AIRA's mission is "to coordinate among the parties the conduct of collaborative aircraft icing research activities that improve the safety of aircraft operations in icing conditions."

Full-text icing presentations given at previous AIRA research implementation forums and AIRA sessions of the American Society of Mechanical Engineers conferences are available online at no cost. Presenters representing industry and government address icing aspects such as propulsion system icing, the physics of ice adhesion, airframe and engine company perspectives on icing challenges and opportunities, weather forecasting, and icing research.

Membership and collaboration efforts have expanded to include other countries. Collaborative icing research programs, ongoing and in development, are identified. Some listed programs link to presentations, training materials and images.

Source

* National Technical Information Service
Internet: <www.ntis.gov>

— Rick Darby and Patricia Setze