

Opportunities for and vulnerabilities to error in everyday flight operations

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Analyses of incident reports, jumpseat observations of line operations and task analyses were performed to better understand the causes of pilot error and develop defenses against consequential errors. Between 60 and 80% of aviation accidents and incidents can be attributed, at least in part, to human error. Most incident reports submitted to the Aviation Safety Reporting System are written by experienced, skilled, well-trained and conscientious pilots. Sheer probability could block such incidents from evolving into accidents since performance errors occur on a daily basis in the course of everyday flight operations. Our effort is to move beyond the traditional view of errors as a source of failure toward a better understanding the root causes of system failures.

Pilot errors are naturally and predictably occurring events often attributable to many opportunities in the operating environment and to human cognitive vulnerabilities. On the operational side, interruptions and distractions are opportunities for error that are unpredictable in source, timing, and nature. They are the norm in everyday operations. Consequently, their impact is highly underestimated. To respond to distractions, pilots interleave novel activities with habitual, well-practiced sequences of actions, continuously making decisions about adding, shedding, and/or rescheduling actions. On the human side, error vulnerability arises from cognitive limitations. Memory (particularly for deferred actions), sidetracking and preoccupation with interrupting events, automaticity, assumptions and expectations based on habit make pilots particularly vulnerable to the demands of intrusive events. Thus, interruptions and distractions pose significant threats to pilots during seemingly routine flight operations.

Figure 1 (not shown) starts with a 'textbook' version of taxi out procedures (in gray) to be performed by the captain (left column), the first officer (right column), and both pilots together (checklists in the middle columns). This version represents an ideally linear sequence of events and is the one taught and practiced by the pilot in ground school and simulator training. On this version we overlay some of the typical interruptions and distractions (in orange) observed in routine flights during our field study. Each of the observed events typically carries a workload cost (in yellow) in the form of additional activities that have to be performed either immediately or deferred until some later time. The workload cost is assimilated by the pilot who is forced to "navigate" through a complex and dynamic flurry of activities without making a single error.

Expecting to eliminate interruptions and distractions or mitigate cognitive vulnerabilities is unrealistic. Observations from line operations coupled with task analyses can contribute significantly to a better understanding of the causes for pilot error and aid in the design of robust procedures that offer multiple layers of defense against error. Understanding cockpit interruptions and distractions will enhance existing training programs by aligning the realities of routine line operations with consequences for human error.