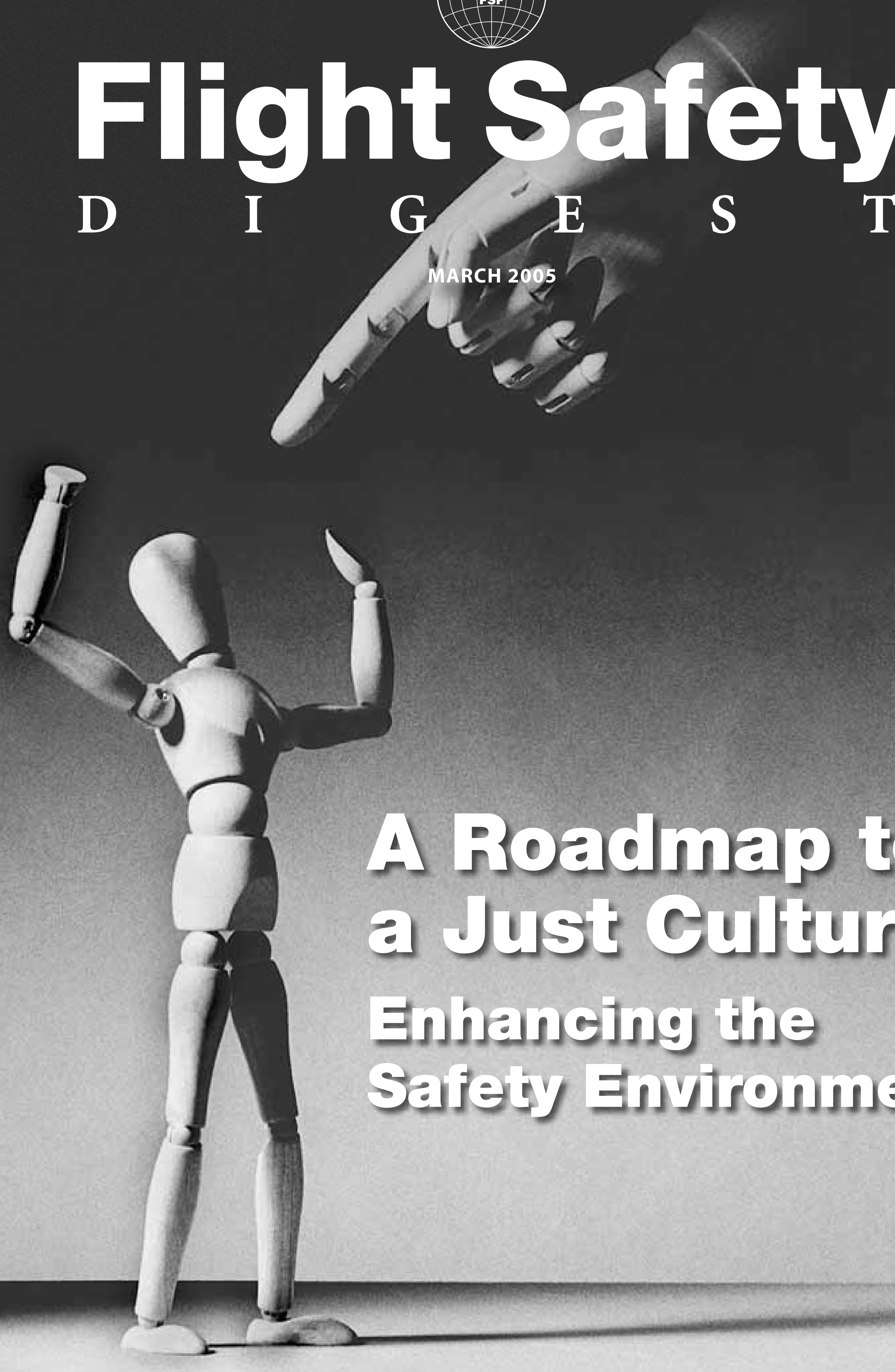
FSF

Flight Safety DIGEST

MARCH 2005



A Roadmap to a Just Culture: Enhancing the Safety Environment

Flight Safety Digest

Vol. 24 No. 3 March 2005

FLIGHT SAFETY FOUNDATION SINCE 1947

In This Issue

A Roadmap to a Just Culture: Enhancing the Safety Environment

Even an organization that promotes a 'no blame' culture cannot tolerate irresponsible or careless acts. This report offers guidelines for a 'just culture' that balances trust, which encourages reporting of safety-related information, with strict but fair consequences for unacceptable behavior.

— GLOBAL AVIATION INFORMATION NETWORK (GAIN) WORKING GROUP E,
FLIGHT OPS/ATC OPS SAFETY INFORMATION SHARING

This report is an overview of how aviation organizations can promote improvements in the level and quality of reporting of safety information. Any effective safety information system depends crucially on the willing participation of the workforce, the front-line workers who are in direct contact with hazard. In aviation organizations, these are air traffic controllers, pilots, flight crews, maintenance personnel and others who can provide key information about aviation safety problems and potential solutions.

In order for these workers to come forward and report errors or mistakes, an organizational climate conducive to such reporting must exist — a just culture.

The report was developed by the Flight Operations/ATC Operations Safety Information Sharing Working Group of the Global Aviation Information Network (GAIN). In providing the report to members of the aviation safety community, the working group hopes to achieve the following objectives:

- Provide an overview of what is meant by a just culture;
- Heighten awareness in the international aviation community of the benefits of creating a just culture;
- Provide a portrayal of just culture implemented in aviation organizations and share lessons learned; and,
- Provide initial guidelines that might be helpful to others wishing to benefit from the creation of a just culture.

To obtain information for this report, the working group conducted a literature review and gathered information from several aviation organizations that have begun to implement just culture principles and concepts. The report provides a discussion of the theories and principles of a just culture, information on the benefits of a just culture, steps an organization might take to begin creating a just culture, and describes case studies of organizations that have begun implementing a just culture.

Reason (1997) describes a just culture as an atmosphere of trust in which people are encouraged, even rewarded, for providing essential safety-related information, but in which they are also clear about where the line must be drawn between acceptable and unacceptable behavior. An effective reporting culture depends on how the organization handles blame and punishment. A "no blame" culture is neither feasible nor desirable. Most people desire some level of accountability when a mishap occurs.

Most people desire some level of accountability when a mishap occurs.

In a just culture environment, the culpability line is more clearly drawn.

There are a number of benefits of having a just culture vs. a blaming culture (or indeed a no-blame culture) and the three main ones have been described as:

- Increased safety reporting;
- Trust building; and,
- More effective safety and operational management.

A just culture supports learning from unsafe acts in order to improve the level of safety awareness through the improved recognition of safety situations and helps to develop conscious articulation and sharing of safety information.

The process of clearly establishing acceptable vs. unacceptable behavior, if done properly in a collaborative environment, brings together different members of an organization that might often have infrequent contact in policy decision making. This contact, as well as the resulting common understanding of where the lines are drawn for punitive actions, enhances the trust that is at the core of developing a just culture.

The report also discusses the following key aspects that need to be addressed in order to improve the quality and quantity of incident reporting through the creation of a just culture:

- Changes to the legal framework that support reporting of incidents;
- Policies and procedures that encourage reporting;
- Clear definition of the roles and responsibilities of the people required to implement and maintain a just culture reporting system;
- Feedback to users and aviation community — rapid, useful, accessible and intelligible feedback to the reporting community;
- Professional handling of investigations and lessons dissemination;

Engineering a Just Culture

The term "no blame culture" flourished in the 1990s and still endures today.

Compared to the largely punitive cultures that it sought to replace, it was clearly a step in the right direction. It acknowledged that a large proportion of unsafe acts were "honest errors" (the kinds of slips, lapses and mistakes that even the best people can make) and were not truly blameworthy, nor was there much in the way of remedial or preventative benefit to be had by punishing their perpetrators. But the "no blame" concept had two serious weaknesses. First, it ignored — or, at least, failed to confront — those individuals who willfully (and often repeatedly) engaged in dangerous behaviors that most observers would recognize as being likely to increase the risk of a bad outcome. Second, it did not properly address the crucial business of distinguishing between culpable and nonculpable unsafe acts.

In my view, a safety culture depends critically upon first negotiating where the line should be drawn between unacceptable behavior and blameless unsafe acts. There will always be a gray area between these two extremes where the issue has to be decided on a case-by-case basis. This is where the guidelines provided by "A Roadmap to a Just Culture" will be of great value. A number of aviation organizations have embarked upon this process, and the general indications are that only around 10 percent of actions contributing to bad events are judged as culpable. In principle, at least, this means that the large majority of unsafe acts can be reported without fear of sanction. Once this crucial trust has been established, the organization begins to have a reporting culture, something that provides the system with an accessible memory, which, in turn, is the essential underpinning to a learning culture. There will, of course, be setbacks along the way. But engineering a just culture is the all-important early step; so much else depends upon it. ■

— James Reason

- Educating the users with regard to the changes and motives of the new system; and,

- Methods for developing and maintaining a safety culture.

In addition, some expected obstacles to the creation of a just culture have briefly been noted, such as the difficulty in changing legal procedures, and persuading senior management to commit resources to implementing and maintaining the reporting system.

The report discusses four case studies of organizations that have begun to implement a just culture, including an airline company, two civil aviation authorities, and an air navigation service provider (ANSP). These case studies are discussed with regard to changes to their legal systems, the type of reporting system adopted (e.g., voluntary, mandatory, confidential); the implementation process; the roles and responsibilities of the people involved; the reporting procedures; and the methods of feedback to the aviation community.

This document is a first attempt at outlining some of the issues surrounding just culture in the aviation community. Its purpose is to provide some preliminary guidance on how to create a just reporting culture and some insights on how to plan the implementation of such a system.

In addition, five appendixes provide further information:

Appendix A, page 24: The advantages and disadvantages of various types of reporting systems (mandatory, voluntary and confidential).

Appendix B, page 26: Some possible constraints to achieving a just culture.

Appendix C, page 30: The perspectives of various aviation organizations on just culture (International Civil Aviation Organization [ICAO], regulatory authorities, an airline, ANSPs, International Federation of Air Traffic Controllers' Associations [IFATCA], International Federation of Air Line Pilots' Associations [IFALPA]).

Appendix D, page 33: A glossary of acronyms.

Appendix E, page 34: A form for readers to provide feedback on the report.

GAIN Overview

GAIN is an industry and government initiative to promote and facilitate the voluntary collection and sharing of safety information by and among users in the international aviation community to improve safety. GAIN was

"It is often said that pilots and controllers talk at each other all day long, but rarely communicate."

first proposed by the U.S. Federal Aviation Administration (FAA) in 1996, but has now evolved into an international industrywide endeavor that involves the participation of professionals from airlines, air traffic service providers, employee groups, manufacturers, major equipment suppliers and vendors, and other aviation organizations. To date, six world conferences have been held to promote the GAIN concept and share products with the aviation community to improve safety. Aviation safety professionals from more than 50 countries have participated in GAIN.

The GAIN organization consists of an industry-led Steering Committee, three working groups, a Program Office, and a Government Support Team. The GAIN Steering Committee is composed of industry stakeholders that set high-level GAIN policy, issue charters to direct the working groups and guide the program office. The Government Support Team consists of representatives from government organizations that work together to promote and facilitate GAIN in their respective countries. The working groups are interdisciplinary industry and government teams that work GAIN tasks within the action plans established by the Steering Committee. The current GAIN working groups are:

- Working Group B, Analytical Methods and Tools;
- Working Group C, Global Information Sharing Systems; and,
- Working Group E, Flight Ops/ATC Ops Safety Information Sharing.

The Program Office provides technical and administrative support to the Steering Committee, working groups and Government Support Team.

Flight Ops/ATC Ops Safety Information Sharing Working Group (WG E)

A workshop at the Fifth GAIN World Conference in December 2001 highlighted the need for increased interaction between air traffic controllers and pilots on aviation safety issues. A quote from "Crossed Wires: What Do Pilots and Controllers Know About Each Other's Jobs," *Flight Safety Australia*, May–June 2001, by Dr. Immanuel Barshi and Rebecca Chute, succinctly captures the need seen by many at this workshop and in the aviation community for increased collaboration between pilots and controllers. The authors introduce the article saying, "It is often said that pilots and controllers talk at each other all day long, but rarely communicate."

Responding to this need, in January 2002 the GAIN Steering Committee chartered the Flight Ops/ATC Ops Safety Information Sharing Working Group, designated Working Group E, to foster increased collaboration on safety and operational information exchange between flight operations and air traffic operations. The working group consists of representatives from airlines, pilot and controller unions, air traffic service providers, regulatory agencies, and other aviation organizations.

Working Group E has three main focus areas:

- Promote the development and creation of a just culture environment within the Flight Ops and ATC Ops communities;
- Identify Flight Ops–ATC Ops collaboration initiatives that improve safety and efficiency; and,
- Increase awareness of the benefits of pilot–controller collaboration and promote such collaboration in training and education programs.

After its formation in 2002, the working group concentrated on the second focus area, surveying air traffic controllers, pilots, air traffic service providers and others around the world to learn about existing pilot–controller collaboration initiatives.

Twenty-seven of these initiatives are documented in the report, "Pilot/Controller Collaboration Initiatives: Enhancing Safety and Efficiency," available at <www.gainweb.org>.

The working group and the GAIN Steering Committee realized that in order for pilots, controllers and other front-line workers to come forward and share information about potential aviation safety problems, a just culture environment conducive to such information sharing and collaboration must exist. Therefore, the working group began an effort to search the literature as well as identify existing examples of the creation of a just culture in the aviation safety community. The results are documented in this report, which was prepared specifically to address the first focus area. Working Group E hopes this information will assist other organizations wishing to benefit from the creation of a just culture in their countries and/or organizations.

Another Working Group E product, titled "The Other End of the Radio," is under development and addresses the third focus area.

Overview of the Issue

Any effective safety information system depends crucially on the willing participation of the workforce, the front-line workers who are in direct contact with hazard. In aviation organizations, these are air traffic controllers, pilots, flight crew, maintenance personnel and others who can provide key information about aviation safety problems and potential solutions. Achieving this reporting requires an organizational climate in which people are prepared to report their errors and incidents. Engineering an effective reporting culture must contend with actions whose consequences have focused on blame and punishment. A "no blame" culture is neither feasible nor desirable. A small proportion of unsafe acts are deliberately done (e.g., criminal activity, substance abuse, controlled substances, reckless noncompliance, sabotage, etc.) and they require sanctions of appropriate severity. A blanket amnesty on all unsafe acts would lack credibility in the eyes of employees and could be seen to oppose natural justice.

What is needed is an atmosphere of trust in which people are encouraged to provide essential safety-related information, and in which they are also clear about where the line must be drawn between acceptable and unacceptable behavior. The just culture operates by design to encourage compliance with the appropriate regulations and procedures, foster safe operating practices, and promote the development of internal evaluation programs.

Definitions and Principles of a Just Culture

Definition of Just Culture

According to Reason (1997), the components of a safety culture include just, reporting, learning, informed and flexible cultures. Reason describes a just culture as an atmosphere of trust in which people are encouraged (even rewarded) for providing essential safety-related information, but in which they are also clear about where the line must be drawn between acceptable and unacceptable behavior (Figure 1, page 6).

A just culture refers to a way of safety thinking that promotes a questioning attitude, is resistant to complacency, is committed to excellence, and fosters both personal accountability and corporate self-regulation in safety matters.

A just culture, then, is both attitudinal as well as structural, relating to both individuals and organizations. Personal attitudes and corporate style can enable or facilitate the unsafe acts and conditions that are the precursors to accidents and incidents. It requires not only actively identifying safety issues, but responding with appropriate action.

Principles of a Just Culture

This section discusses some of the main issues surrounding just culture, including the benefits of having a learning culture vs. a blaming culture; learning from unsafe acts; where the border between "acceptable" and "unacceptable" behavior should be; and ways to decide on culpability.

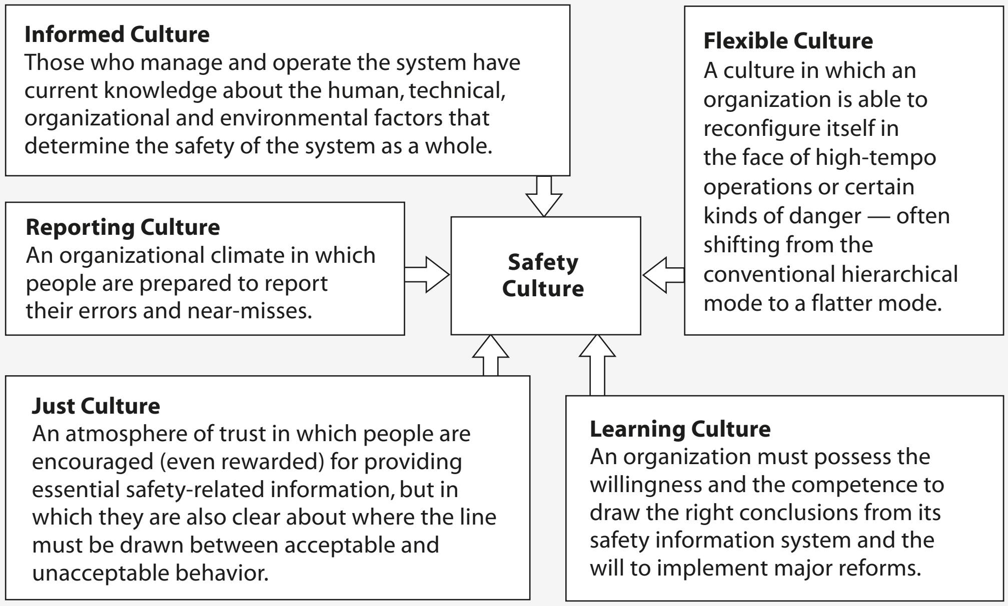
Evaluating the Benefits of Punishment vs. Learning

A question that organizations should ask themselves is whether or not the current disciplinary policy is supportive to their system safety efforts.

- Is it more worthwhile to reduce accidents by learning from incidents (from incidents being reported openly and communicated back to the staff) or by punishing people for making mistakes to stop them from making mistakes in the future?

Figure 1

The Components of Safety Culture: Definitions of Informed, Reporting, Just, Flexible and Learning Cultures



Source: Reason, 1997

- Does the threat of discipline increase a person's awareness of risks or at least increase one's interest in assessing the risks? Does this heightened awareness outweigh the learning through punishment?

- By providing safety information and knowledge, are people more interested in assessing the risks? Does this heightened awareness outweigh the learning through punishment?

- How does your system treat human error? Does your system make employees aware of their mistake? Can employees safely come forward if they make a mistake, so that your organization can learn from the event?

Positions for and against punishment as a means of learning are illustrated below.

In favor of punishment of the negligent actor: "When people have knowledge that conviction and sentence (and punishment) may follow conduct that inadvertently creates improper risk, they are supplied with an additional motive to take care before acting, to use their facilities and draw on their experience in gauging the potentialities of contemplated conduct. To some extent, at least, this motive may promote awareness and thus be effective as a measure of control" (American Law Institute Model Penal Code, 1962).

Against punishment of the negligent actor: "A person acts 'recklessly' with respect to a result if [she/he] consciously disregards a substantial risk and acts only negligently if [she/he] is unaware of a substantial risk [she/he] should have perceived. The narrow distinction lies in the actor's awareness of risk. The person acting negligently is unaware of harmful consequences and therefore is arguably neither blameworthy nor deterrable" (Robinson and Grall, 1983).

Learning From Unsafe Acts

A just culture supports learning from unsafe acts. The first goal of any manager is to improve safety and production. Any event related to safety, especially human or organizational errors, must be first considered as a valuable opportunity to improve operations through experience feedback and lessons learned (International Atomic Energy Agency [IAEA]a).

Failures and "incidents" are considered by organizations with good safety cultures as lessons which can be used to avoid more serious events. There is thus a strong drive to ensure that all events which have the potential to be instructive are reported and investigated to discover the root causes, and that timely feedback is given on the findings and remedial actions, both to the work groups involved and to others in the organization or industry who might experience the same problem. This "horizontal" communication is particularly important (IAEAb).

Organizations need to understand and acknowledge that people at the sharp end are not usually the instigators of accidents and incidents and that they are more likely to inherit bad situations that have been developing over a long period (Reason, 1997). In order that organizations learn from incidents, it is necessary to recognize that human error will never be eliminated, only moderated. In order to combat human errors, we need to change the conditions under which humans work. The effectiveness of countermeasures depends on the willingness of individuals to report their errors, which requires an atmosphere of trust in which people are encouraged for providing essential safety-related information (Reason, 1997).

Four Types of Unsafe Behaviors

Marx (2001) has identified four types of behavior that might result in unsafe acts. The issue that has been raised by Marx and others is that not all of these behaviors necessarily warrant disciplinary sanction.

- Human error is when there is general agreement that the individuals should have done other than what they did. In the course of that conduct where they inadvertently caused (or could have caused) an undesirable outcome, the individual is labeled as having committed an error.

- Negligent conduct is conduct that falls below the standard required as normal in the community. Negligence, in its legal sense, arises both in the civil and criminal liability contexts. It applies to a person who fails to use the reasonable level of skill expected of a person engaged in that particular activity, whether by omitting to do something that a prudent and reasonable person would do in the circumstances or by doing something that no prudent or reasonable person would have done in the circumstances. To raise a question of negligence, there needs to be a duty of care on the person, and harm must be caused by the negligent action. In other words, where there is a duty to exercise care, reasonable care must be taken to avoid acts or omissions which can reasonably be foreseen to be likely to cause harm to persons or property. If, as a result of a failure to act in this reasonably skillful way, harm/injury/damage is caused to a person or property, the person whose action caused the harm is liable to pay damages to the person who is, or whose property is, harmed.

- Reckless conduct (gross negligence) is more culpable than negligence. The definition of reckless conduct varies between countries; however, the underlying message is that to be reckless, the risk has to be one that would have been obvious to a reasonable person. In both civil and criminal liability contexts, it involves a person taking a conscious unjustified risk, knowing that there is a risk that harm would probably result from the conduct, and foreseeing the harm, he or she nevertheless took the risk. It differs from negligence (where negligence is the failure to recognize a risk that should have been recognized), while recklessness is a conscious disregard of an obvious risk.

The definition of reckless conduct varies between countries.

- Intentional "willful" violation is when a person knew or foresaw the result of the action, but went ahead and did it anyway.

Defining the Border of 'Unacceptable Behavior'

The difficult task is to discriminate between the truly bad behaviors and the vast majority of unsafe acts to which discipline is neither appropriate nor useful. It is necessary to agree on a set of principles for drawing this line:

- Negligence is defined as behavior that involved a harmful consequence that a "reasonable" and "prudent" person would have foreseen.

- Recklessness is defined as taking a deliberate and unjustifiable risk.

Reason (1997, Figure 2) believes that the line between "culpable" (or "unacceptable") and "acceptable" behavior should be drawn after "substance abuse for recreational purposes" and "malevolent damage."

Figure 2
Culpable Behavior vs. Acceptable Behavior

Malevolent damage **Substance abuse for recreation**	**Unacceptable Behavior**
Substance abuse with mitigation **Negligent error**	**Acceptable Behavior**
Unsafe acts	**Blameless Behavior**

Source: Reason, 1997

Figure 3 illustrates the borders between "acceptable" and "bad" behaviors, where statements in the safety policy can deal with human error (such as omission, slips, etc.), and where laws come into play when criminal offenses and gross negligence are concerned. Procedures and proactive management can support those situations that are less clear, at the borders.

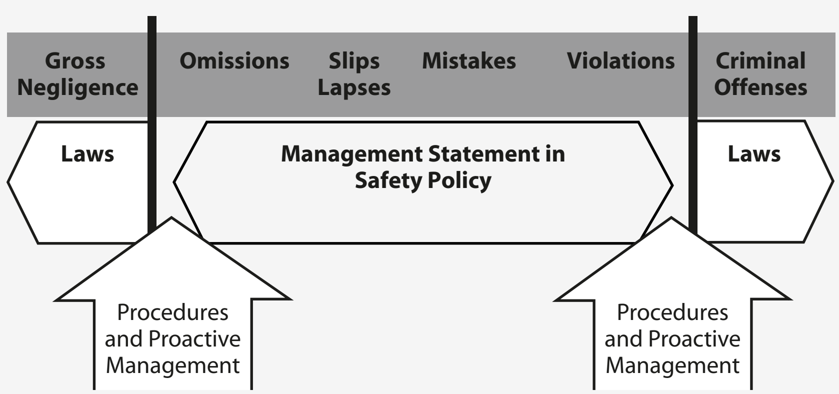
Determining 'Culpability' on an Individual-case Basis

In order to decide whether a particular behavior is culpable enough to require disciplinary action, a policy is required to decide fairly on a case-by-case basis. Three types of disciplinary policy are described below (Marx, 2001). The third policy provides the basis for a just culture. Reason's Culpability Decision Tree follows, presenting a structured approach for determining culpability. This is followed by Hudson's (2004) expanded just culture diagram, which integrates types of violations and their causes, and accountabilities at all levels of the organization.

- Outcome-based Disciplinary Decision Making: This method focuses on the outcome (severity) of the event: the more severe the outcome, the more blameworthy the actor is perceived. This system is based on the notion that we can totally control the outcomes from our behavior. However, we can only control our intended behaviors to reduce our likelihood of making a mistake, but we cannot truly control when and where a human error will occur. Discipline may not deter those who did not intend to make a mistake (Marx, 2001).

- Rule-based Disciplinary Decision Making: Most high-risk industries have outcome-based rules (e.g., separation minima) and behavior-based rules (e.g., work-hour limitation). If either of these rules is violated, punishment does not necessarily follow, as for example, in circumstances where a large number of the rules do not fit the particular circumstances. Violations provide critical learning opportunities for improving safety

Figure 3
Defining the Borders of 'Bad Behaviors'



Source: P. Stastny, Sixth GAIN World Conference, Rome, Italy, June 18–19, 2002

— why, for example, certain violations become the norm.

- Risk-based Disciplinary Decision Making: This method considers the intent of an employee with regard to an undesirable outcome. People who act recklessly are thought to demonstrate greater intent (because they intend to take a significant and unjustifiable risk) than those who demonstrate negligent conduct. Therefore, when an employee should have known, but was unaware, of the risk she/he was taking, she/he was negligent but not culpably so, and therefore would not be punished in a just culture environment.

Figure 4 displays Reason's Culpability Decision Tree, a device for helping to decide on the culpability of an unsafe act. The assumption is that the actions under scrutiny have contributed to an accident or to a serious incident.

There are likely to be a number of different unsafe acts that contributed to the accident or incident, and Reason (1997) believes that the decision tree should be applied separately to each of them. The concern is with individual unsafe acts committed by either a single person or by different people at various points of the event sequence. The five stages include:

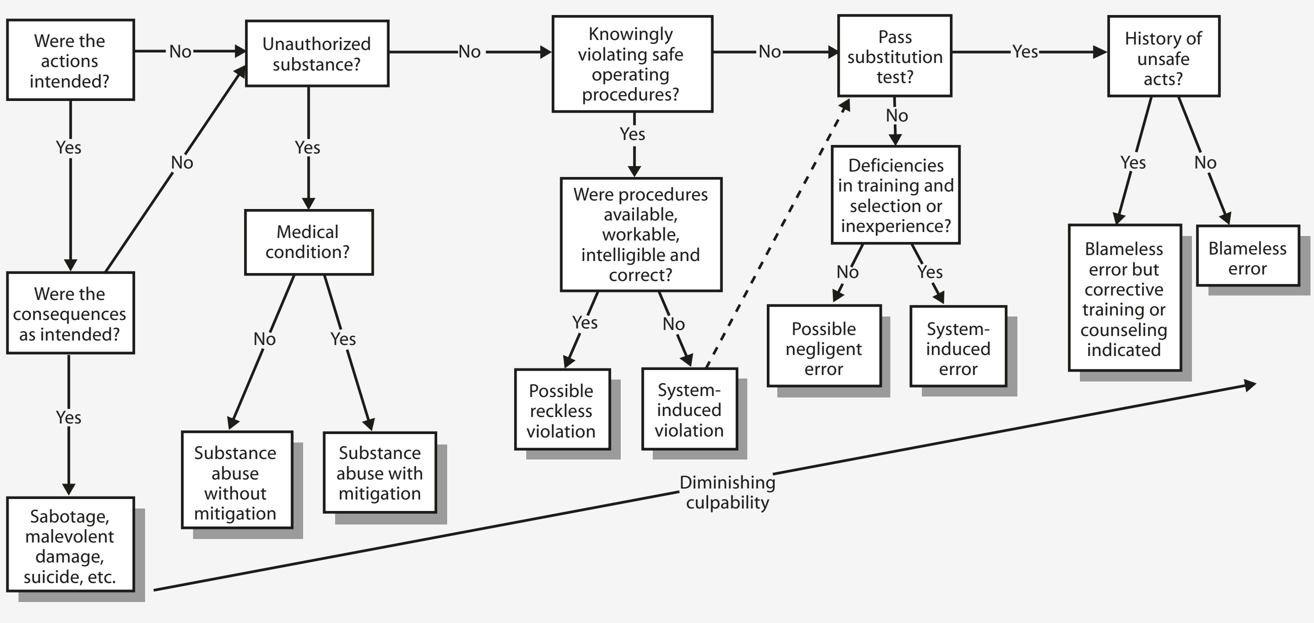
- Intended act: The first question in the decision tree relates to intention, and if both actions and consequences were intended, then it is possibly criminal behavior which is likely to be dealt with outside of the company (such as sabotage or malevolent damage).

- Under the influence of alcohol or drugs known to impair performance at the time that the error was committed. A distinction is made between substance abuse with and without "reasonable purpose (or mitigation)," which although is still reprehensible, is not as blameworthy as taking drugs for recreational purposes.

- Deliberate violation of the rules, and did the system promote the violation or discourage the violation; had the behavior become automatic or part of the "local working practices"?

Figure 4

Reason's Decision Tree for Determining the Culpability of Unsafe Acts



Source: Reason, 1997

- Substitution test: Could a different person (well motivated, equally competent and comparably qualified) have made the same error under similar circumstances (determined by their peers). If "yes," the person who made the error is probably blameless; if "no," were there system-induced reasons (such as insufficient training, selection, experience)? If not, then negligent behavior should be considered.

- Repetitive errors: The final question asks whether the person has committed unsafe acts in the past. This does not necessarily presume culpability, but it may imply that additional training or counseling is required.

Reason's foresight test provides a prior test to the substitution test described above, in which culpability is thought to be dependent upon the kind of behavior the person was engaged in at the time (Reason and Hobbs, 2001).

The type of question that is asked in this test is:

Did the individual knowingly engage in behavior that an average operator would recognize as being likely to increase the probability of making a safety-critical error?

If the answer is "yes" to this question in any of the following situations, the person may be culpable. However, in any of these situations, there may be other reasons for the behavior, and thus it would be necessary to apply the substitution test.

- Performing the job under the influence of a drug or substance known to impair performance;

- Clowning around while on the job;

- Becoming excessively fatigued as a consequence of working a double shift; or,

- Using equipment known to be substandard or inappropriate.

Hudson's Version of the Just Culture Diagram

Hudson (2004) expands Reason's culpability decision tree, using a more complex picture that integrates different types of violation and their causes (Figure 5, page 12). This model starts from the positive, indicating the focus of priority. It defines accountabilities at all levels and provides explicit coaching definitions for failures to manage violations.

This approach (called "hearts and minds") includes the following four types of information to guide those involved in deciding accountability:

- Violation type: normal compliance to exceptional violation;

- Roles of those involved: managers to workers;

- Individuals: the reasons for noncompliance; and,

- Solutions: from praise to punishment.

Determining Negligence: An Example

- Was the employee aware of what he/she has done? No.

- Should he/she have been aware? Yes.

- Applying the substitution test: Substitute the individual concerned [in] the incident with someone else coming from the same area of work and having comparable experience and qualifications. Ask the "substituted" individual: "In the light of how events unfolded and were perceived by those involved in real time, would you have behaved any differently?" If the answer is "probably not," then apportioning blame has no material role to play.

- Given the circumstances that prevailed at the time, could you be sure that you would not have committed the same or similar type of unsafe act? If the answer again is "probably not," then blame is inappropriate. ■

Dealing With Repetitive Errors

Can organizations afford someone who makes repeated errors while on the job? The answer to this question is difficult, as the causes of repeat errors have two different sources:

1. An individual may be performing a specific task that is very prone to error. Just as we can design systems to minimize human error through human factors, we can design systems that directly result in a pronounced rate of error. Therefore, it is critical for the designers to be aware of the rate of error.

2. A source of repeated error may be with the individual. Recent traumatic events in one's life or a significant distraction in life can cause some individuals to lose focus on the details of their work, possibly leading to an increased rate of error. In such cases, it may be an appropriate remedy to remove the individual from his current task or to supplement the task to aid in controlling the abnormal rate of error. ■

What to Do With Lack of Qualification?

An unqualified employee can cross the threshold of recklessness if he does not recognize himself as unqualified or as taking a substantial risk in continuing his current work.

Lack of qualification may only reveal that an individual was not fully trained and qualified in the job, and therefore shows that it is a system failure not to have ensured that the appropriate qualifications were obtained. ■

Creating a Just Culture

Benefits of a Just Culture

The benefits that can be gained from the creation of a just culture in an organization include measurable effects such as increased event reports and corrective actions taken, as well as intangible organizational and managerial benefits:

Increased Reporting

- A just culture can lead to not only increased event reporting, particularly of previously unreported events, but also to the identification of trends that will provide opportunities to address latent safety problems.

- It has been estimated that for each major accident involving fatalities, there are as many as several hundred unreported incidents that, properly investigated, might have identified an underlying problem in time to prevent the accident (*GAIN Operator's Flight Safety Handbook*, 1999).

- A lack of reported events is not indicative of a safe operation, and likewise, an increase in reported events is not indicative of a decrease in safety. Event reporting illuminates potential safety concerns, and any increase in such reporting should be seen as a healthy safety indicator.

- Peter Majgard Nørbjerg of Naviair, Denmark's air traffic service provider, reported that after a June 2001 change to Denmark's law, making confidential and nonpunitive reporting possible for aviation professionals, the number of reports in Danish air traffic control rose from approximately 15 per year to more than 900 in the first year alone.

Trust Building

- The process of clearly establishing acceptable vs. unacceptable behavior, if done properly in a collaborative environment, brings together different members of an organization that often have infrequent contact in policy decision making. This contact, as well as the resulting common understanding of where the lines are drawn for punitive actions, enhances the trust that is at the core of developing a just culture.

- Patrick Hudson noted in 2001 that "most violations are caused by a desire to please rather than willfulness."

Figure 5

Hudson's Refined Just Culture Model

Description	Did they follow all procedures and best practices?	Did they think they were following the procedures and practices?	Everyone does it this way around here. Don't you know?	We can't follow the procedure and get the job done.	I thought it was better for the company to do the job that way.	I thought it was better for me personally to cut a corner.	I meant to do it my way.	Did we do that?
Violation Type	**Normal Compliance**	**Unintentional Violation Awareness/ Understanding**	**Routine Violation**	**Situational Violation**	**Optimizing Violation**	**Personal Optimizing Violation**	**Reckless Personal Optimization**	**Exceptional Violation**
Management	Feel comfortable, but be aware, this may be unusual.	Why didn't people realize this was a problem?	Take active steps to identify this sort of violation. Use MRB.	Get very active. How were poor procedures signed off?	Set standards. Examine procedures. This may be a real improvement.	Set standards. Examine hiring and retention policies.	How did we hire such a person?	Did we not expect such situations to arise? HSEMS problem?
Supervision	Praise the worker.	Investigate and apply MRB.	Investigate and apply MRB.	Investigate. Must listen to workforce.	Why is this not being recognized? Use MRB. Allow variances.	Set standards. Recognize that such people are in workforce.	How did we let him stay here? Didn't we know in advance?	Did we train people in how to react in unusual circumstances?
Workforce	Feel satisfied.	Report if they discover they have violated a procedure.	Get involved in finding out if the procedure is necessary.	Must report all such impossible situations.	Report possibility. Raise before work. Acquire competence.	Decide whether you wish to work here.	Leave company.	Did I check with supervisor and colleagues?
Discipline	None	No blame for worker.	Active coaching of all, at all levels for condoning routine violation.	Blame everyone for not playing their part.	Blame everyone for not playing their part.	Warning letter to worker.	Summary dismissal.	Did they follow all procedures and best practices?
Coaching	Praise the worker. Use as an example for others.	Management needs to examine the quality of procedure system.	Everyone use MRB to see if rule necessary, or ensure compliance.	Coach people to tell (workers) and listen (managers and supervisors).	Coach people to tell (workers) and listen (managers and supervisors).	Coach managers and supervisors on setting standards.	Coach managers and supervisors to recognize and deal with such individuals.	Did they follow all procedures and best practices?

HSEMS = Health, safety and environmental management system   MRB = Managing rule breaking

Source: Shell "Hearts and Minds" Project, 2004

This observation emphasizes the inherent nature of the majority of safety violations: first, that they are indeed inadvertent, and second, that they are intended to further the organization's operational objectives. This fact is well known on the "front lines" of an airline or air traffic service provider, but is often obscured further up in the management structure, particularly during an investigation of a violation or accident.

Likewise, front-line workers may not have a clear understanding of which procedures are "red light" rules (never to be broken) and which are "yellow light" rules (expected to be broken, but for which the worker will be punished if an accident occurs). Establishing a well-defined, well-monitored just culture will help all members of an organization to better define their own responsibilities and understand the roles, influences and motivations of others in the organization.

- It can be expected that a just culture will increase confidence of front-line employees in its management's prioritization of safety over its interest in assigning blame. It will reinforce the organization's common vision and values regarding the need to put safety first in all aspects of its operation.

More Effective Safety and Operational Management

- It can be expected that a just culture will enhance the organization's effectiveness by defining job-performance expectations, establishing clear guidelines for the consequences of deviance from procedures, and promoting the continuous review of policies and procedures.

- Just culture can allow an organization to be better able to determine whether violations are occurring infrequently or if deviation from established procedures has become normalized among its front-line employees and supervisors.

- Outdated or ineffective management structures can be manifested in many ways, as by operational inefficiencies, lost opportunities or safety lapses. While just culture is primarily implemented by a safety motive, it is recognized "that the same factors which are creating accidents are creating production losses as well as quality and cost problems" (Capt. Bertrand De Courville, Air France, 1999).

What Is Expected to Change in an Organization With a Just Culture

The shift from the traditional blame culture to a more constructive just culture can be expected to have tangible benefits that will contribute positively to the overall safety culture of an organization by emphasizing two crucial, yet not mutually exclusive, concepts:

- Human error is inevitable and the system needs to be continually monitored and improved to accommodate those errors; and,

- Individuals are accountable for their actions if they knowingly violate safety procedures or policies.

A just culture is necessary for an organization to effectively monitor the safety of its system, both by understanding the effects of normal human error on the system and by demonstrating its resolve to enforce individual operator responsibility. This responsibility includes adherence to safety regulations as well as reporting inadvertent errors that can alert an organization to latent safety dangers. Operating with a just culture will create conditions conducive to reporting and collaborative decision making regarding policy and procedural changes.

One example of the marked changes in an organization as a result of creation of a just culture occurred at Naviair, the air traffic service provider in Denmark, made possible through a change in its national law. (Details are described in the Case Studies section, page 16.)

Based on the experience of Naviair and others who have implemented just culture, the following values can be expected to be prevalent throughout the organization:

- People at all levels understand the hazards and risk inherent in their operations and those with whom they interface;

- Personnel continuously work to identify and control or manage hazards or potential hazards;

- Errors are understood, efforts are made to eliminate potential errors from the system and willful violations are not tolerated;

- Employees and management understand and agree on what is acceptable and unacceptable;

- Employees are encouraged to report safety hazards;

- When hazards are reported, they are analyzed using a hazard-based methodology, and appropriate action is taken;

- Hazards, and actions to control them, are tracked and reported at all levels of the organization;

- Employees are encouraged to develop and apply their own skills and knowledge to enhance organizational safety;

- Staff and management communicate openly and frequently concerning safety hazards;

- Safety reports are presented to staff so that everyone learns the lessons; and,

- Feedback is provided to users and the aviation community:

  - Acknowledgement — Reporters like to know whether their report was received and what will happen to it, what to expect and when; and,

– Feedback — It is important that the users see the benefits of their reporting in knowledge sharing. If not, the system will die out.

Creating and Implementing a Just Culture

This section briefly describes some of the main steps as well as potential obstacles to achieving a just culture. These have come from a number of sources, including Reason (1997); Johnson (2003); lessons from the Danish experience; Eurocontrol Safety Regulatory Requirements 2 Workshops (2000); and Vecchio-Sadus and Griffiths (2004).

Legal Aspects

In order to reduce the legal impediments to reporting, the two most important issues are indemnity against disciplinary proceedings and having a legal framework that supports reporting of incidents. The first steps in changing the legal aspects could be to:

- Substantiate the current legal situation; does it need to be changed?
- Discuss possibilities of change with company lawyers/legal advisors; and,
- Discuss with operational personnel what changes in the legal policy they think would improve incident reporting.

Potential obstacles: For many organizations, the main challenge of developing a just culture will be to change the legislation, especially if the changes are counter to societal legislation.

Reporting Policy and Procedures

It is important that the following issues are considered with regard to the underlying reporting structure and company commitment:

- Confidentiality or deidentification of reports;
- Separation of agency/department collecting and analyzing the reports from those bodies with the authority to institute disciplinary proceedings and impose sanctions;
- Company commitment to safety; and,
- Some degree of independence must be granted to the managers of the reporting system.

Potential obstacles: Persuading senior management of the need for creating a just culture and to commit adequate resources to it may be difficult.

Methods of Reporting

It is important that issues such as the following are considered with regard to the method by which reports will be collected:

- Rapid, useful, accessible and intelligible feedback to the reporting community;
- Ease of making the report — voluntary reporting should not be perceived as an extra task;
- Clear and unambiguous directions for reporting and accessibility to reporting means; and,
- Professional handling of investigation and lesson dissemination.

The first steps to develop a just culture reporting system could be:

- Decide on voluntary vs. mandatory reporting system;
- Decide on anonymous, confidential, open reporting system;
- Develop procedures for determining culpability (such as the just culture decision tree) and follow-up action (type of discipline or coaching);
- Decide who shall decide culpability (e.g., team consists of safety, operations, management, human resources); and,
- Draft a plan and discuss with a small selection of operational personnel.

Further investigation:

- Decide if and how the reports will be further investigated (the focus of the investigation, face-to-face interview);
- Decide which reports will be further investigated (those which are most severe or those with the most learning potential); and,
- Decide who will investigate the reports.

Potential obstacles: It may not be obvious to all organizations which system would suit them best. Ideally, a variety of reporting methods (or a flexible method) will be implemented, as not one reporting method will suit everyone's needs. It may be necessary for the organization to survey the needs of the potential users to better understand which reporting method would be more readily accepted. A system that is unclear and ambiguous could create distrust in the system, so it is necessary that the procedures to decide culpability must be clear and understood by all. Reporters may not reveal their identity (e.g., in a confidential reporting system) or choose not to be interviewed, which could prevent any further investigation of an event.

Determine Roles and Responsibilities, Tasks and Timescale

For such a system to thrive, a number of different people need to be involved in the implementation and maintenance of the system. A "local champion" will be needed to promote and act as guarantor to ensure the assurances of anonymity will be preserved in the face of external or managerial pressures. Decide and select someone to:

- Champion the system;
- Educate users and implement system;
- Collect and analyze the reports;
- Decide which department will be involved in the disciplinary (decision making) process;
- Feed back the information (develop newsletter); and,
- Develop and maintain the data collection system.

Potential obstacles: Having sufficient resources (e.g., people) to run the system, as well as having enough of the "right" kind of people, who are energetic, well-liked, well-known and respected in the company. Maintaining the energy required for the system to function.

Develop a Reporting Form

It is important to have a reporting form that encourages accurate and complete reporting (e.g., questions that are understandable); otherwise reporters may provide erroneous or misleading responses. Determine:

- What information you want to collect (e.g., only that information that will improve learning in the organization);
- What you want to do with the information (e.g., case studies, summary data) as this will determine what information you collect;
- What format you want to collect it in (e.g., electronic, paper or both);
- What resources are required to develop the system (people, costs); and,
- Whether (and how) the reporting form should be integrated with the current incident-reporting system.

Potential obstacles: It could be that too much/irrelevant data are collected. It is important that it is kept simple, but with enough detail that useful analysis can be applied to it.

Develop Template for Feedback to Potential Users

Determine:

- What type of information you want to disseminate (e.g., summary, case studies, "hotspots," human factors data);
- How to disseminate the information (e.g., newsletter);
- Who will be involved (writing, editing newsletter; senior management endorsing action plan);
- How often you will disseminate the feedback; and,
- Template style of the newsletter, title, etc.

Potential obstacles: The newsletter is not read. It may be necessary to find out what sort of information the audience would like to know about; provide examples that will be of interest and relevant to their jobs. One may need to vary the style over time, so that it maintains their attention, and so that they are likely to contribute to it.

Develop a Plan for Educating the Users and Implementing the System

Potential reporters must know about the reporting scheme and know how to submit a report. This will include induction courses; periodic retraining to remind staff of the importance of reporting; and ensuring that staff are provided with access to reporting forms. Below are some initial steps for implementing the system.

- Develop brochures to explain the changes in the legal system;
- Present the changes to all staff;
- Train a "champion" (or a team) to be the main focus for the system;
- Explain to users how this new system will fit into the current system;
- Have a "Health and Safety Week" campaign to promote the reporting system;
- Include a section on the reporting system in the safety induction course;
- Use e-mail and the Internet to communicate, announcing new information and congratulating participants; and,
- Design posters to describe the reporting system process pictorially.

Potential obstacles: Information about the system may not be disseminated to a wide enough audience and to a deep enough level within the organization.

Developing and Maintaining the Right Culture

A number of additional issues concerning the "cultural" aspects of reporting are necessary in order to maintain motivation to report, such as the trust between reporters and the managers that must genuinely exist for the reporting system to work. The main aims are to develop an open culture in which people feel able to trust the system and to develop new ways to motivate people to use the system. Below are initial ideas.

- System visibility: Make potential contributors aware of the procedures and mechanisms that support the incident-reporting system;

- Maintaining the employees' voice: Ensure that the reports are used to voice the employees' voice and not used to suit existing management priorities;

- Publicized participation: Publish the contribution rate from different parts of the organization to show that others trust the system (but ensure that this does not have the opposite effect, such as asking for certain quotas of reports per month);

- Develop "marketing strategies" for enhancing safety culture (Vecchio-Sadus and Griffiths, 2004):

  – Focus the marketing strategy to suit the audience (e.g., management will have a different focus than the operations personnel);

  – Link safety values to the core business — and show tangible evidence for their effect, such as how safety can enhance production, efficiency, communication and even cost benefits; and,

  – Give reward and recognition: positive reinforcement for reporting incidents;

- Change attitudes and behaviors: Focus on the immediate, certain and positive consequences of reporting incidents and publicize the "payoffs" of reporting incidents;

- Management commitment: Raise awareness of management's commitment to safety, with a "hands-on approach"; have management involved in the reporting process to show that they visibly believe and promote the just culture; and,

- Employee involvement: Ensure employee involvement so they are committed to the need to be actively involved in decision making and the problem-solving process.

Potential obstacles: It takes time and persistence to try and change safety attitudes and behaviors. Maintaining motivation of the personnel set with the task of improving safety reporting can be a potential obstacle.

Three planning aspects that need to be taken into consideration are the required time to undertake the steps and substeps (include start and end dates); the estimated costs involved; and who will undertake the work.

Case Studies

Four case studies are provided to show the several ways in which different organizations have attempted to create a just culture (with various levels of success), including the Danish (Nørbjerg, 2003), the New Zealand Civil Aviation Authority (N.Z. CAA, 2004), and the U.K. Civil Aviation Authority and Alaska Airlines systems. These case studies are described under different headings, depending on the information available.

Danish System

Legal Aspects

In 2000, the chairman of the Danish Air Traffic Controllers Association described the obstacles for reporting during an interview on national prime-time television. This influenced the Transportation Subcommittee of the Danish Parliament to ask for the Danish Air Traffic Control Association to explain their case. After exploring various international legislations on reporting and investigating incidents and accidents, the Danish government proposed a law in 2002 that would make nonpunitive, confidential reporting possible.

Reporting System

The Danish reporting system ensures immunity against penalties and disclosure, but also any breach of the nondisclosure guarantee is made a punishable offense. The system includes the following:

- Mandatory: Air traffic controllers must submit reports of events. It is punishable not to report an incident in aviation;

- Nonpunitive: Reporters are ensured indemnity against prosecution or disciplinary actions for any event they have reported based on the information contained in the reports submitted. However, this does not mean that reports may always be submitted without consequences;

- Immunity against any penal/disciplinary measure: If a report is submitted within 72 hours of an occurrence; if it does not involve an accident; or does not involve deliberate sabotage or negligence due to substance abuse. Punitive measures are stipulated against any breach of the guaranteed confidentiality; and,

- Confidential: The reporter's identity may not be revealed outside the agency dealing with occurrence reports. Investigators are obliged to keep information from the reports undisclosed.

Implementation Process

- Danish Aviation Authority (Statens Luftfartsvaesen) implemented the regulatory framework and contacted those license holders who would mandatorily be involved in the reporting system: pilots, air traffic controllers, certified aircraft mechanics and certified airports.

- Danish Air Traffic Control Service Provider (Naviair)

  - Management sent a letter to every air traffic controller explaining the new system, stating their commitment to enhance flight safety through the reporting and analyzing of safety-related events;

  - Incident investigators were responsible for communicating the change, and were given a full mandate and support from management;

  - An extensive briefing campaign was conducted to give information to air traffic controllers; in the briefing process, the controllers expressed concerns about confidentiality and nonpunitive issues. These issues were addressed by explaining the intention of the law governing the reporting system, the law that would grant media and others no access to the reports and would secure freedom from prosecution. Further, it was emphasized that no major improvement in safety would be possible if knowledge about the hazards was not gathered;

  - Priorities were set up on which reports are dealt with immediately, and on how much attention is given by the investigators. Losses of separation are investigated thoroughly, including gathering factual information such as voice recordings, radar recordings, collection of flight progress strips and interviews with involved controllers; and,

  - Investigative reports have to be completed within a maximum of 10 weeks. The reports include the following elements: aircraft proximity and avoiding maneuvers; safety nets (their impact on and relevance for the incident); system aspects; human factors; procedures; conclusion and recommendations. The ultimate purpose of the report is to recommend changes to prevent similar incidents.

Feedback

Increased reporting: After one year of reporting, 980 reports were received (compared with 15 the previous year). In terms of losses of separation, 40–50 were received (compared with the 15 reported in the previous year);

To reporters: A new incident-investigation department was set up at Naviair with six investigators and recording specialists. They provide feedback to the reporter when the report is first received and when the analysis of the event is concluded. It is important that the organization is ready to handle the reports. Feedback is offered twice a year, in which all air traffic controllers, in groups, receive safety briefings (supported by a replay of radar recordings where possible), and discussions are held of safety events that have been reported and analyzed. Four issues of a company safety letter are distributed to the controllers each year;

To the public: It was acknowledged that, according to the Freedom of Information Act, the public has the right to know the facts about the level of safety in Danish aviation. Therefore, it was written into the law that the regulatory authority of Danish aviation, based on deidentified data from the reports, should publish overview statistics two times per year; and,

Other flight safety enhancements: flight safety partnership — a biannual meeting with flight officers from all Danish airlines is held to address operational flight safety in Danish airspace.

Lessons Learned

- Trust/confidentiality: One break in this trust can damage a reporting system, and reports must be handled with care;
- Nonpunitive nature: It is important that information from self-reporting not be used to prosecute the reporter;
- Ease of reporting: Naviair uses electronic reporting so that controllers can report wherever they have access to a computer;
- Feedback to reporters: The safety reporting system will be seen as a "paper-pushing" exercise if useful feedback is not given; and,
- Safety improvement has been assessed by Naviair, where they think information gathering is more focused and dissemination has improved.

New Zealand Civil Aviation Authority (CAA)

Overview

In 1999, the N.Z. CAA became interested in just culture and started the process of learning how it functions, and the process required to implement it. They are frequently faced with making decisions regarding the choice of regulatory tool that is appropriate to apply to an aviation participant when there is a breach of the N.Z. Civil Aviation Act or Rules, and they saw the just culture model as holding the promise of promoting compliance *and* facilitating learning from mistakes. However, to fully embrace just culture in New Zealand, there will need to be some legislation changes and considerably more selling of the concept to the aviation industry (particularly at the general aviation end) in order to get the necessary paradigm shift (away from fear of the regulator when considering whether or not to report occurrences).

Reporting System

New Zealand operates a mandatory reporting system, with provision for information revealing the identity of the source to be removed if confidentiality is requested (the latter happens only rarely).

The reporting requirements apply to all aircraft accidents and to all serious incidents except those involving various sport and recreational operations. In addition to the notification requirements for accidents and incidents, the rules require the aircraft owner or the involved organization notifying a serious incident to conduct an investigation to identify the facts relating to its involvement and the causal factors of the incident. A report of the investigation is required within 90 days of the incident, and must include any actions taken to prevent recurrence of a similar incident.

Information received under this mandatory reporting system cannot be used for prosecution action, except in special circumstances such as when false information is supplied or when "unnecessary danger" to any other person is caused (N.Z. Civil Aviation Rule [CAR] Part 12.63).

Implementation Process

Just culture seminars: The N.Z. CAA invited relevant people in the aviation industry (including large and small airline operators) and CAA personnel to attend a seminar by a leading expert on just culture. The seminars were extremely well received by all attendees, thus giving the CAA confidence that just culture principles were appropriate to apply in a safety-regulatory context.

The N.Z. CAA has a set of tools that they apply to an aviation participant when there is a breach of the N.Z. Civil Aviation Act or Rules. The tools are many and varied and form a graduated spectrum from a simple warning, through retraining and diversion, to administrative actions against aviation documents, and prosecutions through the court. The CAA bases their decisions on information which arises from a variety of sources such as a CAA audit, an investigation of an accident or incident, or a complaint from the public.

For the past four years, the CAA has been using just culture principles to decide when:

- Information from a safety investigation into a mandatory reported occurrence should cross the "Chinese wall" to be used in a law-enforcement investigation (in this context, they are using just culture to draw the line at recklessness as a surrogate for "caused unnecessary danger," which is the terminology used in the relevant N.Z. Civil Aviation Rule, CAR 12.63);

- Document suspension/revocation is appropriate; and,

- Education or reexamination is appropriate.

The perhaps-natural tendency for a regulatory authority to draw the line below negligence is resisted. By drawing the line below recklessness when making decisions, the CAA believes it will encourage learning from human errors and, once the approach becomes universally understood and accepted by the aviation community, the incidence of nonreporting of safety failures will decrease.

Lessons Learned — Legal Aspects

Application of the just culture in the manner described above requires the director to exercise his discretionary powers. However, the N.Z. CAA does not believe it can fully convince the aviation community that the director will always follow a "just culture" approach while the current wording of certain sections of the Civil Aviation Act (S.43, S.43A and S.44) remains. This is because these sections, which draw the line at "causing unnecessary danger" and "carelessness," effectively outlaw human error that endangers flight safety, irrespective of the degree of culpability. They believe this is the reason why many in the aviation community think twice before reporting safety failures to the CAA and indicates the need for confidential reporting. In order to improve reporting, these sections of the act need to be amended to raise the level of culpability to recklessness (gross negligence) before the particular behavior constitutes an offense.

U.K. CAA MOR (Mandatory Occurrence Reporting) Scheme

The U.K. CAA has recently reviewed the MOR system to try to improve the level of reporting within the U.K. aviation community. The objectives of the MOR are to:

- Ensure that the CAA is informed of hazardous or potentially hazardous incidents and defects;

- Ensure that the knowledge of these occurrences is disseminated; and,

- Enable an assessment to be made and monitor performance standards that have been set by the CAA.

Legal Aspects

Assurance regarding prosecution: The U.K. CAA gives an assurance that its primary concern is to secure free and uninhibited reporting and that it will not be its policy to institute proceedings in respect of unpremeditated or inadvertent breaches of law which come to its attention only because they have been reported under the scheme, except in cases involving failure of duty amounting to gross negligence. With respect to licenses, the CAA will have to take into account all the relevant information about the circumstances of the occurrence and about the license holder. The purpose of license action is to ensure safety and not to penalize the license holder.

Responsibilities

The CAA has the following responsibilities:

- Evaluate each report;

- Decide which occurrences require investigation by the CAA;

- Check that the involved companies are taking the necessary remedial actions in relation to the reported occurrences;

- Persuade other aviation authorities and organizations to take any necessary remedial actions;

- Assess and analyze the information reported in order to detect safety problems (not necessarily apparent to the individual reporters);

- Where appropriate, make the information from the reports available and issue specific advice or instructions to particular sections of the industry; and,

- Where appropriate, take action in relation to legislation, requirements or guidance. The U.K. Air Accidents Investigations Branch

CAA encourages the use of company reporting systems wherever possible.

(AAIB) investigates accidents, and these are passed on to the CAA for inclusion in the MOR.

Potential Reporters

Pilots; persons involved in manufacturing, repair, maintenance and overhaul of aircraft; those who sign certificates of maintenance review or release to service; airport licensees/managers; civil air traffic controllers; persons who perform installation, modification maintenance, repair, overhaul, flight checking or inspection of equipment on the ground (air traffic control service).

Reportable Incidents

- Any person specified above should report any reportable event of which they have positive knowledge, even though this may not be first-hand, unless they have good reason to believe that appropriate details of the occurrence have been or will be reported by someone else.

- Types of incidents:

  - Any incident relating to such an aircraft or any defect in or malfunctioning of such an aircraft or any part or equipment of such an aircraft being an incident, malfunctioning or defect endangering, or which if not corrected would endanger, the aircraft, its occupants, or any other person; and,

  - Any defect in or malfunctioning of any facility on the ground used or intended to be used for purposes of, or in connection with, the operation of such an aircraft or any part or equipment of such an aircraft being an incident, malfunctioning or defect endangering, or which if not corrected would endanger, the aircraft, its occupants or any other person.

Submission of Reports

CAA encourages the use of company reporting systems wherever possible. Reports collected through the company are filtered before they are sent to the CAA (to determine whether they meet the desired criteria of the CAA). The company is encouraged to inform the reporter as to whether or not the report has been passed on to the CAA.

- Individuals may submit an occurrence report directly to the CAA, although in the interest of flight safety they are strongly advised to inform their employers;

- Reports must be dispatched within 96 hours of the event (unless there are exceptional circumstances), and informed by the fastest means in the case of particularly hazardous events; and,

- Confidential reports can be submitted when the reporter considers that it is essential that his/her identity not be revealed. Reporters must accept that effective investigation may be inhibited; nevertheless, the CAA would rather have a confidential report than no report at all.

Processing of Occurrence Reports

The CAA Safety Investigation and Data Department (SIDD) processes the reports (and is not responsible for regulating organizations or individuals). They evaluate the occurrences that require CAA involvement; monitor the progress to closure and follow up on open reports; disseminate occurrence information through a range of publications; record reports in a database (names and addresses of individuals are never recorded in the database); monitor incoming reports and store data to identify hazards/potential hazards; carry out searches and analyses in response to requests within the CAA and industry; and ensure that effective communication is maintained between AAIB and CAA in respect of accident and incident investigation and follow-up.

Confidential reports are directed to and reviewed by the head of SIDD, who initiates a [deidentified] record. The head of SIDD contacts the reporter to acknowledge receipt and to discuss further; after discussions, the report is destroyed; and the record is processed as an occurrence, but annotated as confidential (only accessible by restricted users).

Alaska Airlines

The following section was taken from a corporate statement from Alaska Airlines that was transmitted to all staff.

Legal Aspects

Generally, no disciplinary action will be taken against any employee following their participation in an error investigation, including those individuals who may have breached standard operating procedures.

Disciplinary action will be limited to the following narrow circumstances:

- Employees' actions involve intentional (willful) disregard of safety toward their customers, employees or the company and its property. This is applicable when an employee has knowledge of and/or intentionally disregards a procedure or policy. Reports involving simple negligence may be accepted. In cases where an employee has knowledge but still committed an error, the report may be accepted as long as it is determined that the event was not intentional and all of the acceptance criteria listed herein are met;

- An employee commits a series of errors that demonstrates a general lack of care, judgment and professionalism. A series of errors means anything more than one. Management retains the discretion to review and interpret each situation and determine if that situation demonstrates a lack of professionalism, judgment or care. When determining what reports are acceptable when a series of errors is involved, managers should consider the risk associated with the event and the nature and scope of actions taken as a result of all previous events. A risk table is available to assist managers in making a determination of risk;

- An employee fails to promptly report incidents; for example, when an employee delays making a report within a reasonable time. A reasonable time for reporting is within 24 hours. However, reports should be submitted as soon as possible after the employee is aware of the safety error or close call;

- An employee fails to honestly participate in reporting all details in an investigation covered under this policy. For example, an employee fails to report all details associated with an event, misrepresents details associated with an event or withholds critical information in his/her report; and,

- The employee's actions involve criminal activity, substance abuse, controlled substances, alcohol, falsification or misrepresentation.

Reporting System

The Alaska Airlines Error Reporting System (ERS) is a nonpunitive reporting program which allows employees to report to management operational errors or close calls that occur in the workplace. This system is designed to capture events that normally go unreported. It also provides visibility of problems to management and provides an opportunity for correction.

Roles and Responsibilities

The Safety Division has oversight of the program. Supervisors and local management have responsibility for the day-to-day management of reports submitted, investigations performed and implementation of corrective actions.

Users: Any employee not covered by the Aviation Safety Action Program (ASAP) or Maintenance Error Reduction Policy (MERP). These employees are not covered by ERS because they are certificated by FAA, and the company cannot grant immunity to them in all cases. ASAP provides protection for certificated employees. Pilots and dispatchers are currently covered under ASAP. Until Maintenance and Engineering develops an ASAP, Maintenance and Engineering employees will be covered under MERP.

Generally, no disciplinary action will be taken against … individuals who may have breached standard operating procedures.

Reporting Procedure

- Reporters can file a report on <www.alaskasworld.com>. An employee can also submit a report over the phone by contacting the safety manager on duty.

- A report should be promptly submitted, normally as soon as the employee is aware of the error or close call. Reports made later may be accepted where extenuating circumstances exist.

Feedback

The employee's supervisor will review the report, determine if it meets all criteria for acceptance and notify the employee. If the report is not accepted, the employee's supervisor is responsible for contacting the Safety Division immediately for review.

Concurrence from the Safety Division is required prior to the nonacceptance of a report. The Safety Division will record and review all reports submitted under this program. The Internal Evaluation Program (IEP) will accomplish a monthly review of corrective actions. All long-term changes to procedures and policies will be added to the IEP audit program and become permanent evaluation items for future audits. A summary of employee reports received under this system will be presented to the Board of Directors Safety Committee quarterly. Summary information will also be shared with employees on a regular basis.■

[FSF editorial note: To ensure wider distribution in the interest of aviation safety, this report has been reprinted by permission from the Global Aviation Information Network (GAIN). *A Roadmap to a Just Culture: Enhancing the Safety Environment,* First Edition, was prepared by GAIN Working Group E, Flight Ops/ATC Ops Safety Information Sharing, in September 2004. Some editorial changes were made by FSF staff for clarity and for style. The original 57-page report contains charts, tables, references and appendixes.]

Acknowledgements

The co-chairs and members of the Flight Ops/ATC Ops Safety Information Sharing Working Group (WG E) of Global Aviation Information Network (GAIN) thank all of the individuals and organizations that made this report possible.

Developers

Peter Stastny, Safety Regulation Unit, Eurocontrol (WG E co-chair)

Capt. Al Garin, check airman A330, US Airways (WG E co-chair)

Rachael Gordon, Experimental Centre, Eurocontrol

Carolyn Edwards, Office of System Safety, U.S. Federal Aviation Administration (FAA)

Margaret Ann Johnson, Independent Studies, Human Factors and Ethics

Patrick Moylan, GAIN Program Office (RS Information Systems)

Joe Schanne, Air Traffic Organization, FAA

Reviewers and Contributors

James M. Burin, Flight Safety Foundation

Freddie D. Cline, Duotech Services

Capt. Bill Curtis, Air Canada

Capt. Stu Julian, International Federation of Air Line Pilots' Associations

Tony Licu, Safety Regulation Unit, Eurocontrol

Ian McClelland, New Zealand Transport Accident Investigation Commission

Mike Moodi, The Boeing Co.

Peter Nørbjerg, Naviair

Dave Prewitt, Alaska Airlines

John Vincent, U.K. Civil Aviation Authority

Dale Wright, National Air Traffic Controllers' Association

Independent Reviewers

Patrick Hudson, professor of psychology, University of Leiden

James Reason, retired professor of psychology, University of Manchester

Bert Ruitenberg, International Federation of Air Traffic Controllers' Associations

Max Stevens, New Zealand Civil Aviation Authority

References

American Law Institute Model Penal Code, Article 2. General Principles of Liability, Explanatory Note 2.02, 1962.

Barach, P. and Small, S.D. "Reporting and Preventing Medical Mishaps: Lessons From Non-medical Near-miss Reporting Systems." *British Medical Journal*, Volume 320 (2000): 759763.

Berman, J. and Collier, D. "The Collection and Use of Near Miss Data — Is 'No Blame' Just Wishful Thinking?" Paper presented at Managing Risk in a Changing Organizational Climate. Safety and Reliability Society, Swindon, England, 1996.

Chappell, S.L. "Using Voluntary Incident Reports for Human Factors Evaluations." In McDonald, N., Johnston, N. and Fuller, R. (eds.), *Aviation Psychology in Practice*, pp. 149–172. Aldershot, England: Ashgate, 1994.

Clarke, S. "Organizational Factors Affecting the Incident Reporting of Train Drivers." *Work and Stress*, Volume 12(1) (1998): 6–16.

Cox, S. and Cox, T. "The Structure of Employee Attitudes to Safety: A European Example." *Work and Stress*, Volume 5 (1991): 93–106.

Fleming, M.; Flin, R.; Mearns, K.; and Gordon, R. "Risk Perceptions of Offshore Workers on UK Oil and Gas Platforms." *Risk Analysis*, Volume 18(1) (1998): 103–110.

Flin, R. and Slaven, G. *Managing the Offshore Installation Workforce*. Tulsa, Oklahoma, U.S.: PennWell Books, 1996.

Gordon, R. "The Contribution of Human Factors to Incidents in the Offshore Oil Industry: Development of a Human Factors Investigation Tool." Unpublished Ph.D. thesis, University of Aberdeen, Aberdeen, Scotland, 2002.

GAIN. *GAIN Operator's Flight Safety Handbook*, 1999, <www.gainweb.org>.

GAIN. *GAIN: Using Information Proactively to Improve Aviation Safety*, 2002, <www.gainweb.org>.

GAIN. *Pilot/Controller Collaboration Initiatives: Enhancing Safety and Efficiency*, GAIN Working Group E, 2003, <www.gainweb.org>.

Hudson, P. "Aviation Safety Culture." Safeskies Conference, Canberra, Australia, 2001.

International Atomic Energy Agency (IAEA)a, *Developing Safety Culture in Nuclear Activities*, Safety Report Series, 11.

IAEAb, *Key Practical Issues in Strengthening Safety Culture*, INSAG-15.

International Federation of Air Traffic Controllers' Associations (IFATCA). "A Just Culture in Safety Reporting." Paper presented at the 43rd Annual Conference, Hong Kong, China, March 2004.

IFATCA. "The Need for a Just Culture in Aviation Safety Management." Paper presented at the 11th Air Navigation Conference, Montreal, Canada, September 2003.

Johnson, C. *Failure in Safety-critical Systems: A Handbook of Accident and Incident Reporting*. University of Glasgow Press, Glasgow, Scotland, 2003.

Lawson, J.M. "Evaluation and Development of an Accident Report Form." Proceedings of the 27th Annual Conference of the Ergonomics Society of Australia, Coolum, Australia, 1991.

Lucas, D.A. "Organizational Aspects of Near Miss Reporting." In van der Schaaf, T.W., Lucas, D.A., and Hale, A.R. (eds.), *Near Miss Reporting as a Safety Tool*. Oxford, England: Butterworth-Heinemann, 1991.

Marx, D. "Patient Safety and the 'Just Culture': A Primer for Health Care Executives." Report for Columbia University under a grant provided by the National Heart, Lung and Blood Institute, 2001.

Mearns, K.; Flin, R.; Fleming, M.; and Gordon, R. "Human and Organizational Factors in Offshore Safety" (Offshore Technology Report OTH 543). London, England: U.K. Health and Safety Executive, 1997.

Mearns, K.; Flin, R.; Gordon, R.; and Fleming, M. "Measuring Safety Climate on Offshore Installations." *Work and Stress*, Volume 12(3) (1998): 238–254.

Nørbjerg, P.M. "The Creation of an Aviation Safety Reporting Culture in Danish Air Traffic Control." Paper presented at the Open Reporting and Just Culture Workshop: Legal Impediments, held at Eurocontrol, Brussels, Belgium, 2004.

New Zealand Civil Aviation Authority. Personal correspondence with Max Stevens (and Internet site <www.caa.govt.nz>).

O'Leary, M. "Too Bad We Have to Have Confidential Reporting Programs! Some Observations on Safety Culture." In McDonald, N., Johnston, N., and Fuller, R. (eds.), *Applications of Psychology to the Aviation System*. Aldershot, England: Avebury Aviation, 1995.

Pimble, J. and O'Toole, S. "Analysis of Accident Reports." *Ergonomics*, Volume 25(11) (1982): 967–979.

Reason, J. *Managing the Risks of Organizational Accidents*. Hants, England: Ashgate Publishing, 1997.

Reason, J. and Hobbs, A. *Managing Maintenance Errors: A Practical Guide*. Chapter 11, "Safety Culture." Hants, England: Ashgate Publishing, 2001.

Robinson and Grall. "Element Analysis in Defining Criminal Liability: The Model Penal Code and Beyond." 35 Stan. L. Rev. 681 (1983): 695–696.

Safety Regulation Unit. Eurocontrol Safety Regulatory Requirements 2 Workshops and Guidance to ATM [Air Traffic Management] Safety Regulators, "AGAS and Just Culture." EAM2-GUI 6, 2000.

Stanton, S. "Accident Reporting Form Substance." *Accident Prevention*, December 1990, 13–16.

Tamuz, M. "Developing Organizational Safety Information Systems for Monitoring Potential Dangers." Proceedings of PSAM II, International Conference Devoted to the Advancement of System-based Methods for the Design and Operation of Technological Systems and Processes, San Diego, California, U.S., 1994.

U.K. Civil Aviation Authority. "The Mandatory Occurrence Reporting (MOR) Scheme: Information and Guidance." CAP 382, 2003. Safety Investigation and Data Department, Safety Regulation Group, West Sussex, England (available at <www.caa.co.uk>).

Van der Schaaf, T.W. "A Framework for Designing Near Miss Management Systems." In van der Schaaf, T.W.; Lucas, D.A.; and Hale, A.R. (eds.), *Near Miss Reporting as a Safety Tool*. Oxford, England: Butterworth-Heinemann, 1991.

Vecchio-Sadus, A.M. and Griffiths, S. "Marketing Strategies for Enhancing Safety Culture." *Safety Science* Volume 42 (2004): 601–619.

Wright, P. and Barnard, P. "'Just Fill in This Form' — A Review for Designers." *Applied Ergonomics*, Volume 6(4) (1975): 213–220.

Appendix A
Reporting Systems

This section describes attributes (not necessarily mutually exclusive) of mandatory, voluntary and confidential reporting systems (from Gordon, 2002).

Mandatory Accident and Incident Systems

The traditional method of recording accidents is by using a mandatory system that companies and regulatory bodies manage. One of the main reasons for the mandatory recording of accidents is for legal and insurance purposes, although their purpose is also for learning and prevention of similar incidents.

Nevertheless, a difficulty with learning from such types of information is that people are possibly more reluctant to disclose the whole story because of their reluctance to take the blame for the incident. The other problem with such systems is that because there are not large numbers of accidents to record, high-potential incidents are also included.

Mandatory reporting of incidents means that few will be reported because many incidents go unnoticed and therefore it is difficult to enforce (Tamuz, 1994). Mandatory incident systems are reinforced through automatic logging systems in aviation (e.g., the black box system) and the railway industry (e.g., signals passed at danger, SPD); however, the recording of incidents still depends on reporting by the individual worker (Clarke, 1998).

Voluntary Incident Systems

Voluntary reporting forms are submitted by the reporter without any legal, administrative or financial requirement to do so (Chappell, 1994). In such a system, incentives to report may be offered (such as fines and penalties waived) and the reported information generally may not be used against the reporters. The quality of information received from voluntary reports is generally higher than from mandatory systems, mainly because people who report into voluntary systems do so because they want to see a safety issue pursued. The Aviation Safety Reporting System (ASRS) is a voluntary system and the number of reports depends on the publicity, politics and perceived reporting incentives (Tamuz, 1994).

Confidential Accident and Incident Systems

In order for any workforce to feel 100 percent comfortable about reporting incidents and accidents to management, an exemplary open-reporting culture is required. However, does such an organization exist? O'Leary (1995) believes that in an environment in which the safety culture is not exemplary; for example, where reporters may fear (rightly or wrongly) that they may be disciplined, confidentiality is a necessity. So, how do companies know when they need a confidential system?

The Process of Confidential Reporting

The main purpose of confidential reporting systems is to allow companies to collect larger quantities of information and more detailed accounts of accidents and incidents. In addition, confidential reporting programs allow incidents and hazardous situations to be picked up early on, so that alerting messages can be distributed to personnel on other installations. Furthermore, this information can strengthen the foundation of human factors safety research, which is particularly important since it is generally conceded that more than two-thirds of accidents and incidents have their roots in human and organizational errors.

Confidential reporting programs allow personnel to report their errors or safety concerns to an independent "safety broker." This safety middleman assesses a report, where appropriate draws it to the attention of the operator and safety authority, and over time, builds up a database which can be used to detect safety trends or to change training or procedures. Companies that recognize and support such data-collection systems accept that human beings do not like telling their superiors about their mistakes or those of their workmates.

Confidential accident-reporting systems protect the identity of the reporter. Reports may or may not be submitted anonymously to a confidential program. If the identity of the reporter is known at the time of submission, it enables further details to be collected if necessary. The identity of the reporter is either removed or protected from distribution.

Voluntary confidential incident reporting programs promote the disclosure of human errors, provide the benefit of situations described with candid detail and enable others to learn from mistakes made. Voluntary systems may also produce a higher quality of reporting from individuals motivated by a desire to see an issue pursued.

By protecting the identity of individuals or organizations, confidential reporting systems make it possible to gain the support of the industry and promote incident reporting. ASRS ensures confidentiality by eliminating any information that could identify the flight and the airline, allowing [ASRS] to gather valuable information about incidents, especially regarding the human factors, which is normally difficult to obtain from other sources. Guarantees of confidentiality are ineffective if the organizational conditions enable supervisors or coworkers to deduce who reported a potentially hazardous situation (Tamuz, 1994).

Examples of Confidential Reporting Systems

Since the ASRS system was developed in 1978, many aviation regulatory bodies have followed suit in Britain (Confidential Human Factors

Incident Reporting Program [CHIRP]), Australia (Confidential Aviation Incident Reporting), Canada (Confidential Aviation Safety Reporting Program [currently the Transportation Safety Board of Canada Securitas confidential reporting program]) and South Africa (South African Confidential Reporting System). The British confidential aviation system, CHIRP, which is held by an independent charitable organization, was introduced after it was found that pilot errors were significantly underreported by pilots making the reports. Pilots can make complaints into the system about unsafe or illegal practices by their employers, and it provides evidence of incidents which would otherwise remain unreported, such as ergonomic deficiencies and breaches of discipline.

Other industries, such as the U.K. railway industry, have introduced a confidential reporting system (Confidential Incident Reporting and Analysis System) which is operated by the Centre for Applied Social Psychology at the University of Strathclyde. In addition, the U.S. Nuclear Regulatory Commission (Human Performance Enhancement System [HPES]), petrochemical processing and steel production (Prevention and Recovery Information System for Monitoring and Analysis), U.S. Navy and U.S. Marines (Human Factors Analysis and Classification System) and health care [Medication Errors Reporting Program] have confidential reporting systems in place. Many of these confidential reporting systems have been found to have a direct impact on changing the company's systems, such as introducing new training or redesigning equipment.

The Nuclear Regulatory Commission introduced a human factors confidential reporting system (HPES) in which no penalties are associated with reporting nonconsequential events or "close calls." In the highly charged, political, financially accountable and legal environment of nuclear power, this system was backed by communal pressure and became institutionalized and effective across the industry. The intensified approach to process improvement led to financial gains through more efficient power production (fewer outages, shutdowns and reduction of capacity). The confidentiality and other protections within the system increased in proportion to the sensitivity, value and difficulty of obtaining the desired information (Barach and Small, 2000).

In addition, airline companies, such as British Airways, have implemented their own in-house confidential reporting systems (Human Factors Reporting Program) into their overall safety systems. In British Airways, the benefits of confidential reporting systems have been demonstrated in the increase in information collected from their confidential reporting form (Human Factors Report), compared to their mandatory reporting form (Mandatory Aviation Reporting System), where they believe the Human Factors Reporting Program allows a freer and more complete level of reporting by flight crew.

Berman and Collier (1996) surveyed 50 companies (power generation; aviation; rail; marine transportation; onshore and offshore oil and gas; petrochemical; manufacturing; food and drink) incident reporting systems. The companies used a range of reporting systems such as anonymous, no-blame reporting, and "in-house" and "third-party" confidential reporting schemes. The majority of organizations that had confidential reporting systems used "in-house" systems as opposed to "third-party," and where "third-party" systems were used, they were usually used in addition to the in-house systems.

Anonymous systems existed in many, but not all, companies and even though all of the companies expressed a desire for a culture which obviated its need, they accepted that it was probably not attainable. The majority accepted the need for a hotline, such as the U.K. Health and Safety Executive Hazard Hotline.

In another survey of confidential reporting systems, two-thirds of the 12 reporting systems examined by Barach and Small (2000) were mandated and implemented by federal government with voluntary participation, over three-quarters were confidential and all used narrative descriptions; most offered feedback to their respective communities; some offered legal immunity to reporters as long as data were submitted promptly (e.g., up to 10 days after the event for ASRS).

How can companies transform the current culture of blame and resistance to one of learning and increasing safety? Barach and Small (2000) answered this question with the following three points: by understanding the barriers and incentives to reporting; by introducing norms that inculcate a learning and nonpunitive safety-reporting culture in training programs; and by reinforcing legal protection for reporters. High-risk industries have shown that implementation of incident-reporting systems are essential as they benefit their organization more than they cost the organization.

Disadvantages of Confidential Reporting Systems

Not all companies and safety researchers believe that confidential reporting systems are necessary. Berman and Collier (1996) criticized confidential reporting systems by stating that the value of confidentiality or the need for a no-blame system may not be entirely appropriate, where an overemphasis on confidentiality may hinder companies moving toward an open reporting culture, as it implies that reporters may need to be protected from management.

In addition, other researchers have stated that confidential systems are difficult to validate objectively and it can be difficult for management to accept information from people who wish to remain anonymous (especially managers who are not committed to human factors reporting). However, without such systems, organizations may miss the genuine concerns of crews (O'Leary, 1995). Other limitations of confidential reporting systems are described within the following section.

This section has described some of the ways of collecting detailed information about accidents and incidents, particularly focusing on confidential reporting systems. Industries have found that immunity; confidentiality; independent outsourcing of report collection and analysis by peer experts; rapid meaningful feedback to reporters and all interested parties; ease of reporting; and sustained leadership support are important in determining the quality of reports and the success of incident-reporting systems. The following section describes the steps that need to be taken to implement a confidential reporting system and some of the pitfalls that can occur.

Legal Aspects of Confidential Systems

The rationale for any reporting system is that a valid feedback on the local and organizational factors promoting errors and incidents is far more important than assigning blame to individuals. To this end, it is essential to protect reporters and their colleagues as far as practicable and legally acceptable from disciplinary actions taken on the basis of their reports. But there have to be limits applied to this indemnity. Some examples of where the line can be drawn are to be found in "Waiver of Disciplinary Action Issued in Relation to NASA's Aviation Safety Reporting System" (see U.S. Federal Aviation Administration [FAA] Advisory Circular [AC] 00-46D, "Aviation Safety Reporting Program"; U.S. Federal Aviation Regulations [FARs] Part 193, "Protection of Voluntarily Submitted Information").

One way of ensuring the confidentiality protection and fulfilling the Eurocontrol Confidentiality and Publication Policy is to be found in SRC WP.9.4, "Safety Data Flow" Progress report submitted by Safety Data Flow Task Force. The experience gained in the last three years showed that the Eurocontrol Confidentiality and Publication Policy is functioning and states have started to gain trust in Eurocontrol Safety Regulation Unit/ Safety Regulation Commission. This has to be kept in mind, and the reporting chains should not be jeopardized and compromised by deviation from the mentioned policy. ■

Appendix B
Constraints to a Just Culture

It is neither an obvious nor an easy task to persuade people to file reports on aviation safety occurrences, especially when it may entail divulging their own errors. The three main constraints are personal reasons, trust and motivation.

- Personal: Human reaction to making mistakes does not usually lead to frank confessions. There might be a natural desire to forget that the occurrence ever happened and the extra work required to report is not usually desirable;

- Trust: People may not completely trust the system to keep their details confidential, or they may be worried that they could get themselves or their colleagues into trouble. They may also fear reprisals, depending on the legal environment; and,

- Motivation: Potential reporters cannot always see the added value of making reports, especially if they are skeptical about the likelihood of management acting upon the information; no incentives are provided to voluntarily report in a timely manner and promptly correct their own mistakes.

These three constraints can be further expanded in the following sections. Information is from the GAIN paper, "GAIN: Using Information Proactively to Improve Aviation Safety."

Legal Environment

The legislative environment for accident and incident reporting is partly shaped by the higher-level political and social concerns. The legal position of incident-reporting systems is complicated by differences between different national systems. Incident-reporting systems must define their position with respect to the surrounding legislation and regulatory environment. For example, there are differences in reporting practices in European air traffic control. Some service providers are compelled to report all incidents to the national police force or to state prosecutors who will launch an investigation if they believe that an offense has been committed. This could lead pilots and controllers to significantly downgrade the severity of the incidents that they report in such potentially punitive environments.

Company or Regulatory Sanctions

There is also concern that the information will lead to enforcement proceedings by government regulatory authorities for violations of aviation safety laws and regulations. The threat of regulatory sanctions tends to deter a reporter from submitting complete and factual safety information that may be used against them by regulatory authorities. First, potential information providers may be concerned that company management and/or regulatory authorities might use the information for punitive or enforcement purposes.

Thus, a mechanic[1] [maintenance technician] might be reluctant to report about a confusing maintenance manual that led to an improper installation, fearing that management or the government might disagree about the maintenance manual being confusing, and then punish the mechanic.

Such punishment causes two problems: First, the confusing maintenance manual will still be in use in the system, potentially confusing other mechanics. Second, and far worse, is that such punishment, in effect, "shoots the messenger." By shooting a messenger, management or the government *effectively guarantees that they will never again hear from any other messengers*.

This, in turn, guarantees that those problems in the "unreported occurrences" part of the pyramid will remain unreported — until, of course, they cause an accident or incident, whereupon the testimony at the accident hearing, once again, will be that, "We all knew about that problem."

One aviation regulator, the U.K. Civil Aviation Authority (CAA), announced some years ago that, absent egregious behavior — e.g., intentional or criminal wrongdoing — they would not shoot the messenger, and encouraged their airlines and other aviation-industry employers to take the same approach. That is a major reason why the United Kingdom has some of the world's leading aviation safety information-sharing programs, both government and private. The type of facilitating environment created by the United Kingdom is essential for the development of effective aviation safety information-collection and sharing programs.

Similarly, British Airways gave assurances that they would also not "shoot the messenger" in order to get information from pilots, mechanics and others for British Airways Safety Information System (BASIS). Many other airlines around the world are concluding that they must do the same in order to obtain information they need to be proactive about safety.

Significant progress has also been made on this issue in the United States. In October 2001, FAA promulgated a regulation, modeled on the U.K. example, to the effect that information collected by airlines in FAA-approved flight data recorder information programs (commonly known as flight operational quality assurance [FOQA] programs,[2] will not be used against the airlines or their pilots for enforcement purposes, U.S. Federal Aviation Regulations (FARs) Part 13.401, "Flight Operational Quality Assurance Program: Prohibition Against Use of Data for Enforcement Purposes."

Criminal Proceedings

There may be concern that the information will be used to pursue criminal fines and/or incarceration. The threat of criminal proceedings tends to deter reporters from submitting safety information that may be used against them.

A major obstacle to the collection and sharing of aviation safety information in some countries is the concern about criminal prosecution for regulatory infractions. Very few countries prohibit criminal prosecutions for aviation safety regulatory infractions. "Criminalization" of accidents has not yet become a major problem in the United States, but the trend from some recent accidents suggests the need for the aviation community to pay close attention and be ready to respond.

Civil Litigation

There is concern that the information will increase exposure to monetary liability in civil accident litigation. The threat of civil litigation tends to deter a reporter from submitting safety information that may be discoverable in litigation and possibly used against them in civil action.

One of the most significant problems in the United States is the concern that collected information may be used against the source in civil accident litigation. Significantly, the thinking on this issue has changed dramatically in recent years because the potential benefits of proactive information programs are increasing more rapidly than the risks of such programs. Until very recently, the concern was that collecting information could cause greater exposure to liability. The success stories from the first airlines to collect and use information, however, have caused an evolution toward a concern that not collecting information could result in increased exposure.

This evolution has occurred despite the risk that the confidentiality of information collection programs does not necessarily prevent discovery of the information in accident litigation.

Two cases in the United States have addressed the confidentiality question in the context of aviation accidents, and they reached opposite results. In one case, the judge recognized that the confidential information program would be undermined if the litigating parties were given access to the otherwise confidential information. Thus, he decided, preliminarily, that it was more important for the airline to have a confidential information program than it was for the litigating parties to have access to it (this refers to the accident near Cali, Colombia).

In the other case, the judge reached the opposite result and allowed the litigating parties access to the information (this refers to the accident at Charlotte, North Carolina, U.S.).

As this issue will be decided in future cases, in aviation and other contexts, it is hoped that the courts will favor exempting such programs from the usual — and normally desirable — broad scope of litigation discovery. However, present case law is inconsistent, and future case law may not adequately protect the confidentiality of such programs. Thus, given the possibility of discovery in accident litigation, aviation community members will have to include in their decision whether to establish proactive information programs, a weighing of potential program benefits against the risks of litigation discovery.

Public Disclosure

There is concern that the information will be disclosed to the public, in the media or otherwise, and used unfairly, out of context, to the disadvantage of the provider of the information.

Another problem in some countries is public access, including media access, to information that is held by government agencies. This problem does not affect the ability of the aviation community to create Global Aviation Information Network (GAIN)–type programs, but it could affect the extent to which government agencies in some countries will be granted access to any information from GAIN. Thus, in 1996, FAA obtained legislation, Public Law 104-264, 49 U.S. Code Section 40123, which requires it to protect voluntarily provided aviation safety information from public disclosure.

This will not deprive the public of any information to which it would otherwise have access, because the agency would not otherwise receive the information; but on the other hand, there is a significant public benefit for the FAA to have the information because the FAA can use it to help prevent accidents and incidents.

Definitions of Incidents and Accidents

As we have seen above, companies and their employees have a role to play in filtering accidents and incidents according to what they define as severe enough to report. Some organizations use incident data as an opportunity to learn by discovering their precursors and acknowledging that under slightly different circumstances, the event could have resulted in an accident.

Definitions of incidents that foster learning should be open, unambiguous and sufficiently broad to allow reporters to decide whether or not to include the information. Even though reporters may not benefit directly from reporting an incident, it allows information about unknown hazards to be collected.

Van der Schaaf (1991) argues that it is not good practice to use the same data to learn from and to police, and hence incidents without injury may be a more suitable form of safety data to learn from than incidents resulting in injury, which are mandatory to report and may result in litigation. An organization's interpretation of incidents can influence its choice of information-gathering methods, which in turn affects the quantity and contents of information (Tamuz, 1994).

Types of Incidents

Clarke (1998) found that train drivers' propensity to underreport incidents depended on the type of incident; for example, [a signal passed] at danger (SPD) was most likely to be reported. Furthermore, high levels of reporting were indicative of the priority attached to the type of incident by the organization.

She also found that train drivers reported incidents that posed an immediate hazard but showed less intention to report incidents due to trespassing (even though 41 percent of train accidents in the United Kingdom in 1994–1995 were due to vandalism). One reason given for this underreporting was that they did not want to get someone else into trouble. Train drivers' perceptions of management's negative attitudes to incident reporting were found to reduce drivers' confidence in management and their confidence in the reporting system, and produced a reluctance to report even some serious incidents.

Design of the Reporting Form

The design of the accident-reporting form is another key factor in determining the percentage of accidents that will be recorded (Wright and Barnard, 1975). If it is too time consuming or difficult to complete, the process may not even begin, or the form might not be filled in completely or accurately (Pimble and O'Toole, 1982; Lawson, 1991).

In two studies (Lucas, 1991; Pimble and O'Toole, 1982), the content of reporting forms was found to emphasize the consequences rather than the causes of accidents, hence complete and accurate data were not collected. Pimble and O'Toole (1982) additionally found that insufficient time is allowed for the completion of reports and, hence, insufficient care is taken to ensure that coding is accurate.

The responsibility for accident investigation often rests with the supervisor, who is not always given the skills to do the job properly. In the past, investigators were not familiar with human factors terminology, did not know the difference between immediate and root causes and did not know how to investigate the underlying factors. Therefore, immediate causes became the main culprit (Stanton, 1990). Within a U.K. construction firm, Pimble and O'Toole (1982) found that no standard form was in place, and instead, the company designed their own or adapted existing ones.

Furthermore, there is often no consensus on the purpose and direction of the form (Stanton, 1990). The ideal situation would be that the same report form is used throughout industry, which would be supplemented with a single classification system (Pimble and O'Toole, 1982).

Financial and Disciplinary Disincentives

In the offshore oil industry, financial incentives have been provided to employees for having no lost-time incidents, with the intention of motivating the workforce to work more safely. However, financial incentives are more of an incentive to conceal accidents and incidents to avoid losing financial bonuses and to keep the accident statistics to a minimum.

In a qualitative study of two U.K. offshore oil installations in the North Sea in 1990, Collinson (1999) described the reasons for the underreporting of accidents in which 85 workers were interviewed regarding their opinions of safety on their installation. Although this paper was only recently published, the data are from more than 10 years ago, and safety has improved significantly in the U.K. offshore oil industry since then. Moreover, this is a purely qualitative study, in which the examples are anecdotal and in some cases only a very small number of personnel held these opinions. Despite this, however, the study does highlight examples of substandard reporting procedures which existed in the U.K offshore oil industry 10 years ago and which may still be present today.

Collinson (1999) stated that employees who reported incidents were sometimes indirectly disciplined by being "retrained" or by acquiring a blemished record, thereby encouraging the concealment of self-incriminating information. In addition, he found that contract workers were more likely to conceal accidents because they perceived that being involved in an accident might influence their job security due to being employed on short-term contracts.

In the study, contractors who were involved in an accident were sometimes put on light duties, rather than being sent back onshore, in order that their company did not punish them or cause them to lose out financially. In addition, collective incentive schemes that were tied to safety pay were found to encourage accident concealment and reinforce the blame culture. Management monitored performance with production targets, appraisal systems, performance-related pay, league tables, customer feedback and outsourcing. These examples of accident concealment indicate that a belief in the blame culture had a greater impact on their behavior than the safety culture espoused by management.

Workplace Retribution

Other constraints to reporting include reluctance to implicate self or colleague if subsequent investigations might threaten one's well-being; justified fear of retribution from colleagues/employers (person in authority); disloyalty to colleagues (if they focus on colleagues rather than against management).

Minimizing Incident Statistics

Underreporting by organizations can occur because they are responsible for collecting the incident data as well as responsible for reducing incident frequencies over time. In addition, it is often companies with higher reported rates of incidents that are the focus of regulatory investigation.

Collinson (1999) also reported that offshore employees were encouraged not to report all incidents, so that company records were kept to a minimum. Many of the safety officers confirmed that they had been pressured into downgrading the classification of incidents, such as recording lost-time incidents as restricted-workday cases. The reason given by the safety officers for downgrading the classification of some accidents was because it meant they were asked fewer questions by onshore management.

The onshore safety department was also seen as willing to downgrade classifications, as they were more concerned with achieving British safety awards than ensuring safe work practices. In summary, Collinson (1999) argues that by generating a defensive counterculture of accident and incident concealment, performance assessment was at odds with the safety culture and that underreporting was more likely when employees fear retribution or victimization.

Subcultures: Attitudes to Incident Reporting

Different departments or work teams within an organization may be associated with distinct subcultures and different safety climates that can influence reporting rates (Fleming et al., 1998; Mearns et al., 1998). In particular, work environments in which accident reporting is discouraged often involve "macho" role models, for example in the construction industry (Leather, 1988); the offshore oil industry (Flin and Slaven, 1996; Mearns et al., 1997) and the aviation industry (O'Leary, 1995).

Individuals' Attitudes to Incident Reporting

Researchers have found some links between incident reporting and individual differences. For example, personality in the cockpit was found to influence pilots' propensity to report incidents, where those who scored highly on self-reliance scales tended to have higher levels of guilt, as they took responsibility for mishaps whether or not they were under their control, which may lessen their likelihood of reporting (O'Leary, 1995).

Trommelen (1991, cited by Clarke, 1998) postulated that workers' propensity to report accidents reflects workers' theories of accident causation and prevention to a greater extent than it does the actual frequency of incidents. Statements such as "accidents cannot be prevented" (personal skepticism), "an accident won't happen to me" (personal immunity) and "incidents are just part of the job" are labeled as "unconstructive beliefs" by Cox and Cox (1991).

In a questionnaire study of U.K. train drivers, Clarke (1998) found that very few drivers reported other drivers' rule-breaking behaviors (3 percent), where a third of drivers felt that rule breaking by another driver was not worth reporting. She also found that train drivers were less likely to report incidents if they considered managers would not be concerned with such reports. High levels of nonreporting were most evident when workers felt that incidents were just "part of the day's work" (i.e., "fatalistic attitude") and that "nothing would get done" (i.e., perceptions or beliefs that management is not committed to safety).

These findings indicate that incidents are not reported because they are accepted as the norm, which was further reinforced when drivers perceived that reporting an incident would not result in any action being taken, indicating a lack of commitment by management. However, the results also indicate that drivers would be more likely to report an incident if they thought something would be done to remedy the situation.■

Notes

1. The example is from the airborne environment, but it may well be the case for the air traffic control community.
2. Flight operational quality assurance (FOQA) programs complement Aviation Safety Action Programs (ASAP), announced in January 2001 by the U.S. president, in which airlines collect reports from pilots, mechanics, dispatchers and others about potential safety concerns.

Appendix C
Different Perspectives

International Civil Aviation Organization (ICAO) Perspective

The ICAO position is stated very clearly in Annex 13, Section *Non-disclosure of records* — para. 5.12:

> *The state conducting the investigation of an accident or incident shall not make the following records available for purposes other than accident or incident investigation, unless the appropriate authority for the administration of justice in that state determines that their disclosure outweighs the adverse domestic and international impact such action may have on that or any future investigations:*
>
> *a) All statements taken from persons by the investigation authorities in the course of their investigation;*
>
> *b) All communications between persons having been involved in the operation of the aircraft;*

> *c) Medical or private information regarding persons involved in the accident or incident;*
>
> *d) Cockpit voice recordings and transcripts from such recordings; and,*
>
> *e) Opinions expressed in the analysis of information, including flight recorder information.*
>
> *5.12.1. These records shall be included in the final report or its appendixes only when pertinent to the analysis of the accident or incident. Parts of the records not relevant to the analysis shall not be disclosed.*
>
> *Note: Information contained in the records listed above, which includes information given voluntarily by persons interviewed during the investigation of an accident or incident, could be utilized inappropriately for subsequent disciplinary, civil, administrative and criminal proceedings. If such information is distributed, it may, in the future, no longer be openly disclosed to investigators. Lack of access to such information would impede the investigative process and seriously affect flight safety.*

Related to the subject of nondisclosure of certain accident and incident records, ICAO has issued a state letter (dated Jan. 31, 2002) enclosing the Assembly Resolution A33-17 (Ref.: AN 6/1-02/14). A copy of the letter and enclosure has been circulated for information and reference at SRC13 in February 2002. The letter basically introduces the Resolution A33-17, whereas the ICAO Assembly "urges contracting states to examine and if necessary to adjust their laws, regulations and policies to protect certain accident and incident records in compliance with paragraph 5.12. of Annex 13, in order to mitigate impediments to accident and incident investigations."

Regulatory Perspective

The U.K. Civil Aviation Authority (CAA, 1993) requires that human error events be reported to the authority for safety analysis:

> *Where a reported occurrence indicated an unpremeditated or inadvertent lapse by an employee, the authority would expect the employer to act responsibly and to share its view that free and full reporting is the primary aim, and that every effort should be made to avoid action that may inhibit reporting. The authority will accordingly make it known to employers that, except to the extent that action is needed in order to ensure, and except in such flagrant circumstances as described, it expects them to refrain from disciplinary or punitive action which might inhibit their staff from duly reporting incidents of which they may have knowledge.*

An Airline Perspective

ABC Airlines (pseudonym) disciplinary policy, used by an international air carrier: ABC Airlines understands that it needs a safety and security culture that embraces highest corporate and industry standards. To do this, ABC Airlines requires a willingness to address and remedy all operational shortcomings as soon as possible. This relies on having a comprehensive reporting of all incidents that pose hazards to the customers, staff or operations. All safety issues must be reported without exception. The company is committed to the greatest possible openness in reporting:

> *No blame will be apportioned to individuals following their reporting of mishaps, operational incidents or other risk exposures, including those where they themselves may have committed breaches of standard operating procedures. The only exceptions to this general policy of no blame apportionment relate to the following serious failures of staff members to act responsibly, thereby creating or worsening risk exposures.*
>
> - *Premeditated or [intentional] acts of violence against people or damage to equipment/property;*
> - *Actions or decisions involving a reckless disregard toward the safety of our customers, our fellow employees or significant economic harm to the company; or,*
> - *Failure to report safety incidents or risk exposures as required by standard operating procedures and/or this policy.*
>
> *Staff who act irresponsibly in one of these ways remain exposed to disciplinary action.*

A staff member's compliance with reporting requirements will be a factor to be weighed in the company's decision making in such circumstances. Outside these specific and rarely invoked exceptions, staff members who make honest mistakes or misjudgments will not incur blame — provided that they report such incidents in a proper fashion.

This disciplinary policy reasonably balances the benefits of a learning culture with the need to retain personal accountability and discipline.

Air Navigation Service Providers

The Eurocontrol Performance Review Unit (on behalf of the Performance Review Commission) conducted a survey of the legal constraints, as well as the potential shortfalls in the national safety regulations that would not support nonpunitive reporting in air traffic management. The report found that the main legal issues of safety reporting are about personal data protection and the use of safety data, in particular that arising from the investigation. The respondents thought that it is important that the reporting system is trusted by all interested parties and that reporters need to feel that they will not be penalized through public exposure within or outside their organization for reporting routine, unintentional (honest) mistakes (see 2.1.3). [This applies] particularly with regard to the potential use of the information in court. Some states have addressed this conflict by offering protection to parties reporting honest mistakes.

The majority of respondents considered that their states' national safety regulations did not explicitly mandate the implementation of a nonpunitive environment. Two of the key messages that emerged from the survey were that in many states there are significant legal constraints to nonpunitive reporting in air traffic management. As a result, many staff feel inhibited about reporting. This is particularly the case where states have "freedom of information" legislation in place and where they have not taken steps to protect safety reports from the application of such legislation. The overwhelming majority of respondents (including non-European Union [EU] States) saw EU legislative proposals as a major enabler to implement nonpunitive reporting.

International Federation of Air Traffic Controllers' Associations (IFATCA)

From the 43rd Annual IFATCA Conference in Hong Kong in March 2004, the following comments were discussed regarding the implementation of a just culture. The 2.1.1. IFATCA policy on page 4 4 2 3, paragraph 2.2, *Air safety reporting systems* is that

Whereas IFATCA thinks a voluntary reporting system is essential, member associations should promote the creation of air safety reporting systems and confidential reporting systems among their members.

Additionally,

IFATCA shall not encourage member associations to join a voluntary incident reporting system unless there is a guaranteed immunity for the controller who is reporting. Any voluntary incident reporting system shall be based on the following principles:

a) In accordance and in cooperation with the pilots, air traffic controllers and air traffic control authorities;

b) The whole procedure shall be confidential, which shall be guaranteed by law;

c) Guaranteed immunity for those involved, executed by an independent body.

See also the section on "Collective Aviation Opinion" from the 43rd Annual IFATCA conference, which briefly describes the viewpoints of aviation organizations on prosecution of employees and the resultant effect on safety.

International Federation of Air Line Pilots' Associations (IFALPA)

In a recent statement to the world's media, the IFALPA president strongly denounced the growing trend of apportioning blame following aviation accidents. This threat of civil or criminal proceedings for violations of aviation safety laws and regulations is having a profound and damaging effect on the flow of precious aviation safety information, which is essential if lessons are to be learned from accident investigations.

IFALPA is supported by many prominent international organizations in its concern. ■

Appendix D
Glossary of Acronyms

AAIB	Air Accidents Investigation Branch (U.K. Civil Aviation Authority)
ANSP	Air navigation service provider
ARS	Mandatory Aviation Reporting System (British Airways)
ASAP	Aviation Safety Action Program
ASRS	Aviation Safety Reporting System
ATC	Air traffic control
ATCO	Air traffic control operator
ATM	Air traffic management
BASIS	British Airways Safety Information System
CAA	Civil aviation authority
CHIRP	Confidential Human Factors Incident Reporting Program
CIRAS	Confidential Incident Reporting and Analysis System (U.K. railway industry)
ERS	Error Reporting System (U.K. CAA)
ESAAR	Eurocontrol Safety Regulatory Requirements
EU	European Union
Eurocontrol	European Organization for the Safety of Air Navigation
FAA	U.S. Federal Aviation Administration
FOQA	Flight operational quality assurance
GA	General aviation
GAIN	Global Aviation Information Network
HFACS	Human factors analysis and classification system
HFRP	Human Factors Reporting Program (British Airways)
HR	Human resources
IEP	Internal Evaluation Program
IATA	International Air Transport Association
IAEA	International Atomic Energy Agency
ICAO	International Civil Aviation Organization
IFALPA	International Federation of Air Line Pilots' Associations
IFATCA	International Federation of Air Traffic Controllers' Associations
MAs	Member associations
MERP	Maintenance Error Reduction Policy
MOR	Mandatory Occurrence Reporting
NASA	U.S. National Aeronautics and Space Administration
N.Z.	New Zealand
Ops	Operations
SAASCo	South African Confidential Reporting System
SIDD	Safety Investigation and Data Department (U.K. CAA)
SOP	Standard operating procedure
SPD	Signal passed at danger (railway industry)
SRC	Eurocontrol Safety Regulation Commission
SRU	Eurocontrol Safety Regulation Unit
U.K.	United Kingdom
WG	Working group

Appendix E
Report Feedback Form

Please submit this form to:

GAIN Working Group E (WG E)
c/o RS Information Systems, Inc.
1651 Old Meadow Road
McLean, Virginia 22102 USA
Fax: +1 (202) 267-5234; E-mail: WGE@gainweb.org

Name: ______________________________

Title/Position: ______________________________

Organization: ______________________________

Mailing Address: ______________________________

____

Phone: __________ Fax: __________ E-mail: ______________

1. How useful is this report to your organization? (Please circle one)

   not useful — 1 2 3 4 5 — very useful

2. Do you plan to use this report to help implement a "just culture" in your organization? If so, what information will be most helpful to you?

3. What information would you like to see added to this report?

4. What activities should WG E undertake that would be most useful to your organization?

5. Would you or someone in your organization be interested in participating in WG E?

   Yes/No

6. Would you like to be added to our mailing list?

   Yes/No

7. Other comments/suggestions

U.K. Commercial Air Transport Airprox Rates Declined Following TCAS Adoption

Incidents in which the in-flight separation of aircraft was compromised trended lower in the 1994–2003 period, despite an overall increase in the annual flight hours.

— FSF EDITORIAL STAFF

The 64 airproxes[1] involving at least one aircraft in commercial air transport (CAT)[2] in U.K. airspace in 2003 represented a reduction from the annual average of 93.8 for the previous nine years. This number also was the lowest of the 1994–2003 period. The 2003 airprox rates (per 100,000 flight hours) for the combined two highest risk categories increased compared with 2002 but remained lower than the average rate for the previous nine years.

Data from a report by the U.K. Airprox Board (UKAB), an independent organization sponsored jointly by the U.K. Civil Aviation Authority and the U.K. Ministry of Defence, showed that there were no airproxes in the highest risk category, A, in 2003. The trend was downward in the study period (Table 1, page 36), and there was only one category A airprox from 2001 through 2003.

Airproxes are ranked by the UKAB at the following risk levels:

- Category A: Risk of collision. An actual risk of collision existed;
- Category B: Safety not assured. The safety of the aircraft was compromised;
- Category C: No risk of collision; and,
- Category D: Risk not determined. Insufficient information was available to determine the risk involved, or inconclusive

or conflicting evidence precluded such determination.

Table 1 shows that 53 (82.8 percent) of airproxes in 2003 were in Category C. In the previous nine-year period, 654 (77.5 percent) were in Category C.

Eleven (17.2 percent) of airproxes in 2003 were in Category B. That compared with 139 (16.5 percent) in the previous nine-year period.

Comparing the total airprox data (Figure 1) with the flight hours data shows that although flight hours increased during the study period, the total

Table 1
U.K. CAT Airproxes, by Risk Category, 1994–2003

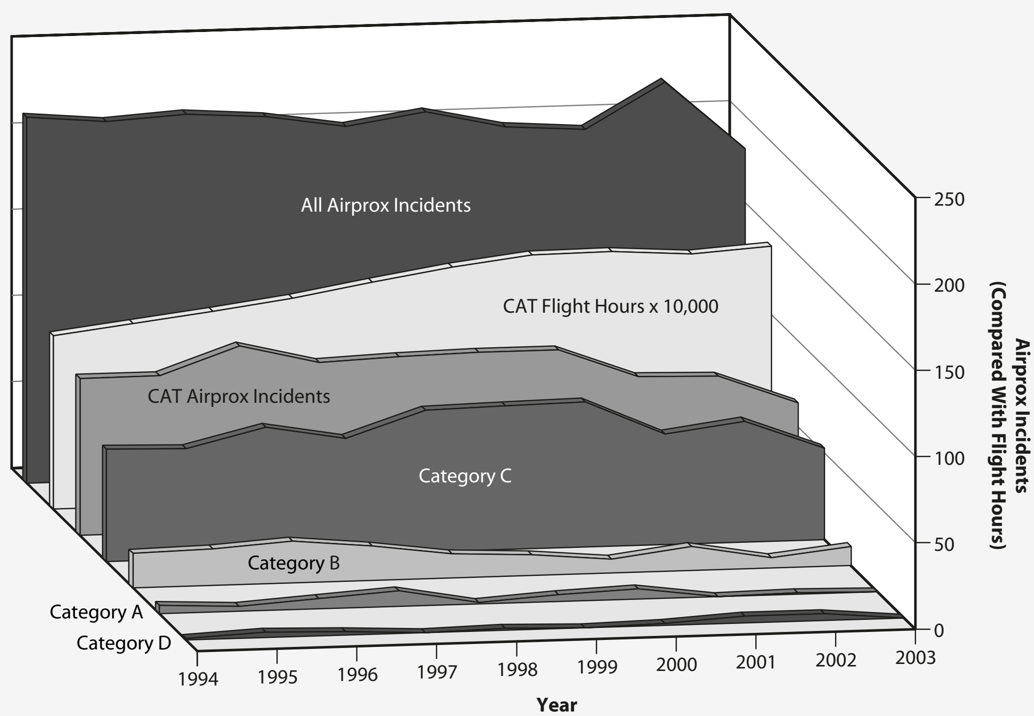
	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Category A	5	3	6	9	1	4	6	0	1	0
Category B	20	21	24	20	14	12	8	14	6	11
Category C	65	64	75	67	82	83	84	64	70	53
Category D	1	3	2	0	1	0	1	4	4	0
Total airproxes	91	91	107	96	98	99	99	82	81	64
Flight hours (thousands)	1,004	1,061	1,118	1,179	1,259	1,332	1,389	1,395	1,366	1,397

CAT = Commercial air transport

Category A: Risk of collision; Category B: Safety not assured; Category C: No risk of collision; Category D: Risk not determined

Source: U.K. Airprox Board

Figure 1
U.K. Airprox Distribution, by Risk Category and Flight Hours, 1994–2003



CAT = Commercial air transport

Category A: Risk of collision; Category B: Safety not assured; Category C: No risk of collision; Category D: Risk not determined

Source: U.K. Airprox Board

airproxes did not increase correspondingly. CAT airproxes represented less than half of the total number of airproxes, the report said.

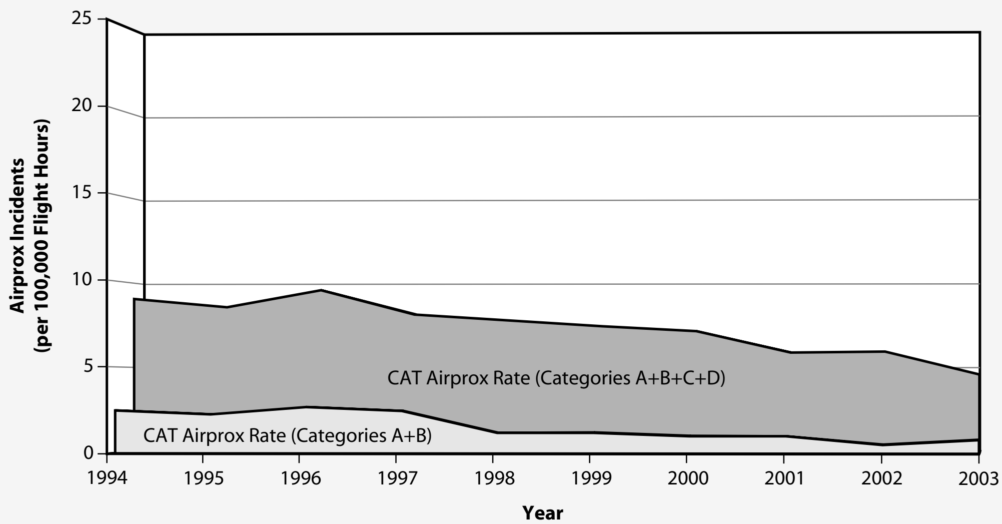
"None of these results support the broad notion that more flying leads inevitably to more [airprox] risk," said the report. Nevertheless, the type of airspace involved was a factor. "For example, four of the 11 risk [Category] B incidents experienced by CAT pilots in 2003 happened outside regulated airspace, where the scope for unexpected encounters is much greater," said the report.

The CAT airprox rate per 100,000 flight hours also declined during the study period (Figure 2 and Table 2), although the rate for combined Category A and Category B increased in 2003 from 2002. This 2003 rate of 0.79 airproxes per 100,000 flight hours compared with 0.51 for 2002 and 1.64 for the previous nine-year period.

"The steep reduction in 1998 of the [airprox] rate coincides with the introduction of TCAS [traffic-alert and collision avoidance system]," said the report. "Thereafter, the … rate has remained consistently well below pre-1998 figures."

The report analyzed airprox causal factors in CAT operations (Table 3, page 38). The

Figure 2
U.K. CAT Airprox Rate Distribution, by Risk Category, 1994–2003



CAT = Commercial air transport

Category A: Risk of collision; Category B: Safety not assured; Category C: No risk of collision; Category D: Risk not determined

Source: U.K. Airprox Board

Table 2
U.K. CAT Airprox Rates per 100,000 Flight Hours, by Combined Risk Categories, 1994–2003

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Categories A+B rates	2.49	2.26	2.68	2.46	1.19	1.2	1.01	1.00	0.51	0.79
Categories A+B+C+D rates	9.06	8.58	9.57	8.14	7.78	7.43	7.13	5.88	5.93	4.58
Flight hours (thousands)	1,004	1,061	1,118	1,179	1,259	1,332	1,389	1,385	1,366	1,397

CAT = Commercial air transport

Category A: Risk of collision; Category B: Safety not assured; Category C: No risk of collision; Category D: Risk not determined

Source: U.K. Airprox Board

Table 3
Most Common Causal Factors in U.K. CAT Airproxes, 2003

Rank	UKAB Causal Factor	Number of Times Reported	Attributed by UKAB to
1	Penetration of airspace without clearance	17	Pilot
2	Did not separate/poor judgment	16	Controller
3	Not obeying orders/following advice from ATC	8	Pilot
4	"Level busts" (altitude deviations)	7	Pilot
5	Undetected readback error	5	Controller
6	FIR conflict[1]	5	Other
7	Did not adhere to prescribed procedures/instructions	4	Controller
8	Bandboxing[2]/high workload	4	Other
9	Late sighting of conflicting traffic	4	Pilot
10	Sighting report[3]	4	Pilot
11	Did not adhere to prescribed procedures	4	Pilot

ATC = Air traffic control CAT = Commercial air transport UKAB = U.K. Airprox Board

Note: A single airprox could have more than one UKAB causal factor.

[1]Conflict between two (or more) aircraft in uncontrolled Class G airspace, the "open FIR" (flight information region)

[2]When two (or more) sectors of airspace are "amalgamated" with aircraft in the enlarged area under one controller

[3]Indicates that, in the UKAB's view, the safety of the aircraft involved has not been compromised in any way.

Source: U.K. Airprox Board

causal factor associated with the most airproxes (17) during 2003 was penetration of the airspace without a clearance from air traffic control by general aviation aircraft or military aircraft. That causal factor, the report said, comprised 10 airproxes involving general aviation aircraft (two of which resulted in Category B airproxes) and seven airproxes involving military aircraft (two of which resulted in Category B airproxes).

"Controllers who did not separate, or exercised poor judgment in trying to separate, aircraft under their control occupied second position [among causal factors]," said the report. ■

Notes

1. The definition used for airprox is "a situation in which, in the opinion of a pilot or a controller, the distance between aircraft as well as their relative positions and speed was such that the safety of the aircraft involved was, or may have been, compromised."

2. Commercial air transport included scheduled and nonscheduled passenger flights in airliners and helicopters, as well as cargo flights.

STATS

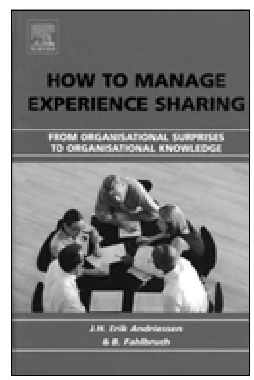
Sharing Organizational Knowledge Poses Challenges Beyond Information Technology

Contributors to a symposium on organizational knowledge say that knowledge includes individual experiences that cannot be transmitted readily through formal informational channels. But some organizations have developed alternative systems to propagate a 'knowledge base.'

— FSF LIBRARY STAFF

Books

How to Manage Experience Sharing: From Organisational Surprises to Organisational Knowledge. Andriessen, J.H. Erik; Fahlbruch, Babette (eds.). Oxford, England, and St. Louis, Missouri, U.S.: Elsevier, 2004. 319 pp. Figures, tables, references, index.

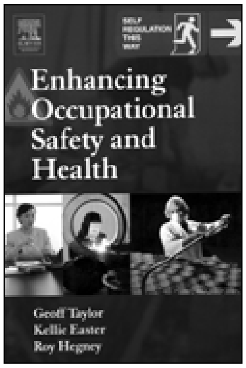


The book consists of papers derived from a 2001 workshop produced by NeTWork, an international, interdisciplinary group that studies "social and scientific problems posed by the diffusion of modern technologies in all domains of work life." The papers examine, from various angles, the transmission of organizational knowledge — often called "organizational memory" — including its connection with safety.

An underlying theme in the papers is the need for organizations to learn from their mistakes (which often come in the form of surprises) and successes, so that individuals within them can work from a knowledge base built by their colleagues and predecessors. In this view, knowledge differs from information, and although technology is capable of storing and making accessible huge amounts of information, technology is inadequate for conveying experience.

"Information is not knowledge, and availability does not guarantee actual use of what is available," say the editors. "Knowledge is information that is experienced and interpreted by humans; knowledge implies expectations and attitudes. Knowledge, moreover, can be explicit, but also can be [unspoken]. A project leader's knowledge concerning a project he has finished contains all the experience with the tools and the clients and the competition, why it took so long to finish, why he finally chose a certain strategy, how he succeeded in persuading the client, etc.

"This is the type of knowledge a colleague might want to hear if she is in a comparable position, and which the project leader is quite willing to tell her. But he loathes to put the whole story in a data system, for many reasons: It takes too much time, he does not exactly know what to write, [and] he certainly does not like to write down his mistakes into a large and impersonal database."



One way that a database can be used to capture knowledge — particularly knowledge based on learning from failures —is to ensure that knowledge can be placed on record without its source being identified publicly, say the editors. They cite the example of the Aviation Safety Reporting System (ASRS) that is administered by the U.S. National Aeronautics and Space Administration (NASA).[1] The system allows pilots, air traffic controllers, cabin crewmembers, maintenance technicians and others to report confidentially noncompliance with regulations or procedures.

Shared knowledge based on successes can be encouraged through various strategies in the general category of "personalization," or direct interaction among people with different experiences or levels of experience, say the authors of one chapter. One such strategy is the encouragement of "communities of practice," based on involving individuals who share an interest in a certain knowledge domain.

"A community builds capability in its practice by developing a shared repertoire and resources such as tools, documents, routines, vocabulary, stories, symbols, artifacts and heroes that embody the accumulated knowledge of the community," say the authors. "This shared repertoire serves as a foundation for future learning." Communities of practice need not be members of the same organizational unit and may be geographically distant from one another.

Enhancing Occupational Safety and Health.
Taylor, Geoff; Easter, Kellie; Hegney, Roy.
Amsterdam, Netherlands: Elsevier Butterworth-Heinemann, 2004. 617 pp. Figures, tables, appendixes, references, photographs, index.

Given enough data, specialists can quantify workplace risk — not for any particular individual, but as a rate among a sufficient number of people. Nevertheless, say the authors, "The technically competent, while having the knowledge to quantify risks, are no more entitled than anyone else to decide who should be exposed to these risks, or the level of risk which is acceptable."

Those whose profession it is to maintain workplace risk at or below the levels that have been deemed acceptable by society cannot be concerned merely with technically determined measures of risk, say the authors; they must also take into account workers' perceptions of risk.

"Blue asbestos, in certain circumstances, [has] given a relatively high number of people … a lung disease which is normally very rare," say the authors. "Unfortunately, however, this has led to extreme demands in relation to other types of asbestos in other situations. The problem is that when we spend money on health and safety, as a general rule, we need to put the money into those areas where the greatest reduction in accidents or the more severe injuries can be achieved. Irrational perceptions can lead to scarce funds going to areas where little or nothing will be achieved, while other more important areas are neglected.

"Nevertheless, the sensitivity of the issue cannot be ignored. If people are worried, irrationally or not, about a hazard in their workplace, particularly one which can't be seen, heard, felt, touched or smelled (like radon or a biological hazard), then it will affect their performance and stress levels and may be a source of costly high labor turnover."

The authors discuss technical factors and human factors in numerous areas of occupational safety and health (OSH) management:

- Origin and types of law influencing occupational health and safety;
- Hazards and threats to safety and health in the workplace;
- Health and ergonomics in the work environment;
- Safety training and health training;
- Health and safety management systems; and,
- Inspections and audits.

The chapter about workplace inspections and audits explains the difference between the two. "Workplace inspections are an important part of any accident prevention or risk management program," say the authors. Inspections should be conducted to check specific workplace conditions, to measure performance, to ensure that acceptable standards are being achieved and to monitor the work environment to identify accident-causation factors and hazards.

The authors say, "The safety audit expands the concept of inspections beyond the readily visible aspects of the work environment to include the qualitative elements that are not easily measured." The safety audit focuses on quantitative information available through data. It identifies how hazard and accident causation factors are recognized, reported and controlled. The safety audit also examines the effectiveness of policies and rules, reporting techniques and training.

Regardless of the severity of an outcome, the authors say, "The causation factors which gave rise to the accident and created the hazard remain unchanged." Information on no-detectable-damage (NDD) accidents must be collected, analyzed and acted on if hazards and injuries are to be avoided.

The authors discuss OSH in an international context. Although the book focuses on self-regulation of OSH, it acknowledges the risk-management approach and the prescriptive approach as practiced in various countries.

The book contains references to select regulations, codes, guidance documents and standards that may be applicable in specific jurisdictions and under certain circumstances. There is an abbreviated guide to OSH administrative and professional organizations and OSH legislation in 42 countries. International organizations, like the United Nations and European Union, are also mentioned.

Reports

Employee Attitudes Within the Federal Aviation Administration. Hackworth, Carla A.; Cruz, Crystal E.; Goldman, Scott; Jack, Dan G.; King, S. Janine; Twohig, Paul. U.S. Federal Aviation Administration (FAA) Office of Aerospace Medicine. DOT/FAA/AM-04/22. December 2004. 24 pp. Figures, tables, appendix, references. Available on the Internet at <www.cami.jccbi.gov> or through NTIS.*

In 1981, following an air traffic controllers' strike (work stoppage), the U.S. Congress directed FAA to assess employee attitudes. Employee attitude surveys (EAS) have been administered periodically since 1984, most recently in 2003. Although the content of the surveys has changed over the years, the core areas of interest have remained the same.

This most recent survey was sent to almost 50,000 employees, with a 46 percent return rate. The survey covered 129 items organized into three major sections. They were as follows:

- Indicators of satisfaction measured employee attitudes toward job satisfaction, supervisor satisfaction, satisfaction with compensation, satisfaction with recognition received and organizational commitment;
- Several categories were related to management and work-environment issues, measuring employee attitudes toward performance management, performance focus, resources, leadership, communication, conflict management, and model work environment. Within these categories were specific items about communication, recognition and rewards, supervisory fairness, employee confidence in supervisors, trust and accountability; and,
- Respondent demographics included data on FAA tenure, present job tenure, job role, gender, region, age, education, and race or ethnicity.

The rating scale for each item ranged from low to high to indicate levels of agreement (e.g., "I trust FAA management"), levels of satisfaction (e.g., "How satisfied are you with your job overall?") or extent (e.g., "To what extent do you have the tools needed to perform your job efficiently?").

The report says, "The FAA, by and large, has a committed workforce with a high level of job satisfaction. However, FAA employees do not believe that poor performers are held accountable." Poor performance will need to be reviewed by management to understand how to link accountability, performance and compensation, says the report.

Accountability, performance and other survey results are used to measure FAA's progress regarding action plans that were established previously as organizational performance indicators.

A copy of the "2003 Employee Attitude Survey" appears in the appendix.

Regulatory Materials

Ground Deicing and Anti-Icing Program. U.S. Federal Aviation Administration (FAA) Advisory Circular (AC) 120-60A. Aug. 3, 2004. Tables, appendixes, references. 24 pp. Available from FAA via the Internet at <http://www.airweb.faa.gov/rgl> or from the U.S. Department of Transportation (USDOT).**

This AC has been updated to reflect changes in industry practices over the past 10 years. It provides information on industry-wide standards for the application and approval processes associated with ground deicing/anti-icing training programs for certificate holders following U.S. Federal Aviation Regulations (FARs) Part 121, *Operating requirements: Domestic, flag and supplemental operations*, section 121.629, "Operation in Icing Conditions."

The AC defines anti-icing as "a procedure used to provide protection against the formation of frost or ice and accumulation of snow or slush on clean surfaces of the aircraft for a limited period of time (holdover time)." The AC defines deicing as "a procedure used to remove frost, ice, slush or snow from the aircraft in order to provide clean surfaces."

Part 121.629 requires a certificate holder's ground deicing and anti-icing program to include these elements:

- A management plan that exercises operational control and ensures proper execution of its approved deicing/anti-icing program;
- Deicing/anti-icing fluid application procedures for each type of aircraft operated;
- Holdover time (HOT) tables and procedures for their use;
- Identification of frozen contaminants on an aircraft, recognition techniques and identification of critical aircraft surfaces;
- Procedures for conducting icing checks — pre-takeoff checks by flight crews, pre-takeoff contamination checks by flight crews and qualified ground personnel, and post-deicing/anti-icing checks by ground personnel;
- Communication procedures between ground personnel and flight crews; and,
- Initial and annual recurrent ground training and qualification for flight crews, dispatchers and ground personnel.

FAA says, "A certificate holder, with a ground deicing and anti-icing program approved in accordance with this AC, may deice and anti-ice aircraft using another certificate holder's ground deicing and anti-icing program that is [also] approved in accordance with this AC."

Appendixes contain sample HOT tables for use in departure planning and pre-takeoff check procedures. Sample tables compare holdover times for three different fluid mixtures (SAE types I, II and IV) as weather conditions change and ambient temperatures change.

A sample form for an aircraft deicing/anti-icing training roster and a station deicing/anti-icing confirmation sample form are included.

[This AC cancels AC 120-60, *Ground Deicing and Anti-Icing Program*, dated May 19, 1994.]

Certification of Part 23 Airplanes for Flight in Icing Conditions. U.S. Federal Aviation Administration (FAA) Advisory Circular (AC) 23.1419-2C. July 21, 2004. Tables, appendixes, glossary, references. 96 pp. Available from FAA via the Internet at <www.airweb.faa.gov/rgl> or from the U.S. Department of Transportation (USDOT).**

This AC provides guidance on methods that demonstrate compliance with icing-protection requirements in U.S. Federal Aviation Regulations (FARs) Part 23, *Airworthiness standards: Normal, utility, acrobatic and commuter category airplanes*. FAA says that it "will consider other methods of demonstrating compliance that an applicant may elect to present."

This guidance document applies to approval of airplane icing-protection systems that operate in icing environments, as defined by FARs Part 25, *Airworthiness standards: Transport category airplanes*, Appendix C, "Icing Envelope." Icing conditions in Appendix C are specified in terms of altitude, temperature, liquid-water content, representative droplet size, cloud extent and other factors.

More specifically, FAA says that this "guidance should be applied to new type certificates (TCs), supplemental TCs and amendments to existing

TCs for airplanes under Part 3 of the U.S. Civil Aviation Regulations (CARs) and [FARs] Part 23 for which approval under the provisions of [FARs Part] 23.1419 is desired." Section 23.1419 addresses deicer boot requirements for airplane type-certification applications made on or after Feb. 1, 1965. Historical background on the evolution of CARs and FARs governing deicing is described.

Information in this AC, says FAA, is neither mandatory nor regulatory. The AC contains detailed technical information on numerous topics. Some topics are:

- The certification plan and FAA concurrence;
- Design objectives for safely operating throughout the icing envelope of FARs Part 25;
- Areas and components of aircraft to be protected and degree of protection;
- Analyses of test data to substantiate decisions and assumptions made regarding icing-protection equipment;
- Visual detection of ice accretions and in-flight icing-detection systems;
- Flight test plans to evaluate degradation in performance and flying/handling qualities;
- Three stages of flight tests — initial dry-air tests with icing-protection equipment installed and operating; dry-air tests with predicted simulated ice shapes installed; and flight tests in icing conditions;
- Types of icing conditions to be tested;
- Ice-accretion definitions for normal icing-protection system operations — by phase of flight and by aircraft category, such as commuter, normal, utility and acrobatic;
- Instructions for continued airworthiness, testing and repairs; and,
- Harmonization between FAA and the European Aviation Safety Agency (EASA).

The AC contains a list of related documents for supplemental research — FAA technical reports, ACs and technical standard orders; SAE International (formerly Society of Automotive Engineers)-recommended practices; an Australian standard and an American Society for Testing and Materials (ASTM) standard.

[This AC cancels AC 23.1419-2B, *Certification of Part 23 Airplanes for Flight in Icing Conditions*, dated Sept. 26, 2002. "All policy related to the certification of ice protection systems on Part 23 airplanes, issued prior to this AC, is cancelled," says FAA.] ■

Note

1. The U.S. National Aeronautics and Space Administration (NASA) Aviation Safety Reporting System (ASRS) is a confidential incident-reporting system. The ASRS Program Overview says, "Pilots, air traffic controllers, flight attendants, mechanics, ground personnel and others involved in aviation operations submit reports to the ASRS when they are involved in, or observe, an incident or situation in which aviation safety was compromised. … ASRS de-identifies reports before entering them into the incident database. All personal and organizational names are removed. Dates, times and related information, which could be used to infer an identity, are either generalized or eliminated."

   ASRS acknowledges that its data have certain limitations. ASRS *Directline* (December 1998) said, "Reporters to ASRS may introduce biases that result from a greater tendency to report serious events than minor ones; from organizational and geographic influences; and from many other factors. All of these potential influences reduce the confidence that can be attached to statistical findings based on ASRS data. However, the proportions of consistently reported incidents to ASRS, such as altitude deviations, have been remarkably stable over many years. Therefore, users of ASRS may presume that incident reports drawn from a time interval of several or more years will reflect patterns that are broadly representative of the total universe of aviation safety incidents of that type."

Sources

* National Technical Information Service (NTIS)
5285 Port Royal Road
Springfield, VA 22161 U.S.
Internet: <www.ntis.gov>

** U.S. Department of Transportation (USDOT)
Subsequent Distribution Office, M-30
Ardmore East Business Center
3341 Q 75th Ave.
Landover, MD 20785 U.S.

B-737's Tires Sink in Blast-protection Surface After Wrong Turn

The report by the Australian Transport Safety Bureau said that just before making the turn, the flight crew had received confirmation from air traffic control that the airplane was in the proper position and that the crew's positioning plans were correct.

— FSF EDITORIAL STAFF

The following information provides an awareness of problems through which such occurrences may be prevented in the future. Accident/incident briefs are based on preliminary information from government agencies, aviation organizations, press information and other sources. This information may not be entirely accurate.

AIR CARRIER

Incident Prompted Review of Holding-bay Markings

Boeing 737-300. No damage. No injuries.

The airplane was being taxied to the runway at an airport in Australia at 1740 local time for departure on a flight to New Zealand. The surface movement controller had told the crew to taxi on Taxiway Sierra and Taxiway Echo to the Runway 27 holding point on Taxiway Papa; as the airplane approached Taxiway Sierra, the crew requested and received confirmation of the taxi instructions and then contacted the aerodrome controller (ADC).

The incident report said, "The flight crew subsequently reported that while taxiing east along [Taxiway] Echo, their attention had been drawn to the lighting associated with the apron works near the intersection of [Taxiway] Tango and [Taxiway] Papa. There was a holding bay located north of [Taxiway] Echo, and the first lead-in light to the holding bay was about 40 meters [131 feet] west of the first lead-in light to [Taxiway] Papa. As the aircraft approached the lead-in lights to the holding bay, the pilot-in-command stopped the aircraft. The copilot asked the ADC, 'Is it hard left Papa here?'"

The ADC was in the airport control tower about 1,450 meters (4,757 feet) west-southwest of the airplane, and from that location and in nighttime lighting conditions, the airplane would have appeared to be at the lead-in light to Taxiway Papa. The ADC confirmed to the crew that the airplane was at Taxiway Papa.

The crew turned the airplane left into the holding bay but quickly realized that the airplane was no longer on a taxiway and turned right to reenter Taxiway Echo and continue to Taxiway Papa.

The captain said later that lights from another airplane obscured his vision and that he "misidentified the double lines on the taxiway shoulder as being the taxiway centerline." As a result, he inadvertently steered the airplane onto the blast-protection surface next to the taxiway shoulder pavement. The tires on the left main landing gear sank several inches into the surface, and the airplane became stuck. The 104 people in the airplane were disembarked and were transported back to the terminal.

As a result of the incident, the operator issued information to its flight crews about airport operations, including cockpit procedures for maintaining situational awareness and operational factors and human factors involved in runway incursions. The airport operator was reviewing options for improving the delineation of holding bays.

Ball-bearing Failure Cited in Loss of Engine Power

Airbus A340-300. No damage. No injuries.

The airplane was being flown at Flight Level 350 (approximately 35,000 feet) on a flight from Canada to Hong Kong when the pilots felt airframe vibration and observed a spontaneous shutdown of the no. 1 engine. All flight deck indications involving the no. 1 engine had been normal until the shutdown. The pilots secured the engine and diverted to an en route airport.

An investigation revealed that the engine had failed because of damage to the balls in the inner race of the ball bearing on the drive shaft of the permanent magnet alternator (PMA). The report said that when the ball bearing failed, "the PMA rotor contacted the stator and created an intermittent short circuit in the PMA, thereby removing the required electrical power to the electronic control unit (ECU).

"Because of a known deficiency in the ECU software, when the ECU lost power due to the intermittent failure of the PMA, it was unable to acquire alternate electrical power from the aircraft, as it was designed to do.

"The no. 1 engine shut down spontaneously as a result of the ECU losing electrical power."

After the incident, Airbus revised the A340 maintenance manual to include specific checks for "evidence of rotor/stator contact and radial play of the PMA drive shaft." In addition, CFM International, manufacturer of the CFM56-5C4 engine, issued a service bulletin to change the ECU software version and to ensure that ECU electrical power "reverts to aircraft power in the event of a complete or partial … PMA failure."

Repeated Engine Surges Prompt 'Mayday' Declaration

Airbus A320. No damage. No injuries.

Nighttime visual meteorological conditions prevailed for the flight from England to Scotland. As the flight crew leveled the airplane at Flight Level 280 (approximately 28,000 feet), "momentary noise and vibration" occurred throughout the airplane. The noise and vibration recurred about one minute later, accompanied by "an orange flash associated with the right engine."

The crew determined that the no. 2 engine had surged and recovered, and engine indications returned to normal. As they began a return to the departure airport, the engine surged several more times, and the crew believed that the no. 1 engine also had surged. They declared mayday, a distress condition, and diverted the flight to a nearby airport.

An investigation determined that a progressive fault in the "P2T2" tube, which measures engine inlet pressure (P2) and total air temperature (T2), had provided inaccurate values to the no. 2 engine computer; this led to incorrect scheduling of compressor inlet-guide vanes, causing the engine surges.

Landing Gear Collapses After Touchdown

Cessna 310. Minor damage. No injuries.

As the pilot conducted an approach to Runway 26 at an airport in England, the three green landing-gear down-and-locked indicator lights were illuminated. The touchdown was described as "smooth," but during the landing roll, the "GEAR UNSAFE" warning horn sounded.

"The pilot looked down and noticed that the left main landing gear down-and-locked green indicator light had extinguished and the red 'GEAR UNSAFE' indicator light had illuminated," the report said.

The left main landing gear collapsed, and the airplane ran off the left side of the runway into a grassy area.

The investigation revealed that the landing gear failure resulted from a "one-time overload force with no evidence of fatigue, corrosion or manufacturing defect." The pilot/owner said that the accident may have occurred because the left main landing gear was "slightly out-of-rig, which allowed the side brace to unlock when running over a bump in the runway, which resulted in the landing gear collapsing."

Refueling Mix-up Cited in Dual Engine Failures

Empresa Brasileira de Aeronáutica (Embraer) EMB-110P1. Minor damage. No injuries.

The airplane was being flown on a daytime approach to an airport in Australia when the pilot observed that the right engine fuel-pump warning light was flashing. Soon afterward, the left engine fuel-pump warning light flashed and the pilot observed that the fuel gauges indicated that the fuel tanks were empty.

The right engine failed, and the pilot received clearance from air traffic control to land the airplane on Runway 18, with a five-knot tailwind. During the landing roll, the left engine also failed. Both main-landing-gear tires were damaged by excessive brake application.

The investigation revealed that each fuel tank contained about three liters (0.8 U.S. gallon) of fuel.

The airplane's fuel records showed that before the first flight of the day, about 180 pounds (114 liters or 30 U.S. gallons) of fuel had been added to the 620 pounds (390 liters or 103 U.S. gallons) of fuel already in the fuel tanks. About one hour before the scheduled departure for a round-trip flight that would end at the incident airport, the pilot had ordered 450 pounds (284 liters or 75 U.S. gallons) of fuel.

The incident report said that the pilot was distracted by senior management responsibilities and that he conducted the departure about 10 minutes after the scheduled departure time. The refueler arrived at the operator's apron (ramp) after departure.

"The pilot subsequently did not check the fuel quantity prior to departing … and assumed that it had been refueled," the report said. "At the time of the incident, the total fuel consumed since the last refueling was 835 pounds [527 liters or 139 U.S. gallons]."

The pilot also omitted a fuel-quantity check before departure for the second leg of the round-trip flight. The report said that the operator had no procedures to "cross-reference and verify that the required quantity of fuel had been added."

After the incident, the operator amended its operations manual to require crosschecking the amount of fuel on the airplane. The operator also said that all EMB-110 flights would require two pilots and redefined the responsibilities of individuals who were both line pilots and company managers.

Ice Found on Control Surfaces After Takeoff Accident

Cessna 414A. Substantial damage. No injuries.

Night visual meteorological conditions prevailed for the departure from an airport in the United States. The pilot said that at rotation speed, the airplane "felt mushy" and that he "immediately decided to [reject] the takeoff."

The pilot said that he made the decision "slightly beyond" the midpoint of the 4,257-foot (1,298-meter) runway. The airplane slid on snow at the departure end of the runway and then struck a snow bank and a fence.

The pilot had landed the airplane at the airport about 15 minutes earlier to board four passengers. He said that during the descent, the airplane encountered light ice and he activated the deice boots. During his preflight inspection before the accident flight, there was "no significant ice" on the airplane and none on the leading edges or on top of any airfoil, he said.

Photographs taken by law enforcement personnel who responded to the accident showed ice on the leading edges of the wings and the vertical stabilizer, the report said. Photographs taken the next day during examination of the airplane by accident investigators showed ice on the leading edges of the wings and the horizontal stabilizer; an investigator said that the ice on the leading edge of the horizontal stabilizer was 0.3 inch (0.8 centimeter) thick.

Wind Shear, Dust Devil Reported During Takeoff

Ted Smith Aerostar 601P. Substantial damage. No injuries.

Day visual meteorological conditions prevailed for the business flight's takeoff from an airport in the United States. During the takeoff roll, the airplane departed the runway to the left and struck a ditch.

A preliminary investigation found that the pilot encountered wind shear and a possible dust devil (whirling cloud of dirt and dust) during the takeoff roll. At the time of the accident, winds at an airport 33 nautical miles (61 kilometers) northeast of the accident were from 250 degrees at 11 knots, with gusts to 17 knots.

Pilot Incapacitation Cited in Fatal Takeoff Accident

Piper PA-23-250 Aztec. Destroyed. Five fatalities.

Daytime visual meteorological conditions prevailed for the flight from an airport in Australia. Witnesses said that soon after takeoff, at about 100 feet above ground level (AGL) to 150 feet AGL, the airplane began to bank left and that the degree of bank gradually increased before the airplane began a rapid descent to the ground in a nearly vertical, nose-low attitude.

The investigation revealed no pre-existing anomaly that could have affected the airplane's airworthiness. An autopsy on the pilot revealed significant narrowing of the coronary arteries.

"The apparently unstable aircraft flight behavior reported by witnesses, the gradually increasing and uncorrected left bank and the subsequent rapid descent and inverted nose-low and near vertical impact attitude are consistent with pilot incapacitation," the accident report said. "Additional supporting evidence is provided by the post-mortem, which found that the pilot had significant coronary artery disease."

The report said that significant factors in the accident included that "control of the aircraft was lost at a height from which recovery was not possible."

Failed Throttle Lever Leads to Emergency Landing

Diamond DA 20-C1 Katana. Substantial damage. No injuries.

A student pilot was practicing power-off stalls at 3,500 feet near an airport in Canada when, during his attempted stall recovery, he was unable to advance the throttle lever. The pilot landed the airplane in a snow-covered field; during the landing rollout, the airplane pitched forward onto its nose and then stopped upright.

A preliminary investigation found that the throttle cable servo rod end bearing had seized and that the attached arm and its associated butterfly valve would not move.

Water in Fuel System Blamed for Engine Failure

Gulfstream AA-5B Tiger. Minor damage. No injuries.

The airplane was being flown in a demonstration to two potential buyers when, soon after takeoff from an airport in England, the engine stopped producing power. During the subsequent emergency landing, the nose landing gear collapsed.

The report said that the subsequent examination of the fuel system revealed "significant amounts of water in the fuel tanks, carburetor bowl, electric fuel-pump filter and the fuel lines aft of the firewall." Nevertheless, "no water was evident from the four drains — one in each fuel tank and one in each sump tank," the report said.

The pilot, a maintenance technician, said that he had obtained fuel samples several times before the flight — before refueling, after refueling and immediately before the flight — and that there was no water in the samples.

Maintenance records showed that the airplane's fuel system was flushed seven months before the accident flight and that the airplane was flown without incident two times before the accident flight; after the second flight, the airplane was parked outside with each fuel tank less than three-quarters full, the report said.

"Aircraft parked outside with partially filled fuel tanks are particularly susceptible to water contamination both through condensation and by direct ingress through fuel-filler caps," the report said. "It is suggested that the entire fuel system of any aircraft stored in this manner should be thoroughly inspected immediately before flight."

ROTORCRAFT

Pilot Cites Wind Gust in Rollover Accident

Robinson R44. Substantial damage. No injuries.

Day visual meteorological conditions prevailed for the business flight in the United States. The pilot said that he was maneuvering the helicopter to land on a cart at an airport. He said that the helicopter touched down on the cart and that as he attempted to lift the helicopter back into the air to center it on the cart, a gust of wind caused the helicopter to roll right. The right skid touched the ground, and the helicopter rolled onto its right side.

Winds at the time of the accident were from 160 degrees at 16 knots with gusts to 23 knots.

Airport officials said that helicopter pilots are prohibited from hover taxiing between airport hangars. Instead, helicopters are landed on carts, which are towed to the hangars by all-terrain vehicles. The accident pilot said that the carts are six inches to eight inches (15 centimeters to 20 centimeters) high and that when a helicopter is centered on a cart, there is about 12 inches (30 centimeters) clearance between the outside of each skid and the edge of the cart.

Failure to Remove Tie-down Cited in Takeoff Accident

Hughes 369HS. Substantial damage. No injuries.

Daytime visual meteorological conditions prevailed for the attempted takeoff from a fishing vessel in the Pacific Ocean near the Federated States of Micronesia.

The helicopter rolled onto its side during the takeoff; the main-rotor blades severed the tail boom, which dropped into the water and sank. A preliminary report said that the left tie-down had not been removed from the helicopter.

Helicopter Rolls Onto Ground During Takeoff, Blade Strikes Passenger

Bell 206B JetRanger. Substantial damage. One fatality.

The helicopter was being operated from a farm field in Canada, and when the pilot attempted to conduct a takeoff, the right skid dug into soft ground.

The helicopter rolled onto its right side, and a main-rotor blade struck the passenger.

Helicopter Strikes Hedge During Tail Wind Landing

Enstrom 480. Substantial damage. Two minor injuries.

After a five-minute flight from a private site, the pilot conducted an approach to a heliport in England. He observed the windsock and estimated the wind as between 270 degrees and 300 degrees at 15 knots to 18 knots. As the helicopter neared the landing area, the pilot encountered wind shear, and the helicopter moved toward a hedge. The helicopter's tail section struck the hedge, and the helicopter rotated right, touched down briefly on its skids and then toppled onto its right side.

A weather aftercast showed that the surface wind was from 340 degrees at 15 knots, with gusts to 25 knots. These conditions would have resulted in a tail wind component during the approach and "would have made precise control of the helicopter more difficult," the accident report said. ■

We Encourage Reprints

What's Your Input?

In keeping with the Foundation's independent and nonpartisan mission to disseminate objective safety information, FSF publications solicit credible contributions that foster thought-provoking discussion of aviation safety issues. If you have an article proposal, a completed manuscript or a technical paper that may be appropriate for *Flight Safety Digest*, please contact the director of publications. Reasonable care will be taken in handling a manuscript, but Flight Safety Foundation assumes no responsibility for material submitted. The publications staff reserves the right to edit all published submissions. The Foundation buys all rights to manuscripts and payment is made to authors upon publication. Contact the Publications Department for more information.

Flight Safety Digest

Subscriptions: One year subscription for 12 issues includes postage and handling: US$280 for members/US$520 for nonmembers. Include old and new addresses when requesting address change. • Attention: Ahlam Wahdan, membership services coordinator, Flight Safety Foundation, Suite 300, 601 Madison Street, Alexandria, VA 22314 U.S. • Telephone: +1 (703) 739-6700 • Fax: +1 (703) 739-6708 • E-mail: <wahdan@flightsafety.org>