RETHINKING CREW ERROR: OVERVIEW OF A PANEL SESSION

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ABSTRACT

This paper was an overview that introduced a panel session on Crew Error: Are We Expecting Pilots to be Perfect? Panel members were Dr. Immanuel Barshi (NASA), Dr. Evan Byrne (NTSB), Dr. Key Dismukes (NASA), Captain Don Gunther (Continental Airlines), and Captain Frank Tullo (Continental Airlines, retired).

ISSUES

The vast majority of airline accidents are attributed to crew error. I argue that this well-known fact is widely misinterpreted, even by experts in aviation safety. Certainly, if pilots never made mistakes the accident rate would go down dramatically, but is it reasonable to expect pilots not to make mistakes? For both scientific and practical reasons I suggest that this expectation is not reasonable. This is a critical issue for which open discussion and debate have long been needed in the aviation community (Dismukes & Tullo, 2000).

The accident rate for part 121 operations in industrialized nations is already very low—an impressive record that has been accomplished by developing very reliable systems, by thorough training, by requiring high levels of experience for captains, and by emphasizing safety. Can the accident rate be further reduced substantially? Absolutely yes. But this will require better understanding of the underlying causes of human error and better ways of managing human error.

We must also change how we think about the causes of error. It is all too easy to say, because crew errors led to an accident, that the crew was the problem: they should have been more careful or more skillful. I suggest that the "blame and punish" mentality or even the more benign "blame and train" mentality does not support safety—in fact it undermines safety by diverting attention from the underlying causes.

Admittedly in general aviation many accidents do show evidence of poor judgment or of marginal skill. This is much less common in part 121 operations because of the high standards of airline operation. Because of limited time this panel focused only on airline operations; much of the discussion, however, has implications for general aviation.

Consider two common fallacies about pilot error:

> Fallacy 1: Error can be eliminated if pilots are sufficiently vigilant, conscientious, and proficient. The truth is that vigilant, conscientious pilots routinely make mistakes, even in tasks at which they are highly skilled. Helmreich and his colleagues have found that on average airline crews make about two errors per flight leg and even more on challenging flights (Helmreich, Klinect, & Wilhelm, 1999; Klinect, Wilhelm, & Helmreich, 1999). And this is, if anything, an undercount because of the difficulty in observing all errors.
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> Fallacy 2: If an accident crew made errors in tasks that pilots routinely handle without difficulty, that accident crew was in some way deficient—either they lacked skill, or had a bad attitude, or just did not try hard enough. But the truth is that the most skillful, conscientious expert in the world can perform a procedure perfectly a hundred times in a row and then do something wrong on the 101st trial. This is true in every field of expertise—medicine, music, and mountain climbing just as much as aviation (Reason, 1990).

We must also be wary of something called "hindsight bias". After an accident we of course know the outcome of the flight. The thorough investigation by the NTSB reveals many details about what happened leading up to the accident. Armed with this information it is easy for us to say the crew should have handled things differently. But the crew in that airplane did not know the outcome. They may not have known all of the details later revealed and they certainly did not realize how the factors were combining to create the conditions for an accident.

In some accidents crews may not have had access to adequate information to assess the situation and make prudent decisions on how to continue. For example, at some airports summer thunderstorms move close to the airport almost every day. The stream of large aircraft approaching normally continues until landing clearly becomes untenable. Obviously if a big

storm cell is sitting right on top of the airport no airline captain will continue an approach to that airport. But what guidance do crews have when numerous cells are in the vicinity of the airport and other aircraft in front of them are making the approach? Many bits and pieces of information may be available to the crew, who weigh the information as well as they can. But I question whether crews always have enough information in time to decide whether to continue or divert and to be absolutely certain that the decision is correct.

I find it ironic that in some windshear accidents the crew was faulted for continuing an approach even though an aircraft landed without mishap one minute ahead of the accident aircraft. Both crews had the same information, both made the same decision, but for one crew luck ran the wrong way. We do not like to admit that any element of luck still pertains to airline safety—and in fact the element of chance in airline operations has been reduced enormously since the 1930s, as described by Ernest Gann in *Fate is the Hunter* (1984). But there are still a few accidents in which we should admit that the crew made decisions consistent with typical airline practice and still met disaster because risk cannot be completely eliminated. Could we lower the risk in these situations? Of course—airlines could adopt policies on diverting to alternate destinations even more conservative than currently used. But it is not clear how well the public would accept a substantial increase in diversion rate.

Tension and tradeoffs between safety and mission completion are inherent in any type of real-world operation. Modern airlines have done an extraordinary job of reducing risk while maintaining a high level of performance. Nevertheless, some small degree of risk will always exist. The degree of risk that is acceptable should be a matter of explicit public discussion, which should guide policy. What we must not do is tell the public they can have zero risk and perfect performance—and then say when a rare accident occurs: "it was the crew's fault", neglecting to mention that the accident crew did what many other crews had done before. I may sound naive about this; I do realize that people want to have their cake and eat it too, but we should not encourage them to think that way.

If investigation of an accident or incident reveals explicit evidence of deliberate misconduct the pilot obviously should be held accountable. If the investigation reveals lack of competence the pilot obviously should not fly again unless retrained to competency. But with these rare exceptions, identifying "pilot error" as the probable cause of accidents is dangerous because it encourages the aviation community and the public to think something was wrong with the crew and that the problem is solved because the crew is dead or can be fired (or retrained in less serious cases). Rather than labeling probable cause, it would be more useful to identify the contributing factors (including the inherent human vulnerability to characteristic forms of error), to characterize the interplay of those factors, and to suggest ways errors can be prevented from escalating into accidents. If probable cause must be retained, it would in most cases be better to blame the inherent vulnerability of conscientious experts to make errors occasionally rather than to blame crews for making errors.

WAYS TO IMPROVE SAFETY

If we accept the fact that some rate of human error is inevitable, what realistically can be done to improve aviation safety? Here are some suggestions:

1. We need much more thorough data on the operational factors that influence crew performance. NTSB reports and ASRS data are invaluable but they have limits. NTSB reports tell us what happened when various threat factors lined up in a particular way—partly by chance--to cause one particular accident. But what about normal operations, day in and day out, in which the same threats are frequently present but do not happen to align to create the conditions for an accident? In this regard two relatively new approaches have much to offer. In line operational safety audits (LOSA) airlines take a large sample of observations from normal line flights, recording what errors were made, the conditions that contributed to the errors, and what the crew did to recover from the errors. LOSA goes far beyond traditional line checks and provides unique data about conditions leading to errors and how errors might be managed. Another potentially major source of operational information is collection of massive amounts of flight data directly from aircraft data buses—known in the U.S. as FOQA. Both technical and political issues exist that must be resolved in order to obtain these data in the most effective and the most appropriate manner. We should move expeditiously to resolve those issues.

2. We need explicit methods to train pilots to detect and trap errors before they get out of hand. These methods must go beyond generalizations about error management—they must provide pilots with

specific techniques they can use in specific situations. Several airlines have developed courses in error management; development of specific techniques, however, is still in early stages.

3. We must conduct research to understand the cognitive and perceptual processes that underlie human vulnerability to characteristic forms of error. This research must also explore how cognitive and perceptual processes interact with environmental features: equipment, tasks, procedures, and organizational policies and practices. Both NASA and the FAA support research in this area, but the amount invested by both agencies combined is small in comparison to the magnitude of the problem and the consequences of a single airline disaster.

4. The design of equipment, tasks, procedures, and organizational policies and practices must start from scratch with the understanding that human users will make errors. Systems should be designed explicitly to help humans detect and recover from errors. In the past several years makers of cockpit equipment have made considerable progress in this approach, but we still have a way to go and we must extend this philosophy to the design of tasks, procedures, and organizational policies and practices.

To summarize, to improve aviation safety we must stop thinking of pilot errors as the prime cause of accidents, but rather think of errors as the consequence of many factors that combine to create the conditions for accidents. It is easy in hindsight to identify ways any given accident could have been prevented, but that is of limited value because the combination of conditions leading to accidents has a large random component. The best way to reduce the accident rate is to develop ways to reduce vulnerability to error and to manage errors when they do occur.

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