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Delayed Pilot Recognition in Lost Communication Events

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Background and Motivation

In July 1992, Battelle completed a research project for the Volpe National Transportation Safety Center (VNTSC) on behalf of the Federal Aviation Administration (FAA). That study, titled "Inability To Communicate On Frequency," used Aviation Safety Reporting System (ASRS) data to examine the causes and effects of loss of communication events.

Loss of communication events, for the purpose of the *Inability to Communicate* research project, included "stuck mikes," aircraft or facility radio problems and failures, and misset radio equipment. Of the two hundred ASRS incident reports reviewed, 99 provided either a reporter's assertion of, or contained information sufficient for the coding analyst to infer, the duration of the communications interruption. As determined by the study, the average (mean) duration for lost communication events was 7.6 minutes, greater than had been anticipated by project analysts on the basis of their aviation background and experience.

Although only 99 of 200 records permitted quantification of loss of com duration, all records used in the *Inability to Communicate* study contained some degree of information about the relative length of communication interruption and associated human factors issues. However, it was beyond the scope of the original research effort to examine the human-factors of the loss of situational awareness that is suggested by the apparent delay in event recognition and correction.

Early detection in loss of communication events would likely reduce the risks associated with these incidents. This project re-evaluated the original 200 records that comprised the Loss of Communication data set in an effort to determine the principal human-factors issues involved in delayed recognition of interrupted communication incidents. We examine issues such as levels-of-attention, workload and flight phase, confusion, and situational awareness.

Objectives and Scope

The overall objective of the "Delayed Pilot Recognition of Lost Communications" project was to determine methods by which lost communication events may be detected and corrected in a timely manner.

Specific Objectives

The five specific objectives of this research project were to:

1. Relate the causes and results of lost-com events to the flight phases in which these events occur,
2. Examine the human agent as a causative and contributing factor in lost communication incidents,
3. Identify the environmental factors influencing human performance in these events,
4. Examine the human as a detector and resolver of these problems,
5. Suggest methods by which event recognition and correction may be facilitated.

Scope

The study was limited to ASRS reports that provided evidence that some delay in pilot recognition of loss of communication had occurred. There was no restriction on type of operation or aircraft, thus records in the data set range from light single engine general aviation aircraft flown for pleasure, to the largest wide body air carrier types.

Approach

Data Set

The 200 records that comprised the initial *Inability To Communicate On Frequency* study were extracted from a review set of approximately 450 ASRS reports. These 200 records were subjected to additional analysis for the "Delayed Pilot Recognition in Lost Communications" project. Not all of the 200 original reports contained sufficient information for subsequent coding; however, 128 records did contain data that provided evidence of delayed pilot recognition in lost communication events.

Methodology

A coding instrument was developed to extract required information from the available reports, data from the original study was also available for cross tabulation. The Delayed Recognition in Lost Com coding form, in addition to previously extracted and analyzed information, asked the following questions:

1. What were the pilot's/flight crews' qualifications and flight time?
2. In what operational phase did the loss of communication occur?
3. Was there an apparent delay in pilot or flight crew recognition of the loss of communication?
4. How did the pilot or flight crew indicate that they recognized the loss of communication?

Development of the coding form required two iterations; a trial coding effort was undertaken to validate the coding instrument. As the study used previously analyzed reports (200), and in that there were few "new" questions, a single inter-rater reliability test was conducted to ensure coder accuracy.

Principal Findings

Reporter and Type of Operation

As indicated in Table 1, the primary reporters in the 128 record data set are reasonably evenly divided between air carrier and general aviation pilots. Of the 3 controller reports, 2 contained sufficient information for coding, while 1 record had secondary reports from air carrier pilots. The type of operation was again fairly evenly split between air carrier and general aviation. The two military reports referenced transport type operations, and are therefore most similar to air carrier reports.

Table 1 — Reporter and Type of Operation
Based on 128 Reports

Reporter	Reports	Percent of Data Set	Operation	Reports	Percent of Data Set
Air Carrier	64	50.0%	Air Carrier	66	51.5%
General Aviation	59	46.1%	General Aviation	60	46.9%
Military	2	1.6%	Military	2	1.6%
Controller	3	2.3%			
Totals	**128**	**100.0%**	**Totals**	**128**	**100.0%**

Operational Phase of Event Occurrence

The operational phase of incident occurrence was examined for air carrier and general aviation operations respectively. For air carrier operations, the largest number of incidents occurred in the Cruise phase (27 of 66 citations[1], 41%). For general aviation, the largest number of events occurred in the combined Approach (18 of 60 citations) and Landing Phase (14 of 60 citations), over 50% of all events. Table 2 provides for Operational Phase vs. Type of Operation.

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[1] Many categories allow for multiple responses (citations), thus there may be more citations than records in the data set.

When all operational types were considered (air carrier, general aviation, and military), delay in event recognition while in Cruise was evidenced in 45 of 128 records (35%). The Approach phase accounted for 36 occurrences (28%), while the Landing phase was cited in 17 (13%) of reports. *Combined* Approach and Landing phase accounted for 53 of 128 citations (41%). Figure 1 provides the operational phase for air carrier, general aviation, and combined air carrier, general aviation, and military at the time of the loss of communication.

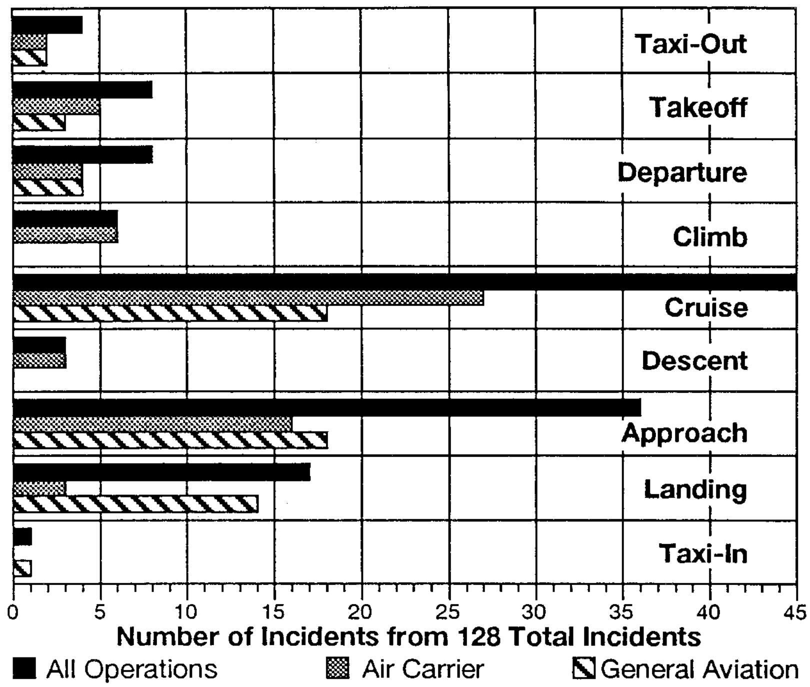

Figure 1 — Operational Phase vs. Type of Operation

Behavior Factors

Preoccupation or distraction in high workload situations was cited as a behavioral factor in 94 of 160 citations (59%). At the opposite end of the causal spectrum, loss of awareness or lowered levels of awareness was noted in 50 of 160 citations. Table 2 illustrates the range of human factors of delay in event recognition. Note that preoccupation or distraction was cited in 73% of records in the data set.

Table 2 — Behavior Factors of Delay in Recognition of Communication Loss
Based on 160 Citations from 128 Reports

Behavior	Cited	% of citations	% of Data Set
Preoccupation or Distraction in High Workload Situations	94	58.8%	73.4%
Loss of Awareness or Lowered Levels of Awareness	50	31.3%	39.1%
Other Miscellaneous Factors:	14	8.8%	10.9%
Subtle Incapacitation	1	0.6%	0.8%
Not Stated	1	0.6%	0.8%
Total Citations, Percent of Citations, and Percent of Data Set	**160**	100.0%	125.0%

Preoccupation or Distraction

Where preoccupation or distraction was evident in high workload situations, flawed operational procedure occurred in 52 of 194 citations (27%), a high workload flight phase noted in 45 citations (23%), and preoccupation with normal operational procedure in 29 citations (15%).

Loss of Awareness or Lowered Levels of Awareness

In this classification, a low workload flight phase was cited as contributory in 31 of 59 citations (53%), while an "Other" classification yielded 24 citations of a mixed variety. Fatigue or boredom was cited by a reporter in only 4 citations.

Com Loss Recognition

The most common reason for discovery of a communications interruption by pilots was a subsequent normal attempt to communicate (53 of 196 citations, 27% of category). Some sort of an unexpected event, such as an unanticipated call from ATC on another frequency or through company frequencies, for example, was cited as a recovery method in 29 citations. Table 3 provides a breakdown of com loss detection.

Table 3 — Detection of Loss of Communication
Based on 196 Citations from 128 Reports

Recognized by...	Cited	% of citations	% of Data Set
Subsequent Normal Attempt to Communicate	53	27.0%	41.4%
Contact on another frequency by controlling ATC Facility, ARINC, company	29	14.8%	22.7%
Expected communication from ATC did not occur	20	10.2%	15.6%
Post-Event discussion with ATC, another pilot, or other such as FSS	20	10.2%	15.6%
Became aware of passage of time with no communication	17	8.7%	13.3%
"Quiet" on the frequency — Lack of radio chatter where expected	17	8.7%	13.3%
External Intervention by another ATC Facility or aircraft	16	8.2%	12.5%
Cockpit monitoring duties and/or scan revealed misset radio equipment	9	4.6%	7.0%
Other, Not Stated, Ambiguous	15	7.7%	11.7%
Total Citations, Percent of Citations, and Percent of Data Set	**196**	100.0%	153.1%

Event Frequency and Pilot Experience

Event frequency was compared to the flight time experience levels of the primary reporter. Experience is recorded in the ASRS data base as 1) Total Time, 2) Time in the Last 90 Days, and 3) Time in Type for each reporter. Examination of data indicates that delay in lost com event is more likely to occur when one or more of the flight crew is low time on the aircraft type — more so for general aviation pilots than for air carrier. Figure 2 provides Event Frequency vs. Time in Type for general aviation (GA) pilots.

Graphing Time-in-Type for air carrier reporters yielded a similar pattern of greater event frequency with low time in time, but the ratio was less pronounced.

Times in Figure 2 are in 50 hour segments from 1 hour to 50, 51 to 100, and so on. The "spike" noted in the 251 to 300 hour segment is, in the analysts subjective opinion, a result of "rounding" by reporters. (A reporter with 276 hours, or 310 hours for example, may tend to round his experience to 300 hours.)

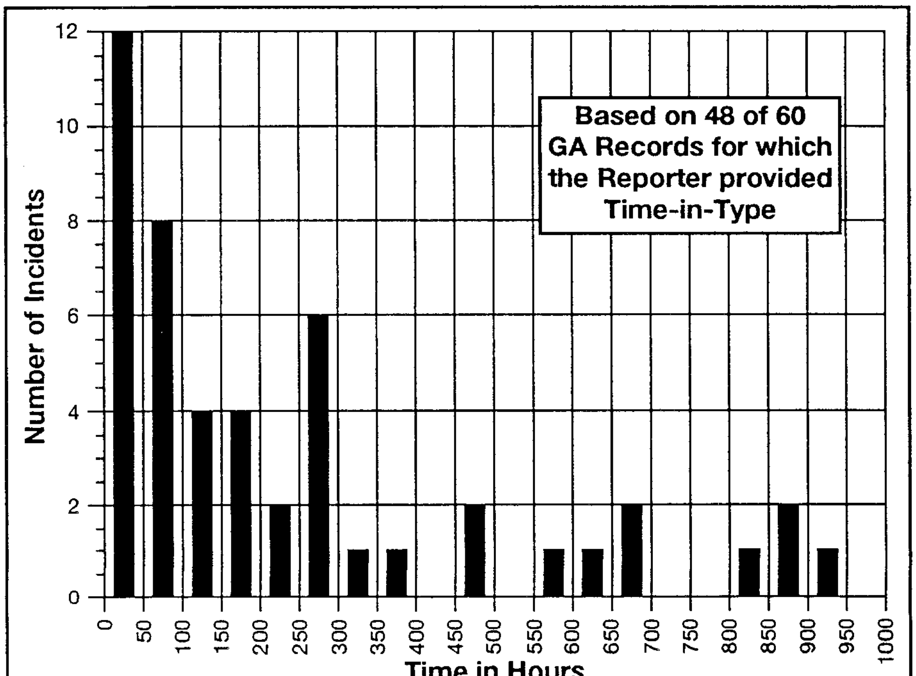

Figure 2 — GA Pilot Time in Type vs. Event Frequency

Discussion

Air Carrier/GA Ratios

Report submissions to the ASRS are approximately 70% air carrier, 20% general aviation, 4% controller, and 1% miscellaneous other. The ASRS Database ratio of air carrier to general aviation reports (3 to 1) is at variance to this study's air carrier to GA ratio of approximately 1 to 1. As there was no attempt by analysts to "balance" air carrier and general aviation records in this review, it appears that general aviation pilots are more likely to experience delay in event recognition than air carrier pilots.

Operational Phase

That air carrier pilots should experience the majority of event occurrences in the Cruise phase is not surprising. An air carrier aircraft will spend more of its time in cruise that in other flight phases, perhaps more than all other flight phases combined. Additionally, on long distance routes, it is generally accepted that air carrier flight crews will experience significantly lowered levels of attention due to reduced ATC communication and lowered stimulation from cockpit management duties.

General aviation pilots generally spend less time in Cruise than do air carrier flight crew. With significantly less cockpit automation and usually a single pilot operation, a general aviation pilot may be required to devote greater attention to positional and situational awareness. Also significant in this data set is that the scope of the study permitted inclusion of records regardless of whether the flight was operated under Visual or Instrument Flight Rules. A significant number of general aviation records in this data set entailed a VFR flight. In that a flight operated under Visual Flight Rules is not required to maintain contact with, or accept instructions or clearances from an ATC Facility for those segments of flight conducted outside of some variety of controlled airspace (such as a TCA, etc.), many pilots will not maintain contact with ATC. With no requirement AND no attempt to communicate, there can be no communication loss.

Event occurrence in the combined Approach and Landing phase illustrates other differences between GA and air carrier operations. Air carrier operations, with two or more pilots, provides for better task sharing. A single general aviation pilot on an instrument approach and landing, with fewer and less sophisticated system and navigational devices, less total and recent experience, encounters a typically higher workload than his airline counterpart. Thus, it is not a surprise that general aviation operations show higher event frequency in the Approach/Landing phase than in other flight regimes, and greater event frequency than for air carrier flight crew.

Operational Phase and Behavior Factors

The Approach/Landing phase demonstrates different human factors of delayed event recognition than does the Cruise phase. In the Approach/Landing phase, preoccupation or distraction in high workload situations is cited in 48 of 53 events. In contrast, the predominant behavior noted in Cruise phase incidents is loss of awareness or lowered levels of awareness.

Conclusions and Recommendations

- **Time in Type**
  There is a significantly increased opportunity for event occurrence when pilot experience in the aircraft type is low. Continued emphasis on the value of situational awareness, as well as adequate instruction in aircraft systems and performance will help, but, this study's statistics on air carrier incidents emphasize that high numbers of flight hours are no guarantee of perfection.

- **Controller Intervention**
  Controller intervention through use of company or ARINC frequencies is effective when used.

- **Intervention Strategies in Approach and Landing**
  Where high cockpit workloads contribute to loss of communication such as during Approach and Landing, adherence to cockpit disciplines (such as the sterile cockpit), and maintenance of positional awareness should serve to reduce delays in event recognition.

- **Intervention Strategies in Cruise**
  In the Cruise phase, notable for a low workload environment and a point where ATC communication and chatter are minimal, review of pertinent records indicates that pilot recognition of interrupted communication may be facilitated by the motherhood and apple pie solution of constant situational and positional awareness. For high altitude flight, noting the location of ARTCC Facility boundaries as marked on charts should serve to alert pilots to required hand-offs.

- **General Considerations for Incident Avoidance**
  In a number of instances, without respect to the type of operation or aircraft, pilots experienced difficulty in returning to an original frequency if there was an error in selection or clearance to a new frequency. A simple and effective aid for pilots is to write down assigned frequencies; should a loss of communication occur at the point of a frequency change, the pilot may easily return to the previous frequency.